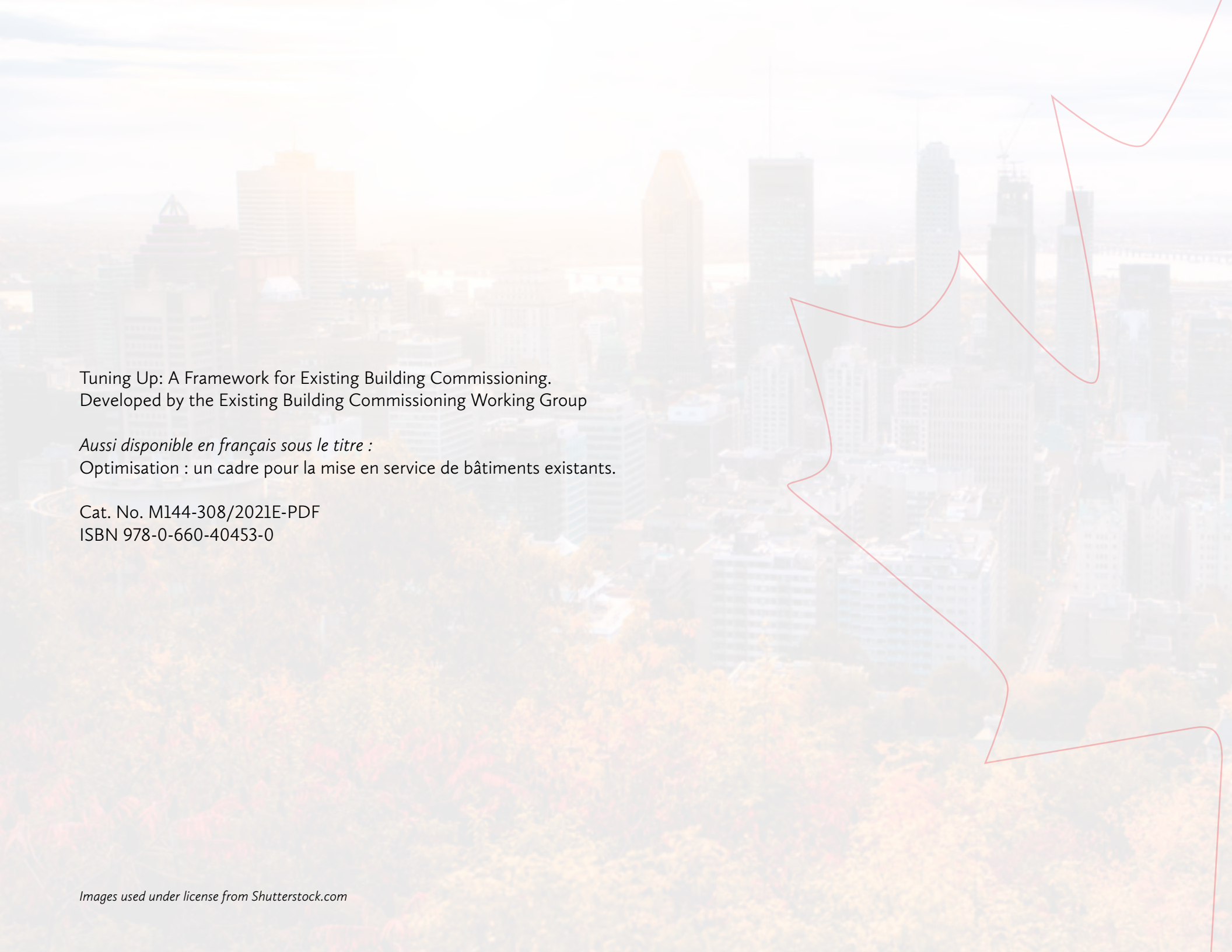


An aerial photograph of a city skyline at sunset. The sun is low on the horizon, casting a warm, golden glow over the buildings. In the foreground, there are trees with vibrant autumn foliage in shades of orange, yellow, and red. The city features a mix of modern skyscrapers and older, more traditional buildings. A large, semi-transparent graphic element, resembling a stylized letter 'A' or a similar shape, is overlaid on the right side of the image.

TUNING UP A FRAMEWORK FOR EXISTING BUILDING COMMISSIONING

Developed by the Existing Building Commissioning Working Group
November 2021



Tuning Up: A Framework for Existing Building Commissioning.
Developed by the Existing Building Commissioning Working Group

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PREFACE

Tuning Up: A Framework for Existing Building Commissioning is the product of a collaborative effort by the Existing Building Commissioning (EBCx) Working Group.

Thanks are extended to the many parties who contributed to the creation of the Framework, including, but not limited to:

- Natural Resources Canada (EBCx Working Group co-chair)
- BC Hydro (EBCx Working Group co-chair)
- BGIS
- BOMA Canada and BOMA Toronto
- Building Commissioning Association, Eastern Canada Chapter
- Building Commissioning Association, Western Canada Chapter
- CFMS Alberta
- City of Dieppe (New Brunswick)
- City of Edmonton
- City of Toronto
- City of Vancouver
- City of Winnipeg
- Energenia
- Efficiency Manitoba
- Efficiency Nova Scotia
- efficiencyPEI/Government of Prince Edward Island
- Enbridge Gas
- Federation of Canadian Municipalities
- Government of British Columbia
- Government of Manitoba
- Government of the Northwest Territories
- Government of Saskatchewan
- Government of Yukon
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- Province of Ontario
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- Ryerson University (Smart Building Analytics Research Group)
- Thurston Engineering Services, CCF

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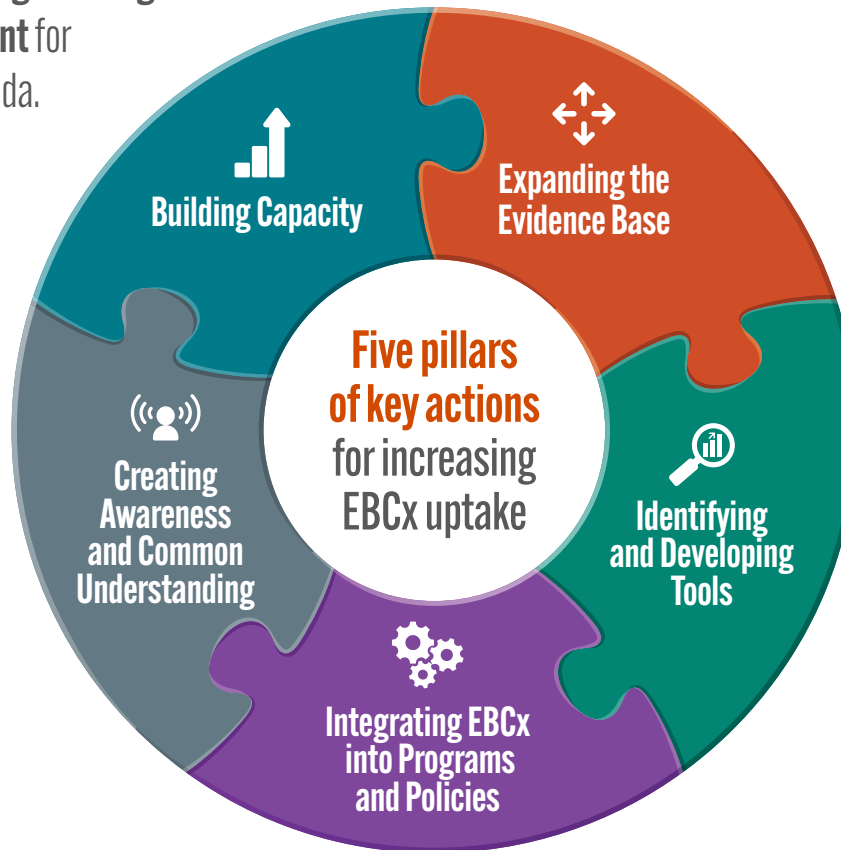
SUMMARY AT A GLANCE

Tuning Up: A Framework for Existing Building Commissioning is a **model blueprint** for increasing the uptake of EBCx in Canada.



OVERARCHING GOAL

To increase the uptake of EBCx across Canada



Existing Building Commissioning (EBCx) is a key process that can help existing buildings operate as expected and meet the current facility requirements.

- ◆ EBCx focuses on **improving or optimizing** (i.e. “tuning up”) the performance of existing equipment and systems and **identifying low-cost or no-cost operational improvements**.
- ◆ **Benefits** can include energy savings, increased occupant comfort, extended equipment life, improved indoor air quality, avoided costs, reduced greenhouse gas emissions, and enhanced operations and maintenance (O&M) staff skills.
- ◆ **Key building types** include commercial, institutional and multi-unit residential buildings.

EBCx is a broad term that includes recommissioning, retro-commissioning and ongoing commissioning.



The Framework is intended to **broaden awareness and understanding of EBCx** and to help **decision-makers** - such as program administrators, policy makers, senior managers and industry associations - **identify programming opportunities and other key areas for action**.



Key actions could form the basis for new programs and activities or be integrated into existing approaches - for an individual organization, for a jurisdiction or region, for Indigenous communities, or Canada-wide.

The Framework was developed by the EBCx Working Group - a working group with representatives from organizations such as federal, provincial, territorial and municipal governments, utilities, academia, industry associations, and commissioning providers.





**PART A
INTRODUCTION**

BACKGROUND AND CONTEXT

Energy efficiency initiatives provide ways to promote energy conservation, lower costs for businesses and individuals, create jobs, stimulate the economy, increase productivity, and reduce greenhouse gas (GHG) emissions. Reducing energy waste in buildings is a key part of this picture.¹

Approximately 18% of Canada's GHG emissions come from residential, commercial and institutional buildings when electricity-related emissions are included² and it is estimated that 75% of the floor space in 2030 has already been built.³

Existing Building Commissioning

Existing Building Commissioning (EBCx) **is a key process that can help existing buildings operate as expected and meet the current facility requirements.**⁴ It focuses on activities such as **assessing, investigating, monitoring** and **verifying** the operations and



maintenance of a building and/or its systems and assemblies, **identifying measures** to improve or optimize performance and **implementing measures, documenting** and **training**.⁵

EBCx focuses on **improving or optimizing** (i.e. “**tuning up**”) the performance of existing equipment and systems and on **identifying low-cost or no-cost operational improvements**.

Involving a different approach than an energy audit or retrofit,⁶ EBCx is a broad term that encompasses recommissioning (RCx), retro-commissioning and ongoing commissioning (OCx).⁷

A brief overview of several key terms for this Framework is included in **Annex A**. Key building types include commercial, institutional and multi-unit residential buildings.

¹ “Making the Places Canadians Live and Gather More Affordable by Cutting Energy Waste” is one of the pillars identified in the *A Healthy Environment and a Healthy Economy: Canada's Strengthened Climate Plan to Create Jobs and Support People, Communities and the Planet*. 2020, p. 8.

² Sources include Environment and Climate Change Canada. *National Inventory Report 1990-2018: Greenhouse Gas Sources and Sinks in Canada: Executive Summary*. 2020; and Natural Resources Canada (NRCan). National Energy Use Database: Comprehensive Energy Use Database.

³ *Build Smart - Canada's Buildings Strategy*. August 2017, p. 10.

⁴ These are detailed in the Current Facility Requirements (CFR), a written document that describes the current functional requirements of a facility as well as expectations of how it should be used and operated. (Building Commissioning Association. *Existing Building Commissioning Best Practices*, p. 35).

⁵ Key sources include: Building Commissioning Association. *Existing Building Commissioning Best Practices*, p. 1-3, 35; NRCan. *Recommissioning Guide for Building Owners and Managers*. March 2008; CSA Z5001:20 standard (Existing building commissioning for energy using systems); and Building Performance Alliance Committee on Commissioning. *The Strategic Guide to Commissioning*, June 2014, p. 17-18.

⁶ Tables providing a brief overview of EBCx compared to an energy audit or a retrofit are included in **Annex B**.

⁷ For this Framework, EBCx is used as a broad term that includes ongoing commissioning in addition to recommissioning and retro-commissioning. A brief illustration of how EBCx fits into the building life cycle is provided in **Annex C**.

EBCx can lead to energy savings (e.g. of 5 to 20%)⁸ and to cost savings. Other benefits can include improved overall building performance, increased occupant comfort, improved indoor air quality, extended equipment life, increased asset value, avoided costs linked with increased energy consumption, reduced GHG emissions, and enhanced operations and maintenance (O&M) staff skills.

As well, EBCx can generate a comprehensive review of how building equipment and systems are working together and the identification of previously unidentified equipment performance or maintenance issues. Recent survey findings suggest that EBCx is a relatively “untapped” market area that has potential and that there is an opportunity for a greater market uptake of EBCx.⁹

EBCx offers a key path for contributing to meeting climate and energy goals and requirements, such as those related to energy performance, conservation, energy use intensity (EUI) and GHG emissions. It can be implemented separately or in combination with retrofits and with renewable energy and other energy-related approaches and programs.

8 Building Commissioning Association and Lawrence Berkeley National Laboratory. *Value of Commissioning: 2018 Market Survey*, p. 21.

9 *Natural Resources Canada's 2018 Commissioning Industry Surveys*. 2018, p. 10.



FRAMEWORK OVERVIEW

The purpose of this Framework is to serve as a model blueprint for increasing the uptake of EBCx practices in Canada. A working group comprised of representatives from organizations such as federal, provincial, territorial and municipal governments, utilities, academia, industry associations, and commissioning providers was created to collaborate on the Framework's development.

Building on past work and work currently underway, the Framework is intended to broaden awareness and understanding of EBCx and to help decision-makers – such as program administrators, policy makers, senior managers and industry associations – identify programming opportunities and other key areas for action.

With an **overarching goal of increasing the uptake of EBCx across Canada**, the Framework is divided into the following five pillars:

Pillar 1 – Creating Awareness and Common Understanding

Pillar 2 – Building Capacity

Pillar 3 – Expanding the Evidence Base

Pillar 4 – Identifying and Developing Tools

Pillar 5 – Integrating EBCx into Programs and Policies

Each pillar includes a specific goal, a summary of related barriers and challenges, recommended key actions, and a list of resources for reference. Some barriers, challenges and key actions may fit into more

than one pillar because they are interconnected. Key actions can be undertaken by individual organizations or groups or as a collaborative effort (e.g. among jurisdictions, groups and/or organizations), including by:

- **organizations and groups** such as utilities; federal, provincial, territorial and municipal governments; Indigenous groups and communities; industry associations; commissioning firms; and organizations that distribute related government funding
- **occupations** such as commissioning providers, energy managers, building owners, building operators, building or property managers, condo board representatives, program administrators, policy makers, engineers and other occupations involved in building O&M

The Framework covers three types of EBCx: recommissioning, retro-commissioning and ongoing commissioning,¹⁰ and the key actions generally apply to these three types. However, because of the specific context of ongoing commissioning, an overview of key considerations related to that type is included in **Annex D**. **Looking ahead**, the key actions identified should be considered by organizations, groups, communities and jurisdictions that are looking to increase uptake of EBCx. Key actions could form the basis for new programs and activities or be integrated into existing approaches – for an individual organization, for a jurisdiction or region, for Indigenous communities, or Canada-wide. Continued collaboration will also be required to prioritize and implement key actions.

¹⁰ A related term, monitoring-based commissioning (MBCx), refers to an ongoing commissioning process that has an emphasis on monitoring and analyzing large amounts of data on a continuous basis. Additional information is included in **Annex A**.

A wide-angle photograph of a city skyline, likely Denver, Colorado, featuring a prominent bridge in the foreground. The bridge has multiple arches and is filled with cars. The background is dominated by a dense cluster of skyscrapers, many with blue glass facades. A red construction crane is visible on the right side. The sky is overcast. The text 'PART B PILLARS' is overlaid in the center in a bold, white, sans-serif font.

PART B PILLARS

PILLAR

01



CREATING AWARENESS AND COMMON UNDERSTANDING



GOAL

Awareness and a common understanding of EBCx and its benefits across key organizations, groups and occupations in Canada



BARRIERS AND CHALLENGES

Key barriers and challenges to achieving this goal include:

- a lack of awareness and common understanding of what EBCx is, of the different types of EBCx (e.g. recommissioning, retro-commissioning and ongoing commissioning), how it compares with other processes (e.g. energy audits), and the related opportunities, costs and benefits
- an absence of simple, plain-language information about EBCx that can be easily shared with a broad audience
- inconsistency in available and accessible information and terminology

- relevant information being located in multiple places rather than being available through an easy-to-find, “one-stop” source
- a lack of understanding for some target audiences (e.g. building owners, property managers) of how to successfully plan and budget for undertaking EBCx

KEY ACTIONS

Recommended key actions for creating awareness and a common understanding of EBCx across key organizations, groups and occupations¹¹ are included here.

¹¹ Key organizations, groups and occupations include:

- organizations and groups such as utilities; federal, provincial, territorial and municipal governments; Indigenous groups and communities; industry associations; commissioning firms; and organizations that distribute related government funding
- occupations such as commissioning providers, energy managers, building owners, building operators, building or property managers, condo board representatives, program administrators, policy makers, engineers and other occupations involved in building operations and maintenance

1.1 Develop and share simple, plain-language material

Short, non-technical material tailored to target audiences (e.g. building owners, property managers, building operators, condo boards, policy makers, program administrators, Indigenous communities) is needed. The material would provide key information such as an overview of EBCx, different types of EBCx, key building types that could benefit from EBCx, and general cost estimates and budgeting information. It would also include brief information about determining when EBCx could be useful or applicable for a building¹² and about potential opportunities and benefits associated with EBCx. Materials should include simple, relatable, and consistent language and terminology that resonate with building owners, managers and operators and other target audiences.¹³ The material should be easy for target audiences to locate and access and for organizations to distribute.

Using different formats (e.g. one-pagers, videos, articles) and distributing through a variety of channels (e.g. industry association websites, newsletters, social media) would help reach a broader audience. Consistent base material could be developed and then customized according to individual needs.

1.2 Produce and share relatable case studies that showcase results

Simple, plain-language case studies and concrete examples that demonstrate results in a simple way that is easily understood

¹² This process could include directing individuals, groups and organizations to the EBCx Pre-Screening Tool (refer to Pillar 1 Resources for additional information).

¹³ Because individuals may not be familiar with commissioning terminology as part of their day-to-day work, incorporating terms such as optimization or enhanced building operations as part of the approach could also be considered (e.g. Continuous Optimization Program [BC Hydro and FortisBC], Building Optimization Program [Efficiency Nova Scotia] and Enhanced Building Operations Program [Efficiency Manitoba]).



should be developed for target audiences (e.g. building owners, building operators, contractors, property managers, Indigenous communities). Storied examples can be particularly relatable.

Case studies (written or video) could illustrate aspects of EBCx such as financial benefit, costs to undertake the project and benefits. The case studies can also show links to other work (e.g. with retrofits) and inclusion of EBCx as part of life cycle management. Examples of how EBCx can contribute to extending equipment life or opportunities to be innovative and go beyond minimum requirements would be useful. These case studies may be shared via conference presentations and through industry associations (e.g. BOMA, Real Property Association of Canada [REALPAC]) and other organizations that connect with key target audiences.



1.3 Create a central resource repository

A central resource repository would provide a one-stop online location for free resources and information related to EBCx. Links to this repository could be posted on other websites (e.g. industry association websites) and shared widely, with the goal of increasing awareness and understanding of EBCx.

Simple, plain-language materials and case studies would be housed in this repository.¹⁴ Having the central repository would enable sharing of consistent content and help organizations that do not have the capacity to produce, house and maintain this content individually. Created, maintained and updated on an ongoing basis, this central repository should be broadly accessible and widely promoted as a key location for information on EBCx.

1.4 Launch EBCx awareness campaigns

Awareness campaigns could involve sharing relatable, non-technical information about EBCx with target audiences through a variety of media options. Involving other organizations that regularly connect with key target audiences and developing specific communication, promotion or marketing strategies could facilitate implementation.

In addition to providing this information using diverse formats and channels (e.g. newsletters, conferences, videos, podcasts, social media), the awareness campaigns could also direct target audiences to relevant technical information and provide access to technical experts.

¹⁴ The central repository should be designed to provide information to individuals from a wide range of organizations and groups. An indexing system that categorizes the information so that it can be easily located and accessed (e.g. based on common topics, types of measures and points of interest) should also be considered.

1.5 Provide and promote awareness sessions and workshops

Offering awareness sessions and workshops designed and customized for target audiences (e.g. building owners, building operators, engineers, property managers, Indigenous communities) at regular intervals would also contribute to increasing awareness and understanding of EBCx. Standardized base material¹⁵ that can be customized for different target groups or for different jurisdictional or community contexts would help to facilitate consistency while allowing for different contextual circumstances.

The awareness sessions and workshops could be provided in conjunction with an awareness campaign and other EBCx programming. Activities could also include outreach to trade training institutions and other educational and training institutions. A goal of this outreach would be to encourage them to incorporate information and training material focused on awareness and understanding of EBCx into existing training programs for related occupations (e.g. engineers, building operators).

1.6 Increase awareness of EBCx through inclusion in broader initiatives

Regular inclusion of EBCx as part of broader initiatives related to energy or building performance would also serve to increase awareness. For example, promotional strategies for other types of programs (e.g. retrofit programs or energy management programs such as ISO 50001) could highlight potential savings and benefits associated with EBCx. As well, information regarding EBCx could be shared with target audiences who are responsible for reporting



data on building performance. Incorporating a requirement for EBCx as a condition for obtaining funding as part of a broader program would also contribute to drawing attention to the potential savings and benefits that can be obtained through EBCx.

There is also an opportunity to increase awareness and reach a broad audience of building owners, operators and property managers through ongoing inclusion of EBCx as part of educational programming and certifications related to building performance and building operations (e.g. those offered by BOMA and the Canada Green Building Council [CaGBC]).

¹⁵ A base level of information could be provided first, followed by more detailed workshop offerings. The content should incorporate and reflect consistent descriptions, language, definitions and terminology related to EBCx.

RESOURCES

Key existing resources include:

Websites

- Building Commissioning Association: <https://www.bcxa.org/>
 - Building Commissioning Association, Western Canada Chapter: <https://www.bcxa.org/about-us/chapters/western-canada-region.html>
 - Building Commissioning Association, Eastern Canada Chapter: <https://www.bcxa.org/about-us/chapters/eastern-canada-region.html>
- Recommissioning for existing buildings [NRCan]: <https://www.nrcan.gc.ca/energy-efficiency/buildings/energy-efficiency-existing-buildings/recommissioning-existing-buildings/20705>

Best Practices Documents

- *Existing Building Commissioning Best Practices* [Building Commissioning Association]: <https://www.bcxa.org/resources/existing-building-commissioning-best-practices.html>
- *Ongoing Commissioning Best Practices* [Building Commissioning Association]: <https://www.bcxa.org/resources/ongoing-building-commissioning-best-practices.html>

Program Examples Using Optimization or Enhanced Building Operations Related Terms

- Continuous Optimization Program [BC Hydro and FortisBC]: <https://www.bchydro.com/powersmart/business/programs/continuous-optimization.html>
- Enhanced Building Operations Program [Efficiency Manitoba]: <https://efficiencymb.ca/business/enhanced-building-operations/>
- Building Optimization Program [Efficiency Nova Scotia]: <https://www.efficiencyns.ca/business-program/building-optimization/>
- ÉcoPerformance [ministère de l'Énergie et des Ressources naturelles, sous-ministériat à la Transition énergétique (Government

of Quebec)]: <https://transitionenergetique.gouv.qc.ca/en/affaires/programmes/ecoperformance> and <https://transitionenergetique.gouv.qc.ca/en/affaires/programmes/ecoperformance/remise-au-point-des-systemes-mecaniques-des-batiments>

Video Example

- Maximize the energy efficiency of your building and save big! Efficiency Nova Scotia YouTube Channel: <https://youtu.be/2GYLfHmkQzc>

Other Resources

- Existing Building Commissioning (EBCx) Pre-Screening Tool [NRCan]: <https://www.nrcan.gc.ca/energy-efficiency/data-research-insights-energy-ef/buildings-innovation/building-optimization/recommissioning/existing-building-commissioning-ebcx-pre-screening-tool/11914>
- *Recommissioning Guide for Building Owners and Managers* [NRCan]: <https://www.nrcan.gc.ca/energy/efficiency/data-research-and-insights-energy-efficiency/buildings-innovation/building-optimization/recommissioning/rcx-guide/3795>
- Essential Attributes of Building Commissioning [Building Commissioning Association]: <https://www.bcxa.org/about-us/essential-attributes.html>
- *The Strategic Guide to Commissioning* [Building Performance Alliance Committee on Commissioning]: https://www.ashrae.org/file%20library/technical%20resources/bookstore/english-ashrae_bpa-brochure_fnl_6-24-14.pdf
- CSA Z5001:20 standard (Existing building commissioning for energy using systems): <https://www.csagroup.org/store/product/CSA%20Z5001%3A20/>

PILLAR

02



**BUILDING
CAPACITY**



GOAL

Strong capacity across Canada to undertake EBCx in a consistent manner, keep up to date on new approaches, and incorporate EBCx into standard building operations and maintenance policies and practices



BARRIERS AND CHALLENGES

Key barriers and challenges to achieving this goal include:

- the wide range of EBCx training and certifications available, rather than standardized approaches
 - the inconsistency in approaches for, and quality of, EBCx practices, both overall and for different types of EBCx
 - the need for increased knowledge of target audiences of
 - when a building is not performing optimally
 - when to undertake EBCx
 - how to support the process
 - how to help buildings to operate efficiently once a commissioning project has been completed or ongoing commissioning has been implemented
 - changing technologies and approaches, which create a need to keep up to date with commissioning processes, including monitoring and verification techniques
- variations in the scope of work that are due to
 - a lack of clear industry standards
 - inconsistency in the use of requests for proposals and the language for procuring EBCx services
 - the potential for a shortage of commissioning providers to meet the anticipated growth in demand for EBCx services

KEY ACTIONS

Recommended key actions for building capacity are included here.

2.1 Promote EBCx training and commissioning provider certification

This key action involves supporting the development and offering of training for prospective and current commissioning providers, as well as promoting

commissioning provider certification, including accredited certifications.¹⁶ The training should include content focused specifically on how to undertake EBCx, either through stand-alone training offerings or incorporated as part of broader training on commissioning. In addition, as part of continuing education, training sessions on specific topics (e.g. topics related to changes in EBCx approaches, current trends or emerging technologies) should be offered on a regular basis. Commissioning provider certification should also be encouraged, and a list of key recommended certifications and training programs that include EBCx should be published and maintained.

Activities to build EBCx workforce capacity could be combined with approaches to stimulate demand for EBCx (e.g. launching a program or requirement that involves EBCx). Options that facilitate and encourage building an inclusive and diverse workforce as well as the capacity to implement EBCx in Indigenous communities and in remote or small communities should also be considered.

Furthermore, a collaborative approach should be undertaken to explore options for having commonly accepted, unified certification(s) for commissioning providers in Canada and to determine if training programs for commissioning providers need to be consolidated or modified. Lists of certified commissioning providers and firms that provide EBCx services could also be published, shared and updated regularly.¹⁷



2.2 Develop national model procurement guidelines for EBCx services

To facilitate increased consistency and clarity regarding how commissioning provider qualifications are defined, national model procurement guidelines for EBCx services should be developed. These model guidelines would include universal definitions pertaining to the scope of work for EBCx services. They would be designed to increase consistency in the approach to requests for proposals (RFP) and requests for qualifications (RFQ).¹⁸ The model guidelines could be adapted as needed for different jurisdictional, regional or community contexts.

¹⁶ Activities could include, for example, subsidizing development and participation in the training, and/or enabling the training offerings in collaboration with training institutions and industry associations.

¹⁷ While the focus is on EBCx, certifications in the industry should also be for new construction to ensure that the training provided by organizations follow the rules for new construction.

¹⁸ As part of building capacity, consideration could be given to options for enabling new and growing firms to apply that would also include an EBCx resource with relevant expertise.



2.3 Provide training related to EBCx to occupations involved in building operations and management

Capacity building related to EBCx should include a range of occupations involved in building operations and management (e.g. building operators, building owners, property managers, contractors, engineers). Training would help build capacity in this area. Examples of topics include

- identifying when a building is not performing optimally
- when to undertake EBCx
- how to support the EBCx process
- requests for proposals for procuring EBCx services
- project management
- how to help buildings to operate efficiently once a commissioning project has been completed and/or ongoing commissioning has been implemented

This training should be available through a variety of formats (e.g. online courses, in person, webinars). It should be promoted to a broad range of regions and communities, including Indigenous communities and remote and small communities.

The training could be stand alone or incorporated as part of a conference to maximize uptake and participation. Organizations could also be encouraged to embed EBCx into the roles and job descriptions of operations and management staff. Incorporating training related to EBCx into existing educational and training programs for relevant occupations, including entry-level training through college and university courses, is also key.

2.4 Support EBCx capacity building through complementary activities

Activities such as hosting networking opportunities to grow the community would also contribute to building capacity for EBCx. These activities could include industry association events, such as those conducted by the Building Commissioning Association, promoting networking events, and creating awards or other forms of recognition for EBCx projects. Other options could include promoting or providing discounted or free student memberships for relevant industry associations.

Opportunities to support capacity building through university and college co-op programs should also be explored. Such opportunities could include offering co-op placements for construction management, engineering or building science students with commissioning firms, utilities, or other organizations that offer programs involving EBCx.

RESOURCES

Key existing resources include:

Training Examples (for commissioning providers and others)

- Commissioning Provider Certificate Program [Building Commissioning Association]: <https://www.bcxa.org/university/certificate-program.html>
- Commissioning courses [Building Commissioning Association]: <https://www.bcxa.org/university/classroom-learning/>, for example:
 - Existing Building Commissioning course
 - New Construction Commissioning course
 - Building Enclosure Commissioning course
 - Combined New Construction, Existing Building, and Building Enclosure Training
- BCxA University [Building Commissioning Association]: <https://www.bcxa.org/bcxa-university/>
- Introduction to Recommissioning (RCx) (e.g. for building owners and building managers) [Canadian Institute of Energy Training (CIET)]: <https://cietcanada.com/programs/intro-rcx/>
- Advanced Course on Building Recommissioning (RCx) [CIET]: <https://cietcanada.com/programs/rcx/>
- Certified Building Commissioning Professional (CBCP) program [CIET]: <https://cietcanada.com/programs/cbcp/>
- Building Enclosure Commissioning [University of Wisconsin-Madison]: <https://interpro.wisc.edu/interdisciplinary-professional-certificates/building-enclosure-commissioning-certificate/>
- Building Controls & Energy Management [British Columbia Institute of Technology (BCIT)]: <https://www.bcit.ca/programs/>



[building-controls-and-energy-management-advanced-certificate-part-time-distance-and-online-learning-5095adcert/](https://www.ashrae.org/professional-development/all-instructor-led-training/instructor-led-training-seminar-and-short-courses/the-commissioning-process-in-new-amp-existing-buildings)

- Commissioning Process in New & Existing Buildings course [ASHRAE]: <https://www.ashrae.org/professional-development/all-instructor-led-training/instructor-led-training-seminar-and-short-courses/the-commissioning-process-in-new-amp-existing-buildings>

Certification Examples (for commissioning providers and firms)

Examples include:¹⁹

- Certified Commissioning Professional (CCP) (ANSI-accredited²⁰) [Building Commissioning Certification Board (BCCB)]: <https://bccbonline.org/ccp/>; <https://www.bcxa.org/certification.html>

¹⁹ This is a list of examples and is not intended to be a comprehensive list of all commissioning provider certifications. A recommendation to publish and share a list of key recommended certifications and training programs is included in this pillar as part of **Key Action 2.1**. Activities to develop the list of key recommended certifications and training programs should include assessment and consideration of coverage related specifically to EBCx.

²⁰ ANSI stands for the American National Standards Institute.

- Building Commissioning Professional (BCxP) Certification (ANSI-accredited) [ASHRAE]: <https://www.ashrae.org/professional-development/ashrae-certification/certification-types/bcxp-building-commissioning-professional-certification>
- Certified Commissioning Authority (CxA) (ANSI-accredited) [AABC Commissioning Group (ACG)]: <https://www.commissioning.org/applyingforxacertification/?nonitro=1>
- Certified Building Commissioning Professional (CBCP) [Association of Energy Engineers (AEE)]: <https://www.aeecenter.org/certifications/certified-building-commissioning-professional> with related training provided by Canadian Institute of Energy Training (CIET)²¹
- Associate Commissioning Professional (ACP) [BCCB]: <https://bccbonline.org/acp>
- Certified Commissioning Firm (CCF) [BCCB]: <https://bccbonline.org/ccf/>
- Certified Building Commissioning Firm (CBCF) [AEE]: <https://www.aeecenter.org/certifications/certifications/certified-building-commissioning-firm-certification-program>

Other Resources

- Building Commissioning Association: <https://www.bcx.org/>
 - Building Commissioning Association, Western Canada Chapter: <https://www.bcx.org/about-us/chapters/western-canada-region.html>
 - Building Commissioning Association, Eastern Canada Chapter: <https://www.bcx.org/about-us/chapters/eastern-canada-region.html>



- *Assessment of Occupational and Skills Needs and Gaps for the Energy Efficient Buildings Workforce* (February 2021) [ECO Canada]: <https://eco.ca/new-reports/new-research-an-opportunity-for-energy-efficiency-in-the-building-sector/>
- Sample Template – Request for Existing Building Commissioning Services Proposal [Building Commissioning Association - Eastern and Western Canada Chapters]: [https://www.bcx.org/uploads/E%20CAN%20Chapter/03-BCA_CDN_EB_RFP_Nov302011_EN%20\(1\).doc](https://www.bcx.org/uploads/E%20CAN%20Chapter/03-BCA_CDN_EB_RFP_Nov302011_EN%20(1).doc)
- Samples of Request for Qualifications (RFQ) and Request for Proposal (RFP) templates for New Construction Commissioning (NCCx): <https://www.bcx.org/resources/?filter=cx-application-samples-and-templates&subFilter=rfq-rfp>

²¹ CIET. Program: Certified Building Commissioning Professional (CBCP) <https://cietcanada.com/programs/cbcp/>

PILLAR

03



**EXPANDING THE
EVIDENCE BASE**



GOAL

A robust evidence base of data and project results to inform policy making, decision-making, and the business case for EBCx



BARRIERS AND CHALLENGES

Key barriers and challenges to achieving this goal include:

- a lack of data, research and results information to inform the business case for EBCx
- an absence of a common forum or format to share data related to EBCx
- challenges associated with accessing building data externally, legacy systems and insufficient infrastructure to obtain data
- difficulties in obtaining data following project completion or collecting it retroactively
- a lack of incentives to provide data
- considerations regarding privacy, confidentiality and commercial sensitivity
- inconsistency in the types and measurement units of data collected, which can hinder compilation and comparison

KEY ACTIONS

Recommended key actions for expanding the evidence base for EBCx are included here.

3.1 Establish a central database for EBCx data and results

A central database would contribute to the consistent collection, compilation and analysis of EBCx data and results. The database should include a broad range of types of quantitative and qualitative data related to EBCx, including and extending beyond

- utility costs and energy savings, to include additional data related to building performance, occupant comfort, health, GHG emission reductions, and maintenance
- data on actual EBCx project costs (e.g. for overall projects and by project phase)
- other relevant building and uptake data

Consideration should be given to ways to make the central

database easily accessible and to include data that covers a range of building types, sectors and sizes.²² An industry or project registry could also be created. The central database could be established for an individual organization, for a jurisdiction or region, for Indigenous communities, or Canada-wide. Opportunities to link to, use or build upon existing data platforms (e.g. ENERGY STAR® Portfolio Manager®) and to access relevant data from other organizations²³ should be explored.



3.2 Gather and share data through case studies

Simple, plain-language case studies that illustrate EBCx results for a broad spectrum of building types and different regional and community contexts would contribute to providing relevant and relatable results information to target audiences (e.g. building owners, building operators, contractors, property managers, Indigenous communities).

Such case studies would contribute to providing an evidence base for key actions that is focused on awareness and integration of EBCx into programs, policies and approaches. Case studies do not need to focus solely on success stories but could instead be comprised of a broad range of examples from current or past projects.

The case studies should include key EBCx results information such as energy savings, cost savings, avoided additional costs, and other data linked to additional aspects. The results could report on building performance, occupant comfort, health, GHG emissions reductions,

maintenance, and EBCx project cost data (e.g. for the overall project and by project phase). Case studies specifically focused on ongoing commissioning and potentially focused on illustrating similar buildings with and without ongoing commissioning in place could also be considered. Templates could be used to facilitate the development of the case studies, as well as consistency in the types and measurement units of the data collected.

3.3 Require standardized data collection

Programs involving EBCx should include a standardized data collection approach. Data types that may benefit from standardization could include, for example, data pertaining

²² Enabling the ability to make relevant comparisons among similar buildings, cities and communities through the inclusion of data reflecting various climatic zones and building types should also be considered.

²³ This data could include, for example, data from industry associations or data collected for research purposes.

to energy savings and cost savings. Using a standardized data collection approach would increase the amount of data available related to EBCx. The approach would also ease consolidation of data from different projects. Data consolidation would enable “apples to apples” comparisons, thus strengthening broad overall reporting and facilitating the use of EBCx as a path for helping to meet targets, goals or specified limits related to building performance. Specifying corresponding measurement units and consistent data collection timeframes would also enhance comparability.

Data collection mechanisms should be user-friendly and streamlined. Steps should be taken to ensure relevant project data is collected (e.g. project cost and results data) and that the mechanisms do not impose a large burden on the data providers.

The following practices can facilitate data collection:

- sharing templates or samples
- collecting data in a new or existing database that can be accessed by program administrators
- incorporating incentives or program requirements to provide data²⁴
- creating an EBCx project recognition program that uses

specified types of submitted data to highlight results and successes²⁵

3.4 Promote the deployment of data gathering infrastructure

This key action involves promoting the use of data gathering infrastructure such as building automation systems with enhanced data logging or live streaming capability,²⁶ as well as sub-metering systems and/or meters that provide the sufficient granularity of tracking consumption for determining savings stemming from EBCx.²⁷ This could be done through voluntary approaches (e.g. incentives, information sharing) or through implementing mandatory requirements such as a program requirement.²⁸ Options for identifying data gathering standards to facilitate consistency among different types of data gathering infrastructure could also be explored.

RESOURCES

Key existing resources include:

Environmental Scan

- *Existing Building Commissioning: A scan of programs and policies implemented by Canadian provinces, territories and utilities* (December 2019) [Pembina Institute]: <https://www.pembina.org/pub/existing-building-commissioning>

²⁴ Incentives could include, for example, financial incentives such as discounts or rebates for providing data, access to aggregate results in exchange for contributing to a database, or financial or in-kind incentives to help with creating case study reports.

²⁵ In addition to providing a steady stream of specific types of data, an EBCx project recognition program could simultaneously promote EBCx to both public and private sectors.

²⁶ Enhanced data logging can involve, for example, increased data logging in terms of frequency and data points and the capacity to output data in a non-proprietary format with high granularity or reflecting changes in readings (i.e. change of value (COV)).

²⁷ As part of the process, encouraging the implementation of MBCx software, which is essentially data gathering infrastructure, could be considered. Additional information regarding MBCx is provided in *Proving the Business Case for Building Analytics*. Lawrence Berkeley National Laboratory, October 2020. <https://doi.org/10.20357/B7G022>.

²⁸ Options for incentivizing or requiring adjustments to existing infrastructure to obtain specific data or for the replacement of systems that are not able to provide key data could be considered as part of the approach.

Examples of Specific Program Results

- Continuous optimization: Program results [BC Hydro]: <https://www.bchydro.com/powersmart/business/programs/continuous-optimization/program-results.html>
- *Proving the Business Case for Building Analytics*. (Results from scaled implementation of Energy Management and Information Systems, as documented by the Smart Energy Analytics Campaign) [Lawrence Berkeley National Laboratory, October 2020]: <https://doi.org/10.20357/B7Go22>

Research

- *Value of Commissioning: 2018 Market Survey* [Building Commissioning Association and Lawrence Berkeley National Laboratory]: <https://www.bcxa.org/wp-content/uploads/2019/07/Cx-Market-Survey-Report-Final-2019.07.16-V.3..pdf>
 - 2018 Commissioning Cost/Benefit Study Findings [Lawrence Berkeley National Laboratory and Building Commissioning Association]: <https://www.bcxa.org/resources/2018-commissioning-cost/benefit-study-findings.html>
 - The Case for Cx: Updated Landmark Study Shows Evolution of Cx Costs and Benefits 2004 – 2018, Course Number: CXENERGY1925 [Eliot Crowe, Lawrence Berkeley National Lab, April 2019]: https://www.commissioning.org/wp-content/uploads/2019/04/Crowe_Lawrence_Berkeley_National_Lab_v1.pdf
- *Natural Resources Canada's 2018 Commissioning Industry Surveys* <https://www.bcxa.org/uploads/resources/Natural%20Resources%20Canada-%20Commissioning%20Industry%20Surveys.pdf>
- *The Cost-Effectiveness of Commercial-Buildings Commissioning: A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction in the United States* [Mills



- et al., December 2004]: https://www.researchgate.net/publication/277288787_The_cost-effectiveness_of_commercial-buildings_commissioning
- NIST Technical Note 1727: Annex 47 Report 3: *Commissioning Cost-Benefit and Persistence of Savings* [Friedman et al., December 2011] <https://www.nist.gov/publications/commissioning-cost-benefit-and-persistence-savings-report-cost-effective-commissioning>

Other Resources

- ENERGY STAR Portfolio Manager Access Page [from NRCAN's website]: <https://www.nrcan.gc.ca/energy/efficiency/buildings/energy-benchmarking/3693>

PILLAR

04

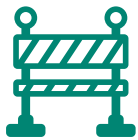


**IDENTIFYING AND
DEVELOPING TOOLS**



GOAL

An inventory of tools that supports the consistent implementation of EBCx and reflects evolutions in approaches and technologies



BARRIERS AND CHALLENGES

Key barriers and challenges to achieving this goal include:

- a lack of awareness and understanding of available tools related to undertaking EBCx and supporting its implementation
- the need to ensure that tools reflect evolving technologies and approaches
- the inconsistency in approaches used and in the quality and rigour of EBCx processes
- security considerations related to certain technologies
- inconsistent inclusion of EBCx costs into operating budgets and financial planning strategies, which can impact what tools can be used

KEY ACTIONS

Recommended key actions related to identifying and developing tools are included here.

4.1 Develop templates, samples, guides, standards and guidelines to support EBCx implementation

Creating, updating and sharing tools such as templates, samples, guides, standards and guidelines would help to support and facilitate EBCx implementation and would contribute to increased consistency in the approaches used.

These tools could include, for example:

- templates for documents such as case study reports or requests for proposals, guides or guidelines for participating in the EBCx process or EBCx projects²⁹ (or for specific activities such as procurement)

²⁹ For example, a guidance document that outlines steps for project phases (spanning from building identification and procurement to monitoring and evaluation of project results) and specifies the nature of involvement for different occupations for each step (e.g. responsible, accountable, consulted, informed, other categories) could be used to support EBCx project implementation.

- samples of relevant reports and inputs and outputs from software-based tools or recommended or standardized methods for calculating and verifying energy savings stemming from EBCx projects, accounting for proprietary considerations where applicable

Available tools should be reviewed and updated on a regular basis to ensure that they continue to be relevant and useful for supporting EBCx implementation.

4.2 Establish a reference inventory for tools

A reference inventory for tools would provide access to information about tools related to EBCx in a single location. The inventory should reflect a broad range of tools, including those that commissioning providers could use when providing EBCx services and tools that others could use as part of supporting EBCx implementation.³⁰

This inventory could be established for an individual organization, for a jurisdiction or region, for Indigenous communities, or Canada-wide. When possible, the inventory should include brief descriptions of the tools and links to additional information. The possibility of creating “toolkits” could also be considered. The reference inventory should be reviewed and updated regularly to ensure that it reflects current tools and evolutions in approaches and technologies.

4.3 Outline the EBCx process through succinct, user-friendly tools

Building on the EBCx Pre-Screening Tool released by NRCan,

concise and easy-to-use tools that outline the EBCx process following pre-screening should be designed and shared. Instead of detailed technical guides, these tools should be simple, plain-language reference tools that illustrate where to start and what is involved in the EBCx process. Key target audiences include building owners and building operators, and similar tools tailored for other target audiences could also be developed.

The tools should highlight aspects such as key steps, activities, roles and responsibilities, and considerations associated with undertaking EBCx. Where applicable, the tools could also include components that contribute to identifying the need for EBCx and illustrating its potential benefits. Formats such as flow charts, maps, simulators or summaries of steps could be considered. These simple, plain-language tools should also include definitions for key terminology that individuals may not be familiar with as part of their day-to-day work.

4.4 Create materials that illustrate tool use

Developing materials that illustrate the use of various tools related to EBCx would contribute to enhancing capacity in this area. Examples include fact sheets with overviews of types of tools and case studies that provide specific examples of tool use. Incorporating tool-related information into training material would also contribute to facilitating effective and consistent tool use. These materials could identify possible tools for specific types of tasks; draw attention to associated costs and benefits; and explain what the tool does, how it can be used, and if it will work for what

³⁰ These tools include, for example, guides, standards, templates, procurement tools, pre-screening tools and other tools geared toward supporting the EBCx process, as well as data gathering software (e.g. MBCx software).

the user is trying to do. Incorporating visual aids and tailoring materials for different target audiences would also enhance use and engagement.

4.5 Monitor tool use and needs

Options for monitoring include mechanisms such as surveys, interviews, web analytics, and other activities designed to gather information pertaining to tool use and needs. Initiating monitoring when a tool is released should be considered to gather information. The information collected would contribute to the strategic development and refinement of tools to align with needs and address key gaps.

RESOURCES

Key existing resources include:

Pre-Screening Tool

- Existing Building Commissioning (EBCx) Pre-Screening Tool [NRCAN]: <https://www.nrcan.gc.ca/energy-efficiency/data-research-insights-energy-ef/buildings-innovation/building-optimization/recommissioning/existing-building-commissioning-ebcx-pre-screening-tool/11914>

Guides, Best Practices and Other Tools

- Recommissioning Guide for Building Owners and Managers* [NRCAN]: <https://www.nrcan.gc.ca/energy/efficiency/data-research-and-insights-energy-efficiency/buildings-innovation/building-optimization/recommissioning/rcx-guide/3795>
- Existing Building Commissioning Best Practices* [Building Commissioning Association]: <https://www.bcxa.org/resources/existing-building-commissioning-best-practices.html>



- Ongoing Commissioning Best Practices* [Building Commissioning Association]: <https://www.bcxa.org/resources/ongoing-building-commissioning-best-practices.html>
- The Strategic Guide to Commissioning* [Building Performance Alliance Committee on Commissioning]: https://www.ashrae.org/file%20library/technical%20resources/bookstore/english-ashrae_bpa-brochure_fnl_6-24-14.pdf
- Efficient Heating, Ventilation and Air conditioning (HVAC) Operation during a Pandemic: Self-evaluation Tool and Guide [NRCAN]: <https://www.nrcan.gc.ca/energy-efficiency/buildings/existing-buildings/recommissioning/efficient-heating-ventilation-and-air-conditioning-hvac-operation-during-pandemic-sel/23577>

CSA Standards

- CSA Z5001:20 standard (Existing building commissioning for energy using systems): <https://www.csagroup.org/store/product/CSA%20Z5001%3A20/>

- CSA Z5000-18 standard (Building commissioning for energy using systems): <https://www.csagroup.org/store/product/Z5000-18/>
- CSA Z320-11 (R2021) standard (Building commissioning): <https://www.csagroup.org/store/product/Z320-11/>
- CAN/CSA Z8001-13 (R2018) standard (Commissioning of health care facilities): <https://www.csagroup.org/store/product/CAN%25100CSA-Z8001-13/>

ASHRAE Guidelines, Standards and Procedures

Examples include:³¹

- ASHRAE Guideline 0-2019 (The Commissioning Process): https://www.techstreet.com/ashrae/standards/guideline-0-2019-the-commissioning-process?product_id=2076120
- ASHRAE Guideline 0.2-2015 (Commissioning Process for Existing Systems and Assemblies): https://www.techstreet.com/ashrae/standards/guideline-0-2-2015-commissioning-process-for-existing-systems-and-assemblies?product_id=1901423
- ASHRAE Guideline 1.2-2019 (Technical Requirements for the Commissioning Process for Existing HVAC&R Systems and Assemblies): https://www.techstreet.com/ashrae/standards/guideline-1-2-2019-technical-requirements-for-the-commissioning-process-for-existing-hvac-r-systems-and-assemblies?product_id=2033701
- ANSI/ASHRAE/IES Standard 202-2018 (Commissioning Process for Buildings and Systems): <https://www.ashrae.org/news/esociety/updated-standard-october-2018> and https://www.techstreet.com/ashrae/standards/ashrae-202-2018?product_id=2025517

- ANSI/ASHRAE/IES Standard 100–2018 (Energy Efficiency in Existing Buildings): <https://www.ashrae.org/news/esociety/updated-standard-100-published> and https://www.techstreet.com/standards/ashrae-100-2018?product_id=2009091
 - ASHRAE 100 Users' Guide [RDH Building Science Inc., 2021]: <https://www2.gov.bc.ca/gov/content/industry/construction-industry/building-codes-standards/existing-buildings/ashrae-standard-100>
- Procedures for Commercial Building Energy Audits [ASHRAE]: <https://www.ashrae.org/technical-resources/bookstore/procedures-for-commercial-building-energy-audits>
 - Brief description of ASHRAE Level 1, 2 and 3 Energy Audits from CleanBC Better Buildings: <https://betterbuildingsbc.ca/faqs/what-are-ashrae-energy-audits/>

Sample Procurement Templates

- Sample Template - Request for Existing Building Commissioning Services Proposal [Building Commissioning Association - Eastern and Western Canada Chapters]: [https://www.bcx.org/uploads/E%20CAN%20Chapter/03-BCA_CDN_EB_RFP_Nov302011_EN%20\(1\).doc](https://www.bcx.org/uploads/E%20CAN%20Chapter/03-BCA_CDN_EB_RFP_Nov302011_EN%20(1).doc)
- Samples of Request for Qualifications (RFQ) and Request for Proposal (RFP) templates for New Construction Commissioning (NCCx) [Building Commissioning Association]: <https://www.bcx.org/resources/?filter=cx-application-samples-and-templates&subFilter=rfq-rfp>

³¹ Other related resources are available online from the ASHRAE® Bookstore (accessed through <https://www.ashrae.org/>), such as ASHRAE Guideline 1.3-2018 (Building Operations and Maintenance Training for the HVAC&R Commissioning Process); ASHRAE Guideline 1.4-2014 (Procedures for Preparing Facility Systems Manuals); and *Commissioning Definitions and Terminology for the Building Industry: A Common Overview*.

PILLAR

05



INTEGRATING EBCx INTO PROGRAMS AND POLICIES



GOAL

Integration of EBCx into programs and policies across Canada



BARRIERS AND CHALLENGES

Key barriers and challenges to achieving this goal include:

- a lack of awareness of the potential benefits stemming from incorporating EBCx into programs and policies
- limited or lack of incorporation of EBCx into program and policy approaches, including retrofit and other energy-related programs and policies
- a lack of operating policies that prioritize regular use of EBCx
- the misconception that undertaking EBCx is expensive and an information gap regarding the cost-effectiveness and return on investment for EBCx
- limited EBCx capacity in program administration and policy development

KEY ACTIONS

Recommended key actions for integrating EBCx into programs and policies are included here.

5.1 Offer and promote programs focused on EBCx

To help increase the uptake of EBCx within a community, region or jurisdiction, offering and promoting specific EBCx programs should be considered.³² The EBCx programs could initially be designed to target specific building categories to stimulate the market and develop skills³³ and then be expanded to include a broader range of buildings. Consideration should be given to providing access to technical experts or energy coaches, located centrally or locally, to support and help with EBCx

³² Program examples include financial or in-kind incentive programs, demonstration projects, and promotional initiatives that include access to technical expertise and information.

³³ Categories could include, for example, municipal, university, school and hospital buildings, Class A, B or C buildings, or specific sizes or types of buildings.

project implementation. Equity, diversity and inclusiveness considerations and options for facilitating EBCx implementation in Indigenous communities and in remote and small communities should also be taken into account as part of program design and delivery.

Time-limited pilot programs could be used to demonstrate the investment potential of implementing low-cost and no-cost measures identified through EBCx. Incentive programs could initially help raise awareness and stimulate the market. However, over the long term, capacity building for commissioning providers and others involved in supporting the EBCx process should be a key part of the approach for enabling and sustaining increased levels of EBCx implementation.

Consideration should be given to incorporating activities that build EBCx capacity, awareness and understanding into the overall approach, either as a component of programs focused on EBCx implementation or as separate, stand-alone programs.



5.2 Incorporate EBCx into labelling, disclosure and other reporting initiatives

This incorporation could involve approaches such as

- including the date of the most recent EBCx process on building energy labels
- incentivizing a voluntary approach with EBCx differentiator branding on buildings as a marketing tool
- developing an environment in which a building's most recent commissioning process is akin to a vehicle's most recent oil change (e.g. "the next building commissioning is due November 2025")

Open disclosure and sharing information about EBCx activities and results should be encouraged. Consistently including EBCx results and status updates in standard building reports and dashboards would contribute to normalizing EBCx implementation. EBCx should also be listed as a possible solution for improving energy ratings.

5.3 Explore integration of commissioning into codes

Options for integrating commissioning into codes for new construction and for existing buildings should be explored.

This practice could involve incorporating commissioning options or requirements into

- updated model building codes and model energy codes for new construction³⁴
- the Alterations to Existing Buildings model code currently under development
- other codes being updated or developed

Consideration should be given to the code development process and needed consultation. Other aspects for consideration include

- reception by and impacts for industry and others
- harmony with other mandatory requirements
- industry's ability to implement the new requirements
- enforcement, as well as mandates, required authorities, and frequency
- whether it would pertain to only certain types of buildings

The potential to integrate EBCx into codes via gradual, staggered or tiered approaches should also be examined.

5.4 Integrate EBCx into other programs, plans, policies and strategies

Integrating EBCx into other programs, plans, policies and strategies related to energy, conservation, sustainability or building performance can provide flexibility and a key avenue for reducing energy waste and optimizing equipment and systems.

For example, EBCx could be incorporated as a component of retrofit or renewable energy programs³⁵ or it could be an alternative option for program participants who do not have funding available for large capital improvements. Requiring EBCx as a condition for receiving program funding could also be considered.

EBCx should be identified in conservation and sustainability plans, policies or strategies as a path to help meet required targets, goals or specified limits for energy efficiency, energy use intensity (EUI) or GHG emissions.³⁶ In addition, the potential for using ongoing commissioning as a tool for implementing energy management systems (EnMS) (e.g. ISO 50001) should be explored. Consideration could also be given to options for incorporating specific EBCx requirements into mechanisms such as regulations, bylaws and building certifications.

RESOURCES

Key existing resources include:

Environmental Scan

- *Existing Building Commissioning: A scan of programs and policies implemented by Canadian provinces, territories and utilities* [Pembina Institute]: <https://www.pembina.org/pub/existing-building-commissioning>

³⁴ Commissioning for new construction is particularly important for high performance or net-zero buildings, to help new buildings, which later become existing buildings, perform as designed.

³⁵ For example, EBCx could be done prior to or following a retrofit. Additional information related to EBCx and retrofits is included in **Annex B**.

³⁶ To facilitate this integration, work could be undertaken to develop brief descriptions, key messages, and other information that could be included within a policy, plan or strategy as a best practice.

Specific Program Examples

- Enhanced Building Operations Program [Efficiency Manitoba]: <https://efficiencymb.ca/business/enhanced-building-operations/>
- Building Optimization Program [Efficiency Nova Scotia]: <https://www.efficiencyns.ca/business-program/building-optimization/>
- ÉcoPerformance [ministère de l'Énergie et des Ressources naturelles, sous-ministériat à la Transition énergétique (Government of Quebec)]: <https://transitionenergetique.gouv.qc.ca/en/affaires/programmes/ecoperformance>
- Community building recommissioning grant [Federation of Canadian Municipalities]: <https://fcm.ca/en/funding/gmf/community-building-recommissioning-grant>
- Smart Energy Analytics Campaign [U.S. Department of Energy]: <https://betterbuildingsolutioncenter.energy.gov/alliance/technology-campaigns/smart-energy-analytics-campaign>
- Local Law 87 (LL87) – Energy Audits and Retro-commissioning [New York City]: <https://www1.nyc.gov/html/gbee/html/plan/ll87.shtml>
- Building Performance Ordinance [Boulder]: <https://bouldercolorado.gov/services/building-performance-ordinance>
- Washington State Energy Code (WSEC) [Washington] - Education and Resources: https://waenergycodes.com/compliance_training.php;
 - Webpage includes links to
 - ♦ *Commissioning Fact Sheet* [Northwest Energy Efficiency Council]: <https://www.waenergycodes.com/pdf/WSEC-Commissioning-10-2017.pdf>; and
 - ♦ *New Energy Code Requirement: HVAC Total System Performance Ratio* [BetterBricks]: https://www.waenergycodes.com/pdf/TSPR-Flyer_6.30.pdf
- 2019 California Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) [California]: <https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center-o>
 - Webpage includes link to an Energy Code Ace Fact Sheet: https://energycodeace.com/download/35803/file_path/fieldList/FactSheet.NR-Commissioning.2019

Codes

- Codes Canada [National Research Council Canada (NRC)]: <https://nrc.canada.ca/en/certifications-evaluations-standards/codes-canada>
- Canada's National Energy Code [NRCAN]: <https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-buildings/energy-efficiency-new-buildings/canadas-national-energy-code/20675>

International Ordinance, Code or Law Examples

- Building Tune-Ups Ordinance (Seattle Municipal Code 22.930) [Seattle]: <http://www.seattle.gov/environment/climate-change/buildings-and-energy/building-tune-ups/about-building-tune-ups>
- Existing Buildings Energy and Water Efficiency (EBEWE) Ordinances [Los Angeles]: <https://www.ladbs.org/docs/default-source/forms/green-building/ebewe-ordinances.pdf>

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ANSI/ASHRAE/IES Standard 202-2018 (Commissioning Process for Buildings and Systems). <https://www.ashrae.org/news/esociety/updated-standard-october-2018> and https://www.techstreet.com/ashrae/standards/ashrae-202-2018?product_id=2025517

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ANNEXES

A photograph of a large, modern brick building with a parking lot in the foreground. The image is overlaid with a semi-transparent blue filter. The word "ANNEXES" is written in large, white, bold, sans-serif capital letters on the left side of the building. The building features a mix of brick and stone textures, with large windows and a prominent corner structure. A blue handicapped parking sign is visible in the parking lot.

ANNEX A – KEY TERMINOLOGY

The following list explains terms related to EBCx.^{37,38}

- **Commissioning (Cx) (or commissioning process)**^{39,40} is a quality-focused process for new and existing buildings. In the case of a new building or major renovation, it focuses on verifying and documenting that the facility and its systems and assemblies are planned, designed, installed, tested, operated and maintained to meet the Owner’s Project Requirements (OPR). For existing buildings, the Current Facility Requirements (CFR) are a key area of focus.
- **Commissioning provider** refers to an individual or firm who is responsible for implementing the commissioning process, including the implementation of EBCx.
- **Current Facility Requirements (CFR)** is a document that describes the current facility functional requirements and expectations about how it should be used and operated. The CFR can include information such as goals, success criteria, benchmarks, measurable performance criteria, cost considerations, and supporting information for meeting the requirements of owners, occupants and users of the facility.
- **Energy audits** are processes designed to determine where, when, why and how energy is being used, with a focus on understanding specific energy-using patterns. An energy audit can be used to identify opportunities to improve efficiency, decrease energy costs and reduce GHGs, through means such as through capital improvements, operational improvements or energy-saving technologies. Energy audits can also be used to verify the effectiveness of energy management opportunities after they have been implemented. An energy audit can be done separately from EBCx or it can be included in an EBCx process.
- **Existing building commissioning (EBCx)**,⁴¹ a term that refers to commissioning applied to existing buildings, is a process that can help existing buildings operate as expected and meet the Current

37 Key sources include: Building Commissioning Association. *Existing Building Commissioning Best Practices*; Building Performance Alliance Committee on Commissioning. *The Strategic Guide to Commissioning*. June 2014; NRCan. *Recommissioning Guide for Building Owners and Managers*. March 2008; NRCan. *Conducting an energy audit; Energy Savings Toolbox – An Energy Audit Manual and Tool*, p. 2; NRCan. *Retrofitting*; CleanBC Better Buildings. *What are ASHRAE Energy Audits?*; Building Commissioning Association. *Ongoing Building Commissioning Best Practices*; Kramer, H., Lin, G., Curtin, C., Crowe, E., and Granderson, J. *Proving the Business Case for Building Analytics*. Lawrence Berkeley National Laboratory, October 2020. <https://doi.org/10.20357/B7Go22>, p. 2.

38 For additional information and tables providing an overview of EBCx compared to an energy audit or a retrofit, refer to **Annex B**.

39 Examples of sources for definitions for commissioning and/or commissioning process include: Building Commissioning Association. *Existing Building Commissioning Best Practices* (p. 35); Building Performance Alliance Committee on Commissioning. *The Strategic Guide to Commissioning* (p. 17-18); CSA Z5001:20 standard (Existing building commissioning for energy using systems); and NRCan. *Recommissioning Guide for Building Owners and Managers*.

40 In addition, an overview that draws from definitions and terminology that appear in commissioning publications for AiCARR [Italian Association of Air-Conditioning, Heating and Refrigeration], ASHRAE, and CIBSE [Chartered Institution of Building Services Engineers] is provided in *Commissioning Definitions and Terminology for the Building Industry: A Common Overview*.

41 Examples of sources for definitions for existing building commissioning include: Building Performance Alliance Committee on Commissioning. *The Strategic Guide to Commissioning*, (p. 17-18); Building Commissioning Association. *Existing Building Commissioning Best Practices* (p. 1-3 & 35); CSA Z5001:20 standard (Existing building commissioning for energy using systems); and NRCan. *Recommissioning Guide for Building Owners and Managers*.

ANNEX A - KEY TERMINOLOGY

Facility Requirements (CFR). It focuses on activities such as: assessing, investigating, monitoring and verifying the operations and maintenance of a building and/or its systems and assemblies; identifying measures to improve or optimize performance; and implementing measures, documenting and training. Areas of focus include improving or optimizing the performance of existing equipment and systems and identifying low-cost or no-cost operational improvements. For this Framework, EBCx is used as a broad term that includes recommissioning, retro-commissioning and ongoing commissioning.⁴²

- **Monitoring-based commissioning (MBCx)** is an ongoing commissioning process that has an emphasis on using technology and/or software solutions to monitor and analyze large amounts of data on a continuous basis. EMIS (Energy Management Information System) tools can be used to organize, present, visualize and analyze the data.
- **New construction commissioning (NCCx)** is a term used for the commissioning process for new construction.
- **Ongoing commissioning (OCx)** is a process for continuously testing and/or tuning building systems that seeks to maintain building performance as expected and as previously commissioned. Typically, this process includes implementing technology and/



or software solutions within the building's automated heating, ventilation and air conditioning (HVAC) control system, which monitor and help optimize operations on a continuous basis.⁴³

- **Recommissioning (RCx)** is a process for commissioning an existing building that has previously been commissioned. It seeks to improve how the building equipment and systems are operating to meet current occupant needs through investigating to identify problems and integration issues and focusing on identifying

⁴² A brief illustration of how EBCx fits into the building life cycle is provided in **Annex C**.

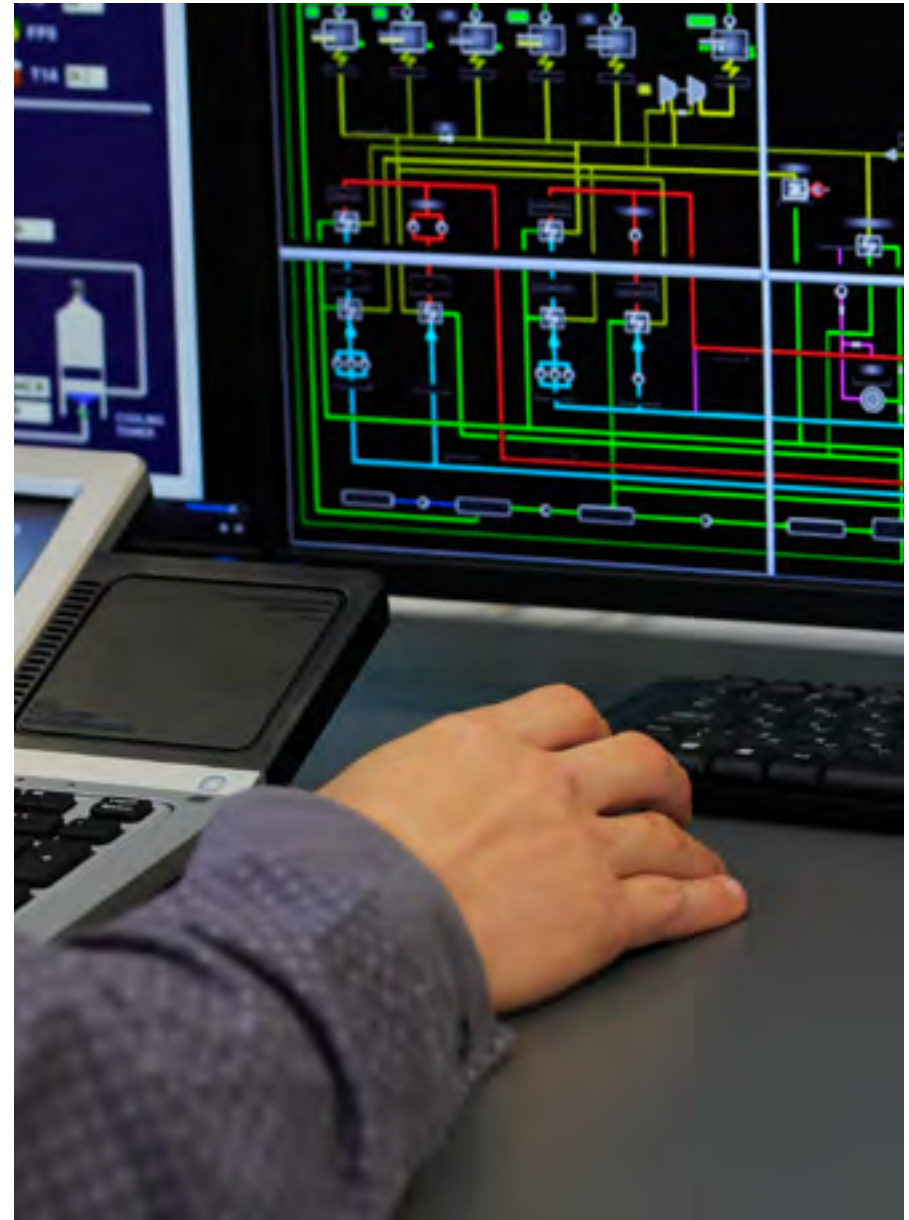
⁴³ Ongoing commissioning could be implemented following new construction commissioning or during a recommissioning or retro-commissioning process as part of helping to maintain an ongoing sustained performance of the building. Recommissioning could be done periodically following the implementation of ongoing commissioning if the building drifts from the baseline.

ANNEX A - KEY TERMINOLOGY

low-cost or no-cost operational improvements to obtain comfort and energy savings. This process can be undertaken alone or along with a retrofit project.

- **Retro-commissioning** is a process for commissioning an existing building that was not originally commissioned. It aims to improve how building equipment and systems function together and to resolve problems that occurred during building design, construction, or day-to-day running to meet current occupant needs.
- **Retrofits** focus on upgrading energy-consuming systems and equipment and typically involve replacing or adding components (e.g. replacing lighting fixtures, HVAC equipment or windows or adding insulation) and capital expenditures.
- **Smart and ongoing commissioning (SOCx)**⁴⁴ is a variant of OCx with a broader focus on system integration across multiple systems (e.g. lighting, security, renewable energy and storage, alongside HVAC) with highly automated monitoring and control systems. SOCx is an emerging approach, with commercialized services focused on existing building markets in certain larger urban centres. There is significant research and development to support its broad integration in commercial systems by 2030.

⁴⁴ SOCx is focused upon in the following recent September 2020 *Building and Environment* article: Gilani, S., Quinn C. and McArthur, J.J. A review of ontologies within the domain of smart and ongoing commissioning. *Building and Environment*. Volume 182, September 2020, 107099. (accessed at: <https://www.sciencedirect.com/science/article/pii/S0360132320304741?via%3Dihub>)



ANNEX B – DISTINGUISHING EBCx FROM ENERGY AUDITS AND RETROFITS

Overview of Approaches

A brief overview of the approaches for EBCx, energy audits and retrofits is included here. ^{45,46}

EBCx	Energy Audit	Retrofit
<p>Focuses on</p> <ul style="list-style-type: none"> improving and optimizing performance of existing equipment and systems “making the best of” what a building already has (e.g. adjusting settings, correcting equipment deficiencies, adding control points) identifying low-cost or no-cost operational improvements, typically with short payback periods (e.g. under 2 years) <p>Includes and extends beyond energy to also include broader building performance and related improvements (e.g. air quality, occupant comfort)</p>	<p>Focuses on</p> <ul style="list-style-type: none"> determining where, when, why and how energy is being used understanding specific energy-using patterns <p>Can be used to:</p> <ul style="list-style-type: none"> obtain energy information that can be considered when identifying capital or operational improvements related to energy (e.g. efficiency, emissions, costs) verify the effectiveness of energy management opportunities after implementation 	<p>Focuses on upgrading energy-consuming systems and equipment</p> <p>Retrofit projects typically involve:</p> <ul style="list-style-type: none"> replacing or adding components (e.g. replacing lighting fixtures and systems, HVAC equipment or windows, or adding insulation) capital expenditures <p>Includes and extends beyond energy to include broader building performance and related improvements (e.g. air quality, occupant comfort)</p>

⁴⁵ Key sources include: NRCan. *Recommissioning Guide for Building Owners and Managers*. March 2008; Building Commissioning Association. *Existing Building Commissioning Best Practices*. NRCan. Conducting an energy audit; *Energy Savings Toolbox – An Energy Audit Manual and Tool*, p. 2; CleanBC Better Buildings. What are ASHRAE Energy Audits?; NRCan. Retrofitting.

⁴⁶ ASHRAE’s *Procedures for Commercial Building Energy Audits* includes information on established guidelines for energy audits.

ANNEX B: DISTINGUISHING EBCx FROM ENERGY AUDITS AND RETROFITS

Primary and Secondary Focuses for EBCx and Energy Audits

A brief overview of primary and secondary focuses for EBCx and energy audits is included here.⁴⁷

Service	O&M Improvements	No-cost and Low-cost Savings Opportunities	Capital Retrofit Savings Opportunities
EBCx	Primary	Primary	Secondary
Energy Audit	Secondary	Primary	Primary

Examples of Potential Crossover or Links

- An **energy audit** could
 - be done separately from **EBCx** or it could be included in an **EBCx** process
 - include a component of **EBCx** and/or could recommend that **EBCx** be done if findings indicate possible optimization opportunities
 - be conducted prior to a retrofit to obtain energy information that can help identify **capital or operational** improvements.
- **Retrofit** projects could include **EBCx**
 - **prior to the retrofit** as part of determining operational improvements that can be achieved through low-cost or no-cost measures
 - **after the retrofit** to assess the integration of new equipment with other building systems and help contribute to the persistence of improved building performance

⁴⁷ Based on a table included in NRCAN. *Recommissioning Guide for Building Owners and Managers*. March 2008, p. 7 (Table was adapted from: Jim Poulos. "Existing Building Commissioning," *ASHRAE Journal*, September 2007, p. 66-78.)

ANNEX C – EBCx IN THE BUILDING LIFE CYCLE

Figure 1 illustrates how EBCx and some specific types of EBCx (e.g. recommissioning, retro-commissioning and ongoing commissioning)⁴⁸ fit into the building life cycle.

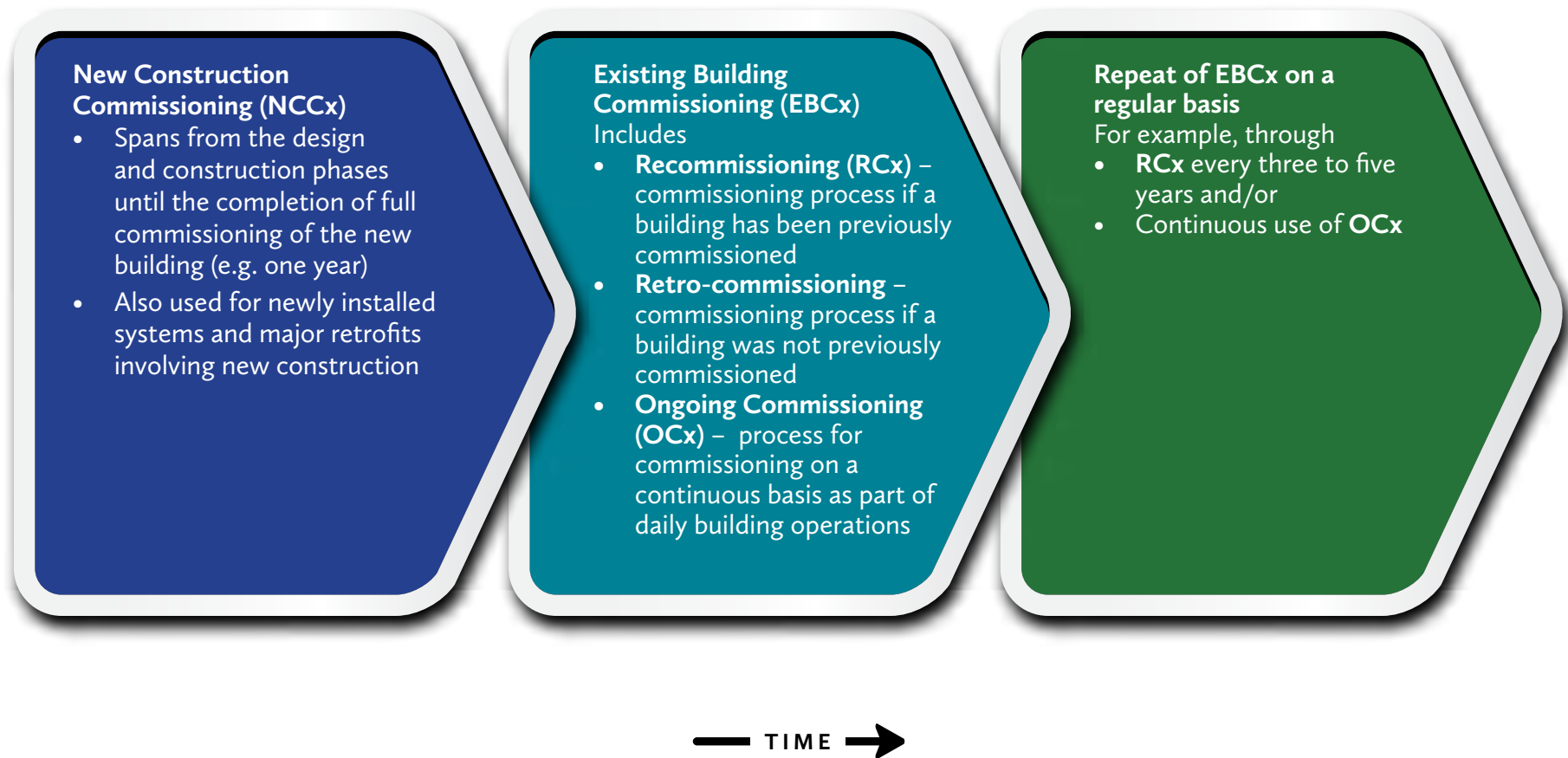


Figure 1 Commissioning in the Building Life Cycle

⁴⁸ Monitoring-based commissioning (MBCx) is an ongoing commissioning process that has an emphasis on monitoring and analyzing large amounts of data on a continuous basis. Additional information is included in **Annex A**.

ANNEX D – ONGOING COMMISSIONING CONTEXT

Rather than being a finite project with a defined start and end, ongoing commissioning (OCx) occurs on a continuous basis and can involve additional roles, responsibilities and technologies. Some key considerations related to OCx (overall and for individual pillars) and related resources are highlighted here.

Key Considerations

- Although the engagement and participation of occupations such as building operators, building owners and building managers are important for all types of EBCx, they are particularly important for OCx because of its ongoing nature.⁴⁹ OCx activities need to be integrated into the regular energy and O&M management practices and workflows.
 - Training and communication are key, and it is important to have O&M staff involved right from the beginning and be present during the process.
 - Instances of bypasses, changes that others in the team are not aware of, sub-optimal fixes, or overrides could potentially negatively impact building performance.
 - Maintaining continued engagement following OCx implementation may be a challenge because of factors such as time passing since the initial OCx implementation and staff turnover
 - It is important to ensure that there are people with expertise

available, on or off-site, to be able to respond to notifications or alarms and to take action to address needs while continuing to align with energy efficiency goals.

- OCx is linked to a number of emerging technologies such as those listed here, and to broader concepts such as artificial intelligence:⁵⁰
 - Energy Management and Information Systems (EMIS)
 - Energy Information Systems (EIS)
 - Fault Detection and Diagnostics (FDD)
 - Automated System Optimization (ASO)
- With respect to terminology, there are a number of related terms⁵¹ (e.g. ongoing commissioning [OCx] and monitoring-based commissioning [MBCx], as well as the emerging approach referred to as smart and ongoing commissioning [SOCx]). Additional information is included in **Annex A**.

Pillar 1 – Creating Awareness and Common Understanding

When undertaking activities to increase awareness and understanding of OCx, the ongoing nature of OCx should be taken into account. Specific considerations and context associated with OCx could be incorporated into broader EBCx awareness materials and sessions or distinct OCx awareness sessions and products could be prepared. Activities to increase awareness and understanding in this area should also include content or materials that are tailored specifically to building operators and O&M staff.

⁴⁹ This context can differ from recommissioning or retro-commissioning processes, which are generally seen as finite projects with start and end dates, carried out by a service provider.

⁵⁰ Additional information can be found at <https://buildings.lbl.gov/emis/best-practice-guidelines-and-resources>.

⁵¹ Note: Continuous Commissioning® is a registered trademark.

ANNEX D - ONGOING COMMISSIONING CONTEXT

Pillar 2 – Building Capacity

As the roles and responsibilities of occupations such as building operators, building owners and building managers are increased in OCx, training for occupations involved in building operations and maintenance is key. Specific OCx training could be provided either as part of broader EBCx training sessions or separate OCx sessions could be provided. As feasible, these training sessions should be tailored for the target audiences according to their roles and responsibilities. Building operators and building managers are key target audiences for this training.

Pillar 3 – Expanding the Evidence Base

There is a need to collect additional data about OCx because very little data pertaining to OCx is available in Canada. In addition to collecting EUI data, OCx data collection activities should include identification of other key performance indicators that would contribute to informing the development of the business case for OCx. Collecting and reporting data on costs avoided through OCx implementation⁵² could contribute to an ongoing business case for OCx as well as to maintaining continued engagement.

Key performance indicators could be tailored to measurement and verification needs (e.g. for energy savings, avoided additional energy costs, GHG emission reductions, extended useful life for equipment, and other benefits such as indoor air/environment quality). Developing



case studies focused specifically on OCx and, for example, illustrating the performance of similar buildings with and without OCx in place could be considered.

Pillar 4 – Identifying and Developing Tools

OCx is linked to a number of different emerging technologies, and information about these technologies and their use should be included as part of the reference inventory for tools. Information about related software (e.g. MBCx software) and tools for facilitating data tagging consistency⁵³ could also be included. In addition, little guidance

⁵² Avoided costs could include, for example, costs that would have occurred if energy consumption had increased (without the implementation of OCx) or avoided equipment replacement costs.

⁵³ Common data tagging schemas can help to create consistency and a common understanding. Inconsistency in data tagging can create challenges for configuration and installation of OCx that could result in the need for manual processes and make OCx implementation more expensive.

ANNEX D - ONGOING COMMISSIONING CONTEXT

exists about how, where and when to implement OCx. Therefore, developing a specific OCx guide for building owners and operators and incorporating a specific OCx section into pre-screening tools (e.g. the EBCx Pre-Screening Tool) could be considered.



Pillar 5 – Integrating EBCx into Programs and Policies

Because OCx incorporates elements of energy management practices, synergies with and the potential for using OCx as a tool for implementing energy management systems (EnMS) (e.g. ISO 50001) should be explored. When considering programming, options could include initiating OCx implementation following new construction commissioning or starting it during a major retrofit or a recommissioning or retro-commissioning process, as part of helping sustain ongoing performance of the building.⁵⁴

RESOURCES

Key existing resources related to OCx include:

- *Ongoing Commissioning Best Practices* [Building Commissioning Association]: <https://www.bcx.org/resources/ongoing-building-commissioning-best-practices.html>
- *Energy Management Information Systems Technical Resources Report* [Federal Energy Management Program, U.S. Department of Energy] <https://www.energy.gov/eere/femp/articles/energy-management-information-systems-technical-resources-report>

- Case studies examples related to OCx:
 - Case studies related to OCx and FDD [CopperTree Analytics]: <https://www.coppertreeanalytics.com/case-studies/>
 - Case studies related to OCx [Parity Inc.]: <https://www.paritygo.com/casestudies/>
- Smart Energy Analytics Campaign Toolkit [U.S. Department of Energy]: <https://betterbuildingsolutioncenter.energy.gov/smart-energy-analytics-campaign-toolkit>
- *Proving the Business Case for Building Analytics*. (Results from scaled implementation of Energy Management and Information Systems, as documented by the Smart Energy Analytics Campaign) [Lawrence Berkeley National Laboratory, October 2020]: <https://doi.org/10.20357/B7Go22>
- *Proving the Business Case for Building Analytics*. Infographic [Lawrence Berkeley National Laboratory]: https://betterbuildingsolutioncenter.energy.gov/sites/default/files/attachments/Building%20Analytics_2020sep16.pdf

⁵⁴ Building Commissioning Association. *Ongoing Commissioning Best Practices*, p. i & 1.

ANNEX E – KEY ACRONYMS

AABC	Associated Air Balance Council	FDD	Fault Detection and Diagnostics
ACG	AABC Commissioning Group	GHG	Greenhouse gas
ACP	Associate Commissioning Professional	HVAC	Heating, ventilation and air conditioning
AEE	Association of Energy Engineers	MBCx	Monitoring-based commissioning
ANSI	American National Standards Institute	NCCx	New construction commissioning
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers	NRC	National Research Council Canada
ASO	Automated System Optimization	NRCan	Natural Resources Canada
BCCB	Building Commissioning Certification Board	O&M	Operations and maintenance
BCIT	British Columbia Institute of Technology	OCx	Ongoing commissioning
BCxA or BCA	Building Commissioning Association	OPR	Owner’s Project Requirements
BCxP	Building Commissioning Professional	RCx	Recommissioning
BOMA	Building Owners and Managers Association	REALPAC	Real Property Association of Canada
CaGBC	Canada Green Building Council	RFP	Request for proposal
CBCF	Certified Building Commissioning Firm	RFQ	Request for qualifications
CBCP	Certified Building Commissioning Professional	SOCx	Smart and ongoing commissioning
CCF	Certified Commissioning Firm		
CCP	Certified Commissioning Professional		
CFR	Current Facility Requirements		
CIET	Canadian Institute of Energy Training		
COV	Change of value		
Cx	Commissioning		
CxA	Certified Commissioning Authority		
EBCx	Existing building commissioning		
EIS	Energy Information Systems		
EMIS	Energy Management and Information Systems		
EnMS	Energy management systems		
EUI	Energy use intensity		