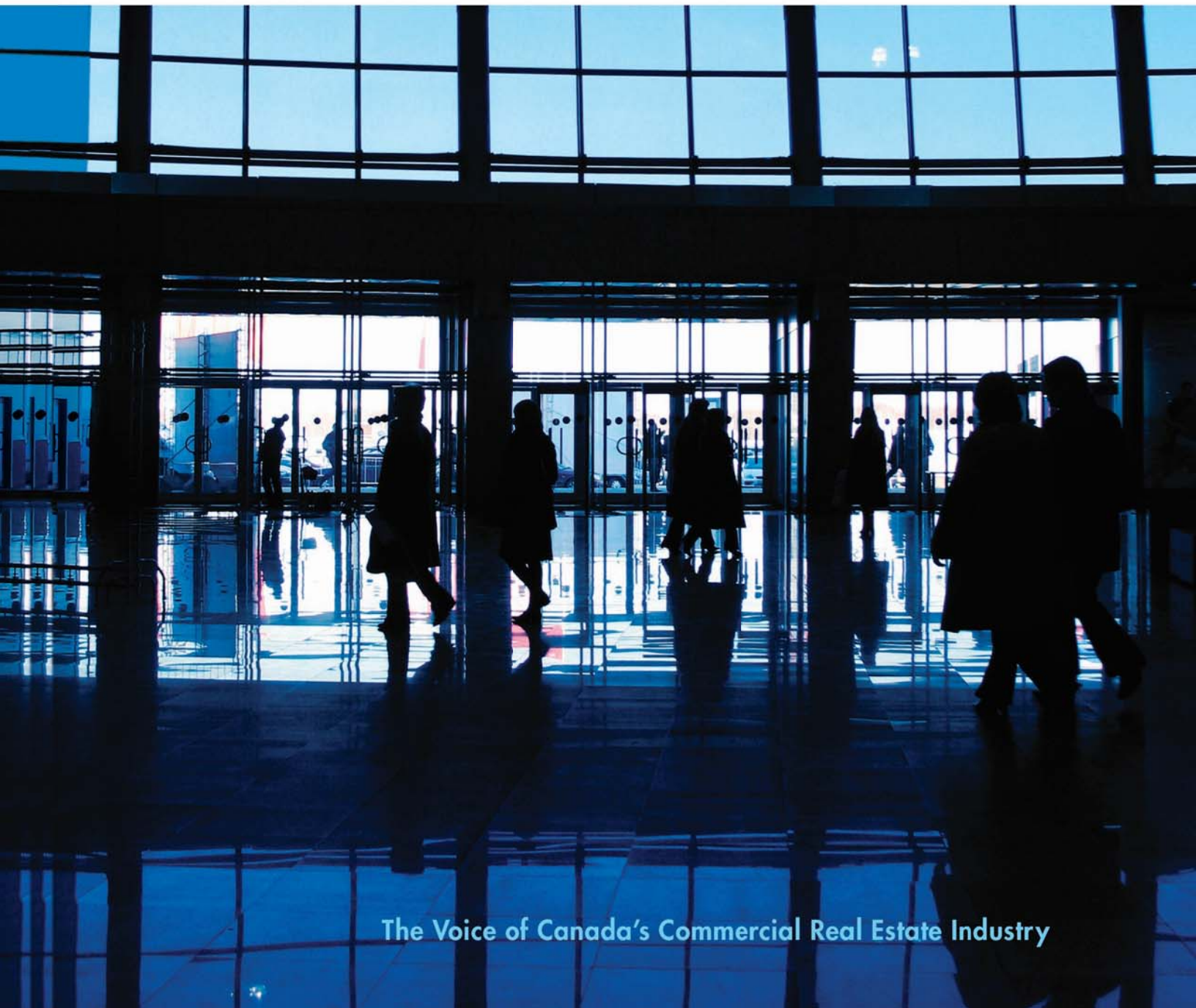




BOMA Canada

Existing Building Commissioning (EBCx)
for Commercial Real Estate
Owners and Managers



Message from the President

BOMA Canada is pleased to present this brief on existing building commissioning researched and compiled by our national Environment and Energy Committee. As a national association, BOMA Canada strives to continuously address issues that are relevant and timely for our members and the commercial real estate industry at large.

Interest in commissioning has grown in the past few years, along with industry's desire to adopt management approaches to help increase energy efficiency in buildings. Existing Building Commissioning is an important part of any real estate management strategy. It is about looking at how building systems are operated and maintained, and is one way to enhance operators' understanding of building performance.

Recognizing both increased interest in commissioning, and its importance to building management, our national Environment and Energy Committee developed this document – *for industry by industry*.

I would like to acknowledge the dedication and hard work of all members of the Environment and Energy Committee in the research and writing of this document, with special thanks to Suneel Gupta, Committee Chair, who led the project and is the primary author of this brief.

Sincerely,



BOMA Canada President, Diana Osler Zortea

Message from Environment & Energy Committee Chair

The original intent of this document was to create a two-page information sheet about existing building commissioning (EBCx); a "reference sheet" to which building managers could refer if asked what EBCx is and how to go about implementing related projects. Since this is still an evolving field, BOMA Canada's Environment and Energy Committee felt it would be a good initiative to pursue. Over the past six months we have added information such as internal vs. external resourcing, professional courses, and so on.

The final document presented is more than the original two-pages but the intent remains the same: We aim to present an overview document that will provide building owners and managers with basic information on EBCx and hopefully drive interest to implement commissioning project(s).

The information captured is based on Committee members' experience and knowledge from the landlord / property management perspective and is therefore not prescriptive (as a traditional project management document would be). Finally, it is meant to be a "living document"; updated from time to time by the Committee as the field evolves.

In closing, I hope you will find the content informative and useful in your pursuit of a commissioning project.



Suneel Gupta
Chair, Environment & Energy Committee

Acknowledgement and Thanks

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Existing Building Commissioning (EBCx) for Commercial Real Estate Owners and Managers

Purpose of Document

This document is intended to help building owners and managers who may be tasked with managing or implementing a commissioning project to understand the key facets of commissioning.

While this document attempts to provide the reader with a good understanding of existing building commissioning, it is not exhaustive, nor is it able to cover the multitude of approaches to commissioning. There are good resources available online that are listed in Appendix 1 of this document for those interested in learning more on this subject.

Finally, the term “Existing Building Commissioning” (EBCx) is used throughout this document because it captures the various forms of commissioning; whereas the use of terms such as “retrocommissioning”, “retuning”, and “recommissioning” describe specific actions or classifications that relate to the overall exercise of commissioning.

Overview

Existing Building Commissioning (EBCx) has gained significant momentum in recent years. The purpose of EBCx is to get existing systems and equipment operating the best that they can. Before replacing perfectly serviceable equipment, EBCx identifies the actions required to ensure that existing systems and equipment are functioning optimally to match current operational needs. The benefits can include saving energy, reduced operating costs, and provide improved occupant comfort and indoor air quality (IAQ).

The Building Commissioning Association (BCxA) defines Existing Building Commissioning (EBCx) as: **“...a systematic process for investigating, analyzing, and optimizing the performance of building systems through the identification and implementation of low/no cost and capital intensive Facility Improvement Measures and ensuring their continued performance.”**¹ EBCx can be further classified as either *Recommissioning* (building systems that have been previously commissioned) or *Retrocommissioning* (building systems that have not been previously commissioned).

While commissioning is not a new concept, increasing interest in applying this practice to existing buildings has been spurred by recent research demonstrating the value of EBCx into saving energy. See [Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse-Gas Emissions for an assessment of EBCx.](#)²

BOMA Canada’s BOMA BEST certification program addresses EBCx in its Energy Management section of the assessment. It also recognizes the importance of continuous commissioning to resolve operating problems, as well as the importance of recommissioning requirements upon major retrofits and occupancy changes. See Appendix 1 for a link to online resources and the BOMA BEST assessments for various building types.

EBCx can be part of a larger site level staged energy retrofit program or part of a site Energy Management Plan. For help on creating an Energy Management Plan see ENERGY STAR’s [Guidelines for Energy](#)

¹Building Commissioning Association (BCA) website as viewed on July 18, 2011. www.bcxa.org

²Mills, Evan: Lawrence Berkley National Laboratory, 2009.

Management Overview.³ For help on an integrated staged energy retrofit approach see ENERGY STAR's **Building Upgrade Manual.**⁴

A commissioning exercise for existing buildings can provide the following potential benefits:

- Reduce utility and other operational costs;
- Save energy through improved operational practices;
- Extend equipment life and reduce repair and replacement costs;
- Improve comfort and IAQ which affects the health, comfort and productivity of building occupants;
- Prioritize and reduce capital costs;
- Reduce ongoing labour/maintenance costs;
- Update building system documentation;
- Update building operator training; and
- Protect/improve asset value.

Overview of EBCx Experience

Though results vary significantly (\$0.15 to \$1.00/sq.ft.), an extensive Lawrence Berkeley National Laboratory study analyzed by Effinger and Friedman in a 2010 article, found a typical EBCx exercise cost to be an average of \$0.30/sq.ft., resulting in 16% energy savings with a simple payback of 1.1 years on average.⁵ The costs and savings will depend upon many factors including scope of EBCx project, site complexities and state of operational documentation.

The top ten measures that resulted in the most savings from the EBCx exercise were:

1. Revise Control Sequence;
2. Reduce Equipment Runtime;
3. Optimize Airside Economizer;
4. Add/Optimize Supply Air Temperature Reset;
5. Add Variable Frequency Drive to Pumps;
6. Reduce Coil Leakage;
7. Reduce/Reset Duct Static Pressure Set point;
8. Add/Optimize Start/Stop;
9. Add/Optimize Condenser Water Supply Temperature Reset; and
10. Optimize Ventilation Air Quantities.

By incorporating operator training and standardizing processes to ensure ongoing commissioning, greater energy savings can be achieved beyond the commissioning project itself. Specifically, greater savings are achieved due to training which helps the implemented improvements persist over time.

³Environmental Protection Agency (EPA): ENERGY STAR®, 2011. <http://www.energystar.gov/index.cfm?c=home.index>

⁴Ibid.

⁵Effinger, J., H. Friedman. "What Saves Energy in Existing Buildings: The Right Measures", ASHRAE Journal, 52(10):84-89).

System Specific Commissioning

While a whole building commissioning approach investigates the interaction of various building systems in its commissioning process, a system-specific commissioning is a narrower scope that may be an option in which:

1. The on-site team has system technical expertise and capacity and have a long term plan to commission one system at a time;
2. Specific systems are known to be malfunctioning and need immediate resolutions;
3. Facilities have simplified HVAC systems; and/or
4. New equipment is being installed.

A system-specific EBCx may also be preferred if there are financial incentives opportunities that focus on specific systems (e.g. chilled water consumption or peak electrical demand). System-specific phases of whole building commissioning allow for cost of the exercise to be spread over a period of time.

System-specific commissioning follows a similar process to EBCx, but is customized to the specifics of the system in place. A system-specific commissioning plan should include:

1. Training for operations staff;
2. Updating of building operating procedures and documentation; and
3. Modifications to preventative and operational maintenance procedures.

Planning and Executing an EBCx Project

An important aspect to an EBCx exercise is that it should follow the planning, investigation, implementation and “hand-off” phases of project management principles. [The Recommissioning Guide for Building Owners and Managers](#) produced by Natural Resources Canada (NRCan) is available to provide greater detail on the project management aspect of EBCx. Table A on page 5 – *Simplified EBCx Scope of Work* – by Enermodal Engineering, provides the phases and activities of the commissioning process in a summarized layout.

Table A: Simplified EBCx Scope of Work⁶

Planning Phase	
1.	Identify candidate building
2.	Hire external and/or appoint internal EBCxA
3.	Review energy bills and benchmark to quantify energy use
4.	Verify no major upgrades or equipment replacements upcoming
5.	Review maintenance and complaints logs for concerns to address
6.	Identify recent upgrades or renovations that did not include Cx
7.	Identify documentation, training, and procedural improvements that will help staff better operate and maintain the building
8.	Develop list of potential issues for investigation to deal with areas of concern and areas for improvement in performance
9.	Develop EBCx plan
10.	Allocate budget and timeline to EBCx investigation
Investigation Phase	
1.	Conduct walk-through investigation to identify problem systems and equipment
2.	Perform detailed investigations and functional testing on problem systems and equipment
3.	Perform simple fixes that can be implemented immediately
4.	Identify low cost / no cost issues as well as capital intensive upgrade recommendations
5.	Tabulate findings including costs and paybacks for all items recommended
6.	Prioritize and schedule upgrades to be implemented
7.	Develop implementation plan
8.	Budget resources, time, and capital for implementation
Implementation Phase	
1.	Appoint internal or hire external project manager
2.	Develop detailed scope of work for each item to be implemented
3.	Hire contractors as required to perform work
4.	Functionally test and commission completed work
5.	Update Operational Plan, O&M documentation, Sequence of Operation, and Systems Manual to accurately reflect current operational programme
6.	Provide staff training as needed to ensure full understanding of current operational programme
Hand-off Phase	
1.	Produce On-going EBCx Plan
2.	Provide staff training to undertake on-going EBCx
3.	Produce final EBCx report
4.	Develop implementation plan including budget, resource allocation, and time schedule for future work identified but not included in this project
5.	Hold hand-off meeting including debriefing on achievements, potential process improvements, and next steps.

⁶ Courtesy of Enermodal Engineering

Externally Resourced Commissioning vs. Internally Directed Commissioning

While the commissioning process requires the active participation of the operations staff, it is often beneficial to bring in the services of an independent (third-party) Commissioning Provider (CxP). These are qualified professionals with specialized expertise in building commissioning. There are several benefits of using the services of a CxP, including:

- 1) **Improved Project Management** – While providers differ in the exact delivery of their services; most follow a set scope with a focus on timelines and expected deliverables. The attention to scope, timing and deliverables ensure improved projects.
- 2) **Increased Saving Opportunities** – CxP's can use their experience from prior projects to the benefit of the current project. Experience of specific building systems or manufacturers' knowledge can result in recommendations that ensure better savings and more accurate cost estimates. These practitioners are able to categorize measures as immediate or requiring additional capital and typically also have the capability of providing savings estimates.
- 3) **Improved Trouble Shooting Capabilities** – Commissioning Practitioners are often equipped to deal with resolving Indoor Air Quality (IAQ), comfort and noise issues. Attention is often given to ensuring additional problems do not arise in the process of addressing a specific problem. Furthermore, CxPs have calibrated measurement devices that are typically too expensive for property management's in-house EBCx exercise.
- 4) **Timely Execution of Project Plan** – Ideally an EBCx project should take place over three quarters (9 months) of a year to ensure optimized operation through all the seasons and to allow Commissioning Practitioners to perform tests over different seasons. By staying focused on the EBCx initiative, this ensures a timely execution for the project.

Depending upon the site skill level, capacity and complexity, buildings may utilize an internally directed commissioning process. Some of the potential benefits from an internally driven EBCx include:

- 1) **Reduced Commissioning Costs** – Having an in-house champion can ensure costs for commissioning are minimized. There is a learning curve associated with this that can result in delays; but overall, this option could result in improved cost savings and internal retention of knowledge.
- 2) **Greater Input and Acceptance of Process** – An internally driven program allows greater input as to the direction of opportunities; such as a team-driven initiative that can overcome some of the resistance to participate.
- 3) **Improved "hand-off"** – Having the same commissioning team involved throughout the process can allow for the hand-off stage to be adopted as standard operator procedures. This also allows for an internally driven continuous commissioning program to be rolled out.
- 4) **Training and certification** – Training and certification for commissioning professionals is expanding and governing bodies supporting and setting standards for these programs are also evolving. Currently, there are training and certification courses offered for commissioning professionals in the United States. Given the increased attention to commissioning as an important business strategy, such training programs are likely to be rolled out in Canada in the near future. Table B on page 7 includes some of the certifications and courses available for commissioning consultant or for operations training.

Table B: Training and Certification

Organization	Certification Credentials	Description	Further Information
<p>Association of Energy Engineers</p>	<p>Certified Building Commissioning Professional</p> <p>Accreditation for field practitioners managing Cx projects</p>	<p>Three-day "Fundamentals of Building Commissioning" training program.</p> <p>"Comprehensive Five-Day Training Program for Building Commissioning Professionals course followed by a four hours exam</p>	<p>www.aeecenter.org/i4a/pages/index.cfm?pageID=3666</p>
<p>American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)</p>	<p>Commissioning Process Management Professional</p> <p>Accreditation for building owners managing Cx projects</p>	<p>Currently no training courses offered. Certification based upon experience and successful passing of a 2.5 hour exam.</p>	<p>www.ashrae.org/certification/page/2086</p>
<p>Building Commissioning Association (BCA)</p>	<p>Certified Commissioning Professional</p> <p>Accreditation for field practitioners managing Cx projects</p>	<p>Currently no training courses offered. Certification based upon experience and successful passing of a 2 hour Exam.</p>	<p>www.bcxa.org</p>
<p>National Environmental Balancing Bureau (NEBB)</p>	<p>Retro-commissioning Certified Professional</p> <p>Accreditation for managers in NEBB certified TAB firms running EBCx projects</p>	<p>Requires firm to be certified.</p> <p>Requires certification in Testing and Balancing (TAB) procedures.</p> <p>Refer to website link for details.</p>	<p>www.nebb.org/</p>
<p>University of Madison Wisconsin</p>	<p>Various Commissioning Process Certifications</p>	<p>Various certification designations involving course, practical experience and exams.</p>	<p>www.cx.engr.wisc.edu</p>

Getting the Most of Your EBCx Project

While commissioning is not a new concept, EBCx is new to many building owners. The following suggestions may help get the most out of your EBCx project:

- 1) **Scoping of EBCx Deliverables** – A detailed project scope will ensure the greatest success for cost savings. Many EBCx projects are instigated through a Request for Proposal (RFP) process. The RFP should solidify the scope, pricing and sample copy of the expected deliverables.
- 2) **Determining the EBCx Process** – There is flexibility within the commissioning processes to allow for customization to site requirements. The process needs to factor in, for example, the site budget, staff capacity, timelines and operational priorities. It is often difficult for a Commissioning Practitioner to fully cost the EBCx project at the outset. It is recommended, therefore, to request a staged approach to the EBCx, which will provide the CxP with an opportunity to refine the project. This in turn, will help to ensure manageability and competitive pricing. The staged approach can include the following:
 - i. Planning, Investigation and Analysis phase;
 - ii. Implementation and Hand-off phase; and
 - iii. Development and implementation of an ongoing commissioning plan.

See page 5 for Simplified EBCx Scope of Work.

- 3) **Selection of CxP** – While there is great consensus in EBCx, common standards for the industry is evolving⁷. This can lead to various approaches and service provisions. The selection process requires the building owner to be diligent with service provider selection. The following are suggested steps to consider incorporating into the selection of a CxP:
 - i. The Property Manager may want to consider arranging to interview the commissioning practitioners to see if their approach to EBCx will satisfy the project's goals.
 - ii. The Canadian Chapters of the Building Commissioning Association have developed a standard Request for Proposal (RFP) template, to assist building owners and EBCx project managers solicit these services on a more consistent basis. The template is available from any Canadian BCA member.
- 4) **Building Performance and Savings Monitoring & Verification (M&V)** – Establishing an M&V plan from the start of the project will help ensure that building performance and savings materialize from the EBCx process. Adequate M&V will also allow for adequate time to collect building performance data and in turn verify the accuracy of calculations. In addition, M&V also allows the property managers track the persistence of energy savings.

There are some very good resources available to assist with M&V planning, such as the California Commissioning Collaborative Guidelines for [Verifying Existing Building Commissioning Project Savings](#) (available as a free download).

- 5) **Industry-Consistent Documentation** – Completing an EBCx project generally results in much improved documentation for the building. For example, updating (or creation of an entirely new) “Systems Operation Manual” (this term is used interchangeably with others, such as “operations manual”, “building operations plan”, etc.) and the creation of a “Commissioning Plan”. The latter includes completion of additional performance testing documents that are consistent with industry standards. The “hand-off” phase should include training and an “Ongoing Commissioning Plan”.

⁷ In May 2011 CSA Z320, a Canadian standard on Building Commissioning has been released and is available for online purchase. See Appendix 1 for link.

The development of a “Performance Monitoring and Verification Plan”. Additional energy audits may also be recommended, and, if undertaken, thoroughly documented.

Need Further Help?

While EBCx is not considered a traditional measure for energy efficiency, it lends itself to achieving significant energy reductions while improving occupant comfort and management of building operations. There are great benefits to considering EBCx as part of your energy management strategy. This document includes a list of resources for more information on EBCx (see “Suggested Resources” in Appendix 1).

We Welcome Your Comments!

BOMA Canada would like to receive your candid feedback on this document or the subject of Existing Building Commissioning. Kindly send us an email with your thoughts to: info@bomacanada.ca.

Appendix 1: Suggested Resources

Guides & Publications

1. Building Commissioning Association (BCxA): **Best Practices in Commissioning Existing Buildings**, 2008. [Download Report](#)
2. California Commissioning Collaborative: **California Commissioning Guide: Existing Buildings**, 2006. [Download Report](#)
3. California Commissioning Collaborative: **Guidelines for Verifying Existing Building Commissioning Project Savings**, 2008. [Download Report](#)
4. Canadian Standards Association (CSA): **Z320-11 – Building Commissioning Standard & Check Sheets**, 2011. [Download Report](#)
5. Effinger, J., H. Friedman, D. Moser: **A Study on energy Savings and Measure Cost Effectiveness of Existing Building Commissioning**, 2009. Prepared for California Energy Commission Public Interest Energy Research (PIER). [Download Report](#)
6. ENERGY STAR®: **Building Upgrade Manual**, 2008. United States Environmental Protection Agency (EPA), Office of Air and Radiation, 2008 Edition. [Download Report](#)
7. Mills, Evan: **Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions**, 2009. Lawrence Berkeley National Laboratory, Berkeley, CA. Prepared for: California Energy Commission Public Interest Energy Research (PIER). [Download Report](#)
8. Natural Resources Canada's (NRCan) CanmetENERGY: **Recommissioning (RCx) Guide for Building Owners and Managers**, 2008. First Edition. [Download Report](#)
9. Natural Resource Canada's (NRCan) Office of Energy Efficiency (OEE): **Recommissioning Case Study - TELUS House, Vancouver, British Columbia**, December 2008. [Download Report](#)
10. US Department of Energy Efficiency & Renewable Energy, Federal Energy Management Program: **Operations & Maintenance Best Practices: A Guide to Achieving Operational Efficiency**, Chapter 7: "*Commissioning Existing Buildings*", 2010. [Download Report](#)

Websites

1. **BOMA BEST**: Resources & Links to programs assessments. See Energy Management Section for "Maintenance and Commissioning". [Go to Website](#)
2. **Building Commissioning Association (BCA)**: Various resources such as templates, reports. [Go to Website](#)
3. **Natural Resources Canada's (NRCan) CanmetENERGY**: Energy Efficient Buildings, Building Operation Optimization resources. [Go to Website](#)
4. **US Environmental Protection Agency (EPA's) ENERGY STAR® Program**: Buildings and Plants. [Go to Website](#)

Appendix 2: References

1. Building Commissioning Association (BCxA): "Commissioning for Existing Buildings" definition, as viewed on July 19, 2011 (website).
Link: www.bcxa.org
2. Effinger, J., H. Friedman: "What Saves Energy in Existing Buildings: The Right Measures", ASHRAE Journal, 52(10):84-89). October 2010.
3. ENERGY STAR®. "Guidelines for Energy Management Overview", as viewed July 19, 2011. United States Environmental Protection Agency (EPA) (website).
Link: <http://www.energystar.gov/index.cfm?fuseaction=guidelines>.
4. ENERGY STAR®. "Building Upgrade Manual", 2008. United States Environmental Protection Agency, Office of Air and Radiation, 2008 Edition.
Link: http://www.energystar.gov/ia/business/EPA_BUM_Full.pdf
5. Mills, Evan. "Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse-Gas Emissions", 2009. Lawrence Berkley National Laboratory, Berkeley, CA
Link: <http://cx.lbl.gov/2009-assessment.html>
6. John Kokko. Simplified EBCx Scope of Work, 2011. Enermodal Engineering.
Link: <http://www.enermodal.com/>



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