



Bank of Montreal High-Rise Office Building Case Study

Existing Building Retro-Commissioning (EBCx)

PROJECT SUMMARY



Building

Bank of Montreal Tower Toronto (BMTT) high-rise office building built in 1974

Location

55 Bloor Street West, Toronto, Ontario

Project Details

The objective of this project was to reduce the energy consumption and carbon footprint associated with the Bank of Montreal's high-rise office building at 55 Bloor and to report findings and lessons learned.

Commissioning Scope

BGIS Professional Services was retained by the Bank of Montreal (BMO) to provide existing building retro-commissioning services (EBCx) focusing on the mechanical systems within the building. The building systems included the ventilation systems (supply and exhaust fans), the heating system (three boilers serving reheat coils and fan coil units), the cooling system (two chillers, one cooling tower), the plumbing/pumping systems, and the associated building automation system. The facility had no known retro-commissioning performed to date on any of the systems after construction.

BGIS investigated and optimized the existing mechanical systems between January and March 2021. BGIS coordinated with the on-site operations staff while monitoring the performance of the building systems and implemented measures to improve energy performance, equipment operation and occupant comfort. BGIS reviewed the operation of the existing building systems, implemented corrective measures to return the systems back to their intended design and performance specifications, and made recommendations to improve their performance.

Project Details

Size of Commissioned Area: 436,436 sq.ft (20 floors)

Energy Cost Savings (Mar – Oct 2021): 19% cost savings

Simple Payback: < 6 months

Energy Consumption Savings (Mar – Oct 2021): 4,300 GJ (15% savings)

GHG Emission Reductions (Estimated) (Mar-Oct 2021): 45 tCO₂e (7% savings)

Quantified annual non-energy benefits: Noted in sections below.

PROJECT OVERVIEW AND BACKGROUND

The Bank of Montreal Tower Toronto (BMTT) at 55 Bloor Street West, Toronto, Ontario is a high-rise office building built in 1974. The building currently services approximately 2,500 employees.



Figure 1: BMTT Roof Image from Google Maps

The building is owned by Manulife Financial Corporation and is leased by BMO. The primary use of the building is office with retail on lower levels and below grade. The BMO occupied levels included in this study are floors 3 to 19 and mechanical penthouse (floors 20, 21).

The BMO Critical Facilities department directly operates and maintains some of the systems and equipment. The Critical Facility systems are not within the scope of responsibility of the facility management company (BGIS) described in this study, and therefore not included in this retro-commissioning study.

At the time of the site visits, floors 6, 8, 9, 10, 11 and 16 were unoccupied, as part of BMO’s pandemic response to COVID-19.

The building envelope consists of precast concrete cladding, windows, and a flat roof.

THE HVAC SYSTEM CONSISTS OF THE FOLLOWING:

- Ventilation - 4 air handling units (AHUs)
- Heating plant - 3 hot water boilers
- Cooling plant - 2 chillers and 1 cooling tower (2 cells)
- Fan coil units (FCUs) provide local heating and cooling at the perimeter and cooling in the interior on the floors
- Both digital and pneumatic controls
- Siemens Building Automation System

Utility	Consumption	Cost *	Average Rate *
Electricity	32,947 GJ	\$1,120,436	\$34.01 / GJ
Electricity	9,152,017 kWh	\$1,120,436	\$0.1224 / kWh
Natural gas	20,515 GJ	\$137,762	\$6.54 / GJ

* Taxes are excluded

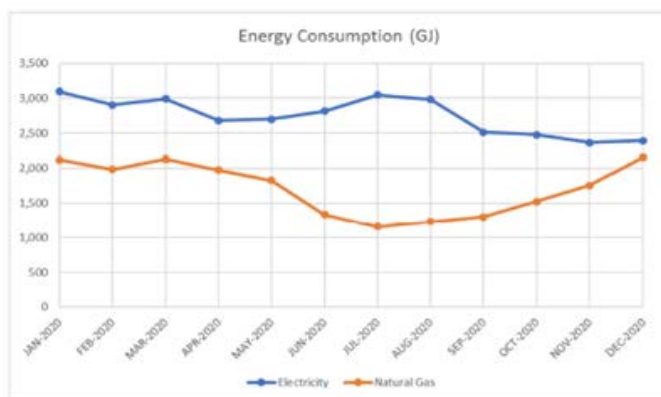


Figure 2: Building Energy Consumption (GJ) Jan-Dec 2020

For reference, in 2018 the building consumed 8.5 GWh of electricity and 520,000 m³ of natural gas amounting to an annual energy cost of \$4,224,621.

A summary of the energy utility data from January to December 2020 is also shown above as well for reference.



Figure 3: BMTT, North & West Elevations

What is Commissioning?

Building commissioning is a systematic and documented process of helping to ensure that building systems perform according to the design intent and the owner's operational needs.

Existing Building Commissioning (EBCx):

- Provides a better environment for occupants
- Reduces indoor air quality problems
- Reduces occupant complaints
- Reduces contractor call-backs
- Reduces warranty issues
- Reduces energy consumption
- Reduces operational costs

The primary objective of this existing building retro-commissioning (EBCx) project is to reduce the energy consumption and associated carbon emissions at 55 Bloor St. W. by investigating and optimizing existing mechanical systems. The outcome of this exercise is intended to support corporate energy and carbon emissions reduction targets for BMO.

A secondary objective is to demonstrate the value of conservation projects in high-rise commercial buildings to encourage more investments in energy conservation through retro-commissioning projects in similar buildings.

This project promotes Canada's energy efficiency objectives and addresses its clean energy and climate change goals. This is accomplished by reducing energy consumption (electricity and natural gas) and related carbon emissions, promoting energy stewardship through building occupant communications, and improving building conditions for the employees.

Bank of Montreal's leadership through retro-commissioning and promotion of energy stewardship can encourage other large commercial building owners, building operators, and/or other property managers to implement similar solutions. The lessons learned and results delivered through this case study can be replicated by those organizations.

PROJECT SCOPE OF WORK

BGIS Professional Services was retained by the Bank of Montreal (BMO) to provide EBCx focusing on the mechanical systems within the building. The building systems included the ventilation systems (supply and exhaust fans), the heating system (3 boilers serving reheat coils and fan coil units), the cooling system (2 chillers and 1 cooling tower), the plumbing/pumping systems, and the associated building automation system. The facility had no known commissioning performed to date on any of the systems after construction.

BGIS investigated and optimized the existing mechanical systems between January and March 2021. It was noted that EBCx services had not been performed at this building in the past.

BGIS coordinated with the on-site operations staff while monitoring the performance of the building systems and implemented measures to improve energy performance, equipment operation and occupant comfort. BGIS reviewed the operation of the existing building systems, implemented corrective measures to return the systems back to their intended design and performance specifications, and made recommendations to improve their performance.

COMMISSIONING ACTIVITIES WITHIN THE SCOPE OF WORK

Reviewed drawings of the ventilation, heating, and cooling systems

Reviewed the sequences of operation contained in the BAS controls drawings

Reviewed the current facility requirements of the building (e.g. occupancy schedules) and compared them to the current sequences of operation

Reviewed the operation of the equipment (representative sample) still being controlled by standalone pneumatic controls for proper operation and efficiency

Reviewed the documented sequences of operation with the BGIS building operator and BAS vendor technician (Siemens) to determine what adjustments may have been made to the original sequences at the time of completion of building construction or BAS installation, and identified any new sequences of operation that may be undocumented

Proposed simple low cost / no cost adjustments to the BGIS operations team for review and approval prior to implementation. These adjustments included changes to BAS time of day scheduling, setpoint reset schedules and control sequences that will provide immediate energy consumption savings

Documented the implemented low cost / no cost measures

Determined more capital-intensive opportunities related to the BAS to further optimize operating sequences that reduce energy consumption

Prepared a list of capital-intensive opportunities and estimated associated energy consumption and cost savings

PROJECT MANAGEMENT

BGIS Professional Services was requested by BMO and the BGIS Facility Management Team to perform these services.

BMO and BGIS understand the importance of having a successful commissioning process to ensure that building systems operate as designed. Proper operation of these systems is critical to the efficient and robust operation of the building, and leads to fewer comfort complaints, service calls and utility consumption. All of these factors impact the operating cost of the building.

BGIS reviewed the operation of existing equipment, compared those results against the original design intent, and proposed a retro-commissioning plan to improve the efficiency of the building systems including operating strategies, component replacements, and system retrofits. The findings, changes made, and recommendations were summarized in a Final Existing Building Retro-Commissioning Report prepared by a BGIS Building Performance Specialist.

Acknowledgement should be given to the BGIS building operations team and The Mitchell Partnership (TMP) for their insight and knowledge of the history of the building. Discussions with both parties helped identify opportunities and measures for recommendation.

It should also be noted that the Siemens Insight software at the BAS computer and hard copy documentation were useful through the review.

INVESTIGATION AND ISSUES IDENTIFIED

The key opportunities identified during the EBCx assessment of 55 Bloor St. West were as follows:

01

Various Building Automation System (BAS) improvements

02

Optimization of cooling tower sump heaters

03

Temperature controls/cooling system issues at meeting rooms

04

Simultaneous heating and cooling at perimeter fan coil units

05

Reheat coil control valves pass water when closed, necessitating manual workarounds and occupant discomfort

06

Sub-optimal floor air distribution systems

07

Adjustments to HVAC and lighting on/off schedules

08

Retrofit of the general floor lighting

For further details see the 'Implementation and Results' and 'Non-Energy Project Benefits' sections on the following pages.

IMPLEMENTATION AND RESULTS

The following Tables 1 & 2 detail the recommended “Low Cost/No Cost” Recommendations and Capital Project Recommendations together with the resulting anticipated/calculated savings estimates. Only whole building utility meters were available to measure energy savings as there was no detailed monitoring available to verify/attribute any energy savings to specific measures and/or systems.

Where the anticipated savings are not calculated, insufficient data was available, or observations of existing conditions were too limited in time to allow for a reasonable extrapolation over a year of operation. Note that the associated costs were none or minimal and these measures are relatively quick and easy to implement. In some cases, ‘TBD’ is shown below where a vendor quotation is needed and/or further data is required to be gathered to calculate savings estimates.

Item	Description	Costs	Savings	Simple Payback (years)
A1	Investigate and rectify BAS issues	N/A	N/A	N/A
A2	Investigate optimization for cooling tower sump heaters	N/A	Not calculated	N/A
A3	Investigate meeting room temperature comfort	N/A	N/A	N/A
A4	Eliminate simultaneous heating and cooling at perimeter fancoil units	N/A	Not calculated	N/A
A5	Turn off lighting on unoccupied floors	N/A	\$25,638	N/A
A6	Apply night setback – unoccupied floors	N/A	Not calculated	N/A
A7	Apply night setback – assumed unoccupied floors	N/A	Not calculated	N/A
A8	Apply optimum start for main air handling units	TBD	TBD	TBD
A9	Reduce outside air airflows	N/A	\$19,436	N/A
A10	Implement free cooling	N/A	\$69,350	N/A

Table 1: Low Cost/No Cost Recommendations

TESTIMONIAL:

“It has been a good experience to work with the BGIS energy, sustainability and building performance teams.

*To have them here gave us the opportunity to realize how much we can do in order to **improve the energy consumption in the building.***

*The retro commissioning program showed us **our strengths and deficiencies** and the way to improve our systems for better energy consumption performance.*

Energy conservation will be a priority for us and we will always consider improving the building efficiency from an energy conservation perspective.”

Jorge Sierra Gomez,
Bank of Montreal Building Operations
55 Bloor Street W

It should be noted that the commissioning “costs” should be viewed as an investment in improved performance and subsequent savings. The final costs associated with commissioning were consistent with the original project budget.

For capital project recommendations, the facility management company will incorporate the recommendations into its capital budget. The only capital project recommendation that was implemented at the time of this report is item ‘B2 Replace reheat coil control valves’ listed below.

Item	Description	Costs	Savings	Simple Payback (years)
B1	Update and modernize Building Automation System	\$59,000	N/A	N/A
B2	Replace reheat coil control valves	\$16,000	N/A	N/A
B3	Replace pneumatic controls with electronic controls	TBD	N/A	N/A
B4	Replace lighting fixture lamps (16 floors)	\$191,230	\$37,186	5.1
B5	Upgrade floor air distribution system from constant volume to variable volume (16 floors)	\$3.36M to \$4.16M	\$168,000	20 to 24.8

Table 1: Capital Project Recommendations

PROJECT BENEFITS

Energy consumption savings calculations are shown in Figures 3 and 4. BGIS used Option C from the International Performance Measurement and Verification Protocol (IPMVP) to compare the whole building energy to the same period in 2020 normalized/adjusted for 2021 weather. Occupancy assumptions did not change from the baseline as the occupancy was similar through these two time periods during the COVID-19 pandemic.

Actual utility bills were collected and uploaded into a BGIS utility bill analysis tool to measure the results from March-October 2021 relative to March-October 2020, and then normalized for 2021 weather using a weather regression model specific to the building.

The electricity consumption savings attributed to the EBCx is 4,737GJ (20%) and approximately \$161,110 when comparing the months of March - October 2021 to March - October 2020.

The corresponding greenhouse gas emissions savings from electricity savings is estimated to be approximately 13 tCO₂e.

The natural gas consumption savings attributed to the EBCx is 647 GJ (6%) and approximately \$4,230 when comparing the months of March - October 2021 to March -October 2020.

The corresponding greenhouse gas emissions savings is estimated to be approximately 32 tCO₂e.

Therefore, during the period of March 2021 to August 2021, the total energy cost savings is \$165,340 (19%); total energy consumption savings is 5,384 GJ (15%); and the total estimated greenhouse gas emissions savings is 45 tCO₂e (7%).

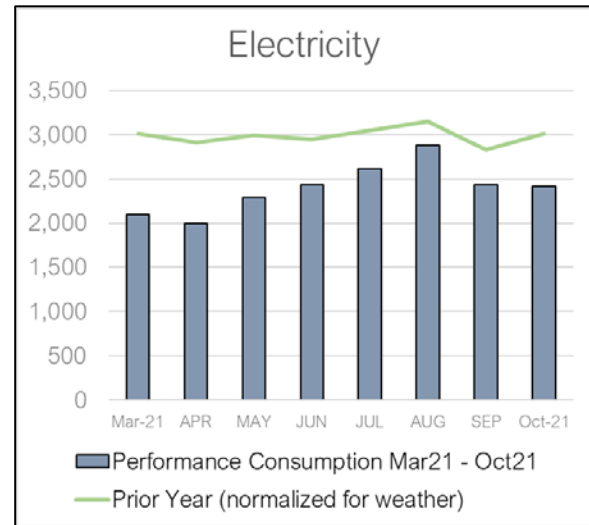


Figure 4: Electricity Consumption (GJ)

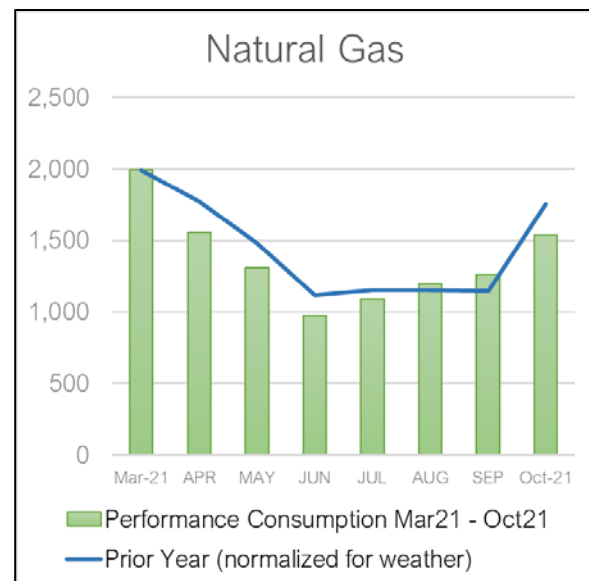


Figure 5: Natural Gas Consumption (GJ)

NON-ENERGY PROJECT BENEFITS

A1

Investigate and rectify BAS Issues: Improved BAS information accuracy (e.g. accurate airflow & CO₂ readings), operator control (BAS workstation graphics match existing installation, communication with controllers restored), occupant comfort (e.g. humidifiers are enabled)

A3

Meeting room temperature controls: Improved occupant comfort

B1

Update and modernize Building Automation System: More accurate and complete reference BAS documentation, improved operator usability at BAS workstation (if implemented)

B2

Replace reheat coil control valves: Improved occupant comfort, less time spent by operators to regularly adjust bypass valve at reheat coil control valves

B3

Replace pneumatic controls with electronic controls: No maintenance required on control air compressor systems (if implemented)

B4

Replace lighting fixture lamps (16 floors): Reduced maintenance on replacing burnt out lamps (if implemented)

Note that these benefits above—while tangible—could not be easily quantified in this case.

PROJECT TEAM

Building Owner/Manager	Manulife Financial Corp
Project Sponsor	Bank of Montreal (BMO)
Commissioning Provider	BGIS
Controls Contractor	Siemens
Building Operations	BGIS

LESSONS LEARNED

01

Obtaining client agreement and support for the recommended measures is imperative in ensuring a successful EBCx project. Particularly support at the executive-level when significant funding is required.

02

Educating the client and occupants in the why and how of the proposed Cx actions helped ensure the likelihood of success (e.g. removing ability for occupants to adjust thermostats so that there is no simultaneous heating and cooling in the same space may have become an issue otherwise).

03

Demonstrating how energy consumption reductions would contribute to the client's GHG reduction goal generated support for the proposed Cx measures.

04

COVID-19 Facility lockdowns presented challenges in terms of access to the building systems, and interaction with the commissioning stakeholders on site.

This project was undertaken with the financial support of Natural Resources Canada.



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