BRITISH COLUMBIA BUILDING PERFORMANCE STUDY

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EXECUTIVE SUMMARY

British Columbia's existing buildings account for two-thirds of all energy consumed in the Province and 41% of the Province's total GHG emissions. Recognizing the significant role that buildings play in meeting the Province's efforts to address climate change, energy, and water consumption and waste generation, this study sought to evaluate the performance of buildings in British Columbia and provide special consideration to the potential impact of third-party rating systems on achieving public policy objectives.

The study reviewed energy consumption data for 281 buildings from across the Province, including 147 BOMA BESt certified buildings and 134 non-certified buildings. The majority of certified buildings were office buildings (121), followed by retail (19), multi-unit residential (5) and industrial (2)[1]. In contrast, the vast majority of non-certified buildings were multi-unit residential buildings (110), followed by office (14), hotels (6), retail (2) and other buildings (2). A further breakdown of the sample set is detailed in section 3 of the report.

Phase 1: Performance Baseline & Benchmarking → **Phase 2:** Rating System Analysis → **Phase 3:** Policy Implications

KEY FINDINGS

General

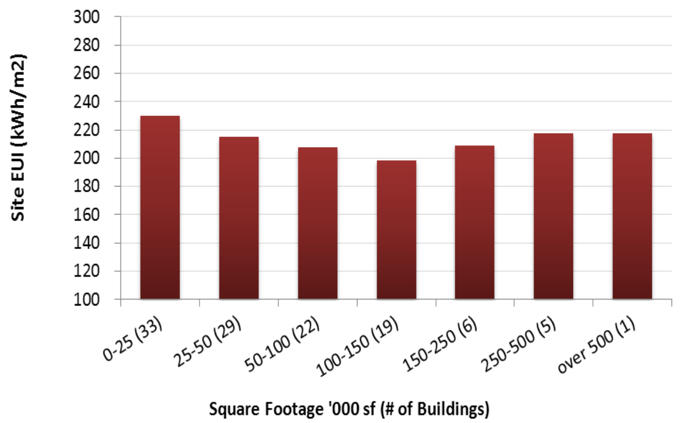
- Bringing the bottom quartile of office buildings and MURBs in the study up to the median EUI for the respective building types would result in a reduction of 5% of total energy consumption in British Columbia.
- Extreme variations in energy use intensity, water use intensity, and waste exist across buildings.

> This study validates what we suspected internally. It's worth certifying not only our new buildings, but we are now considering all our existing buildings."
>
> - Jonathan Meads
> Sustainability Manager,
> Concert Properties

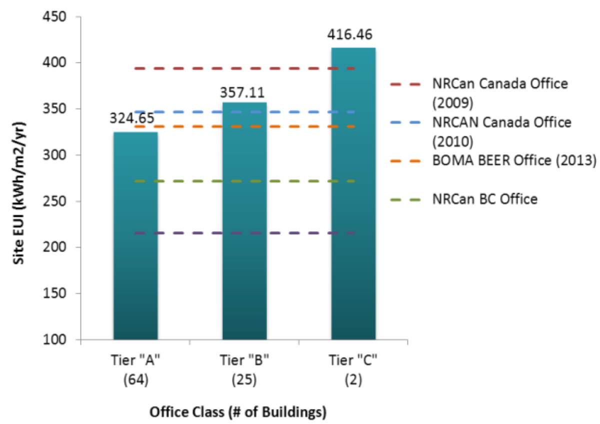
[1] BOMA BESt only introduced a certification for multi-unit residential buildings in 2012, which accounts for why there were only five such buildings in the study.

Office Buildings

- The average site energy use intensity (EUI) for all office buildings in the study was 335 kWh/m2/yr, 23% higher than the NRCan benchmark for buildings in BC and the Territories. The top 25th percentile had an average EUI of 261 kWh/m2/yr compared with 378 kWh/m2/yr for the bottom quartile.
- Bringing the bottom quartile of office buildings up to the median EUI for all office buildings in the study would result in a potential reduction of 5% of total energy consumption by all office buildings in the Province.
- The average water use intensity of all office buildings in the study was 1.32 m3/m2/yr, significantly higher than both comparative benchmarks (0.91 and 0.642 m3/m2/yr), with the bottom quartile of buildings exhibiting values exceeding 1.90 m3/m2.
- The average waste diversion rate for office buildings was 59% and the median 55%, below targets set by the Province and regional governments.
- Newer office buildings showed a slight reduction in GHG emission intensities.
- GHG emission intensity was positively correlated with the number of floors in office buildings. The greater the number of floors the higher the relative GHG emission intensity.



AVERAGE SITE EUI FOR MURBS BY FLOOR AREA



AVERAGE EUI OF OFFICE BUILDINGS BY BUILDING CLASS

Multi-Unit Residential Buildings

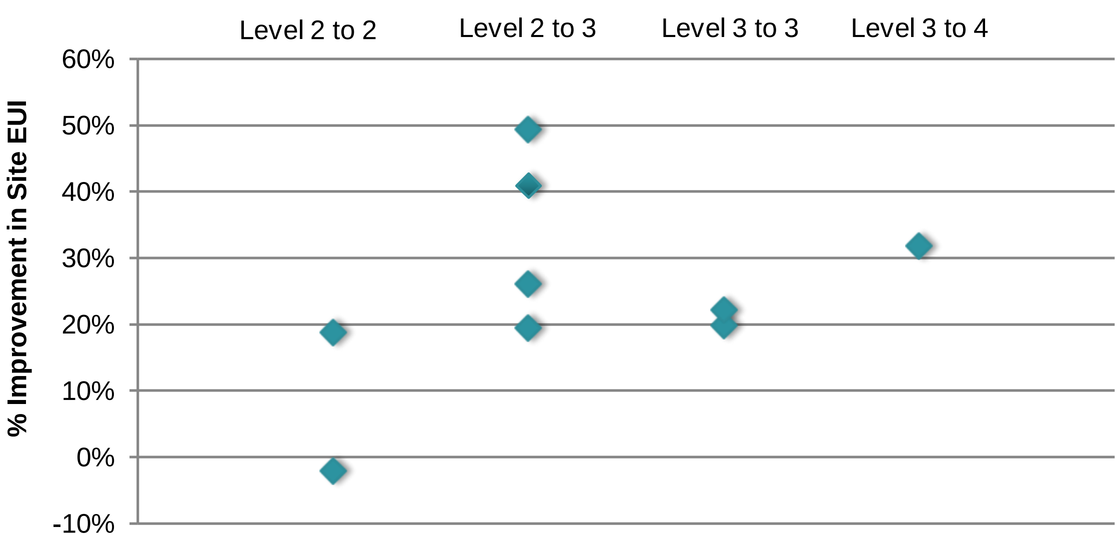
- The average site EUI for all MURBs was 215 kWh/m2/yr, much better than benchmarks in other comparative studies , with the top quartile achieving an average site EUI of 153 kWh/m2/yr and the bottom quartile averaging 259 kWh/m2/yr.
- In contrast to other studies, there was a slight negative correlation between building age and energy performance for MURBs, although tentative given the relative age distribution of buildings in the study.
- The energy performance of low-rise MURBs was 28% better than mid-rise MURBs and 22% better than high-rise MURBs.
- GHG emission intensity values mirrored energy use intensity levels.

BOMA BESt Certification

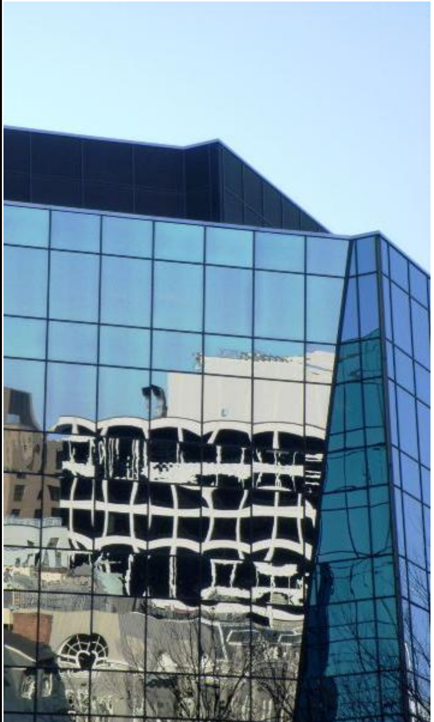
- BOMA BESt office buildings that recertified showed a 25% improvement in energy use intensity (EUI) over buildings that had only gone through the original certification process. Similarly, recertified buildings achieved a 30% reduction in annual building water usage per square meter of space and an average increase of 8% in diverted waste.
- BOMA BESt attracts all types of buildings and performers and is a useful tool not just for high performing buildings but is being used by many lower performing buildings as a means to start benchmarking environmental performance and work towards continual environmental improvement.
- Extrapolating findings with respect to BOMA BESt to LEED EB:O&M was not possible given the study's scope. A more detailed credit-level analysis of both rating systems is required to assess equivalencies between the two frameworks.
- Level 4 BOMA BESt buildings were the best performing buildings in the study;
- Almost all BOMA BESt buildings had some form of energy management policy (99.3%)
- Just over half (55%) of certified buildings were conducting waste audits every three years.

With respect to BOMA BESt, it must be stressed that certification is based on pre-certification data and serves as an exercise in benchmarking a building. First-time certification is not an indicator of performance improvement, but rather a tool to help building owners and managers benchmark and work towards continual improvements in environmental performance.

The study's findings indicate that there is significant room for improvement in most aspects of building performance across all building types. Findings also indicate that the act of recertifying is strongly associated with improvements in building performance.



PERCENTAGE IMPROVEMENT IN EUI AMONG BOMA BEST BUILDINGS THAT RECERTIFIED



Recommendations

The study presents the following key policy recommendations coming out of the report's findings and the process undertaken to complete the report[2]:

1. Improve access to energy consumption data from utilities.

2. Mandate reporting of building energy, waste and water data.

3. Incentivize and/or mandate auditing and retro-commissioning of all buildings.

4. Consider rating systems at the credit level to achieve policy objectives.

5. Focus efforts and support on Class B and C office buildings and residential buildings.

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CITY OF SURREY the future lives here.

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[2] The recommendations provided in this report are those of Light House and the report's authors and do not necessarily reflect the views and positions of the study's partnering and sponsoring organizations.

EXECUTIVE SUMMARY

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1. INTRODUCTION

1.1. Context

In the face of mounting focus on energy efficiency and climate change, provincial and municipal governments are seeking effective options for achieving significant reductions in energy consumption and GHG emissions, as well as reductions in water consumption and waste production. Within the Province of British Columbia, data reported by local governments in Community Energy and Emission Inventory Reports indicate that BC's existing buildings account for two-thirds of all energy consumed in the Province, more than half of which in turn comes from residential, commercial and small-medium size industrial buildings (see Figure 1).[4] These same buildings account for 41% of the Province's total GHG emissions (see Figure 2). Focusing attention on the performance of existing buildings is therefore a worthwhile effort from a resource savings perspective, not to mention the associated benefits in terms of cost savings, job creation, tenant comfort, and reduced pressure on energy infrastructure.

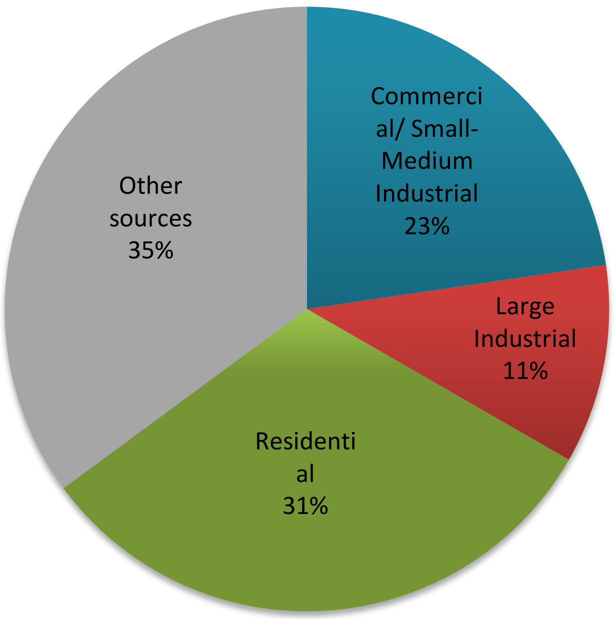


Figure 1: Energy Consumption by Buildings in British Columbia

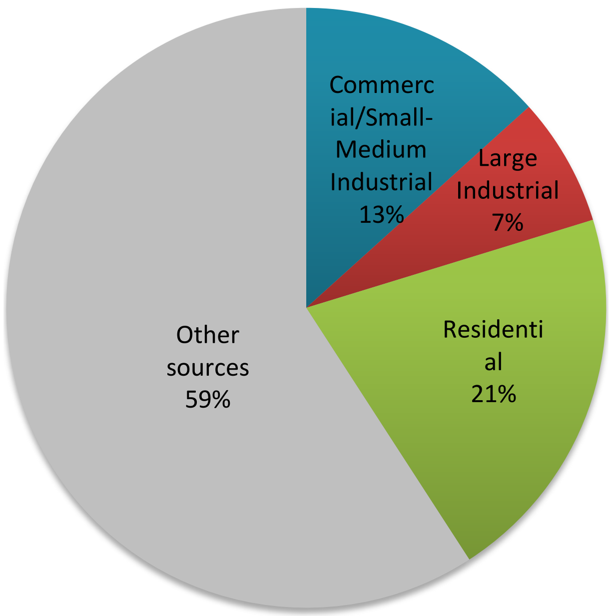


Figure 2: GHG Emissions from Buildings in British Columbia

One of the most significant barriers facing the development of effective policies and programs to improve building performance is the serious lack of energy, waste and water data for buildings in British Columbia. Meaningful data is essential to inform the development of strategies that support improvements in building performance and help meet public sustainability objectives with respect to GHG emissions, energy, waste and water.

[4] Total energy consumption reported for all buildings in British Columbia is 1.069 billion GJ or 297 billion kWh. Source: 2010 CEEI dataset as of January 23, 2013 available at http://www.env.gov.bc.ca/cas/mitigation/ceei/reports.html.

At the same time, industry has responded by developing green building rating systems (e.g., BOMA Building Environmental Standards (BOMA BESt) and Leadership in Energy and Environmental Design (LEED)) to benchmark and improve the performance of new and existing buildings (see section 5.2 of this report for a detailed description of both rating systems). Governments at all levels across North America have either adopted or are contemplating the adoption of policies encouraging or regulating partial or full compliance with third-party green building rating systems, specifically ordinances and bylaws requiring new construction to meet a prescribed certification level under LEED and more recently Green Globes (the platform on which BOMA BESt was developed). For example the US government has recently required all new federal buildings to be certified under LEED since 2003 (LEED Gold since 2010) and just recently recognized Green Globes as well.[5] However, there has been no analysis undertaken to determine the extent to which these third-party rating systems support green building policy objectives, such as GHG emission reduction.

1.2. Study Objectives

The purpose of this study is to evaluate the performance of buildings in British Columbia and consider the potential impact of third-party rating systems on achieving public policy objectives. The extent to which third-party rating systems can support public policy objectives for existing buildings has been given limited consideration in the past. This report aims to address this analytical gap, by answering the following questions in the BC context:

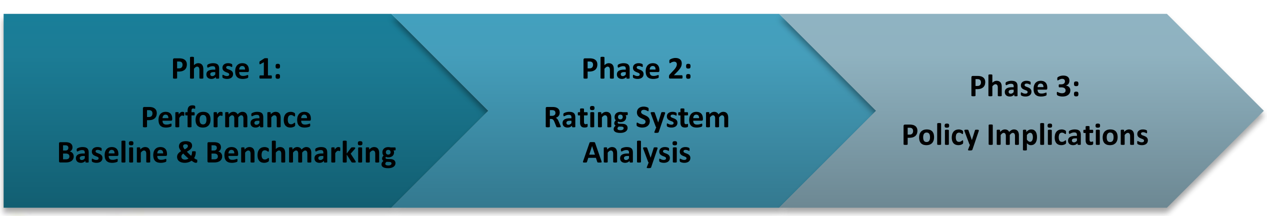
1. What is the state of building performance in British Columbia and how does building performance correlate with various building characteristics, such as age, type, size and location.

2. Can third-party certification systems for existing buildings help governments in BC to meet their green building and related policy objectives?

3. If the answer to #2 is yes, then what else can / should governments in BC do to require / encourage / incentivize the pursuit of third-party certification systems for existing buildings?

To address these questions the study reviewed environmental performance data for 281 buildings from across the Province, including 147 BOMA BESt certified buildings and 134 non-certified[6] buildings.

The study was divided into three phases intended to provide a more comprehensive understanding of actual building performance, and the role of industry standards and public policy in achieving building performance targets.



[5] Sustainablebusiness.com, "Industry-Friendly Green Building Standard Wins Big" (October 28, 2013).
[6] "Non-certified" buildings refer to existing buildings that were not certified under BOMA BESt. Three of the non-certified buildings in the study sample had been certified under LEED for New Construction at the time they were built. It was determined that these buildings could be included in the study because LEED NC 2009 did not consider actual building performance and it is generally accepted that energy modeling is not a reliable indicator of a building's actual energy performance.

Phase 1 of the study sought to establish baseline performance data for buildings across BC. Building performance data on energy, waste and water was obtained for 147 BOMA BESt certified and 134 non-certified buildings. This data was then analyzed and compared against other relevant and available performance benchmarks.

The central objective of phase 2 was to evaluate the ability of third-party green building rating systems to meet public policy objectives around energy conservation, water conservation and waste diversion and reduction. In addition, phase 2 also sought to assess the degree of alignment between LEED for Existing Buildings Operations & Management (LEED EB:O&M)[7] and BOMA BESt and through that process, speculate on the potential impact that both systems could have on building performance. The presumption being that if there was a high degree of alignment, then LEED EB:O&M buildings would be expected to perform comparable to BOMA BESt certified buildings. Work comprised a series of interviews with property managers of recertified buildings, a credit-level analysis of BOMA BESt points to identify which points yielded the greatest performance gains at the least cost and a credit-level comparison of both rating systems. This approach was taken because the limited number of buildings certified under LEED EB:O&M at the time of the study made it impossible to undertake a direct comparison of performance data between LEED EB:O&M certified, BOMA BESt certified and non-certified buildings. The findings were used to consider the degree to which both rating systems could support public policy objectives with respect to building performance and sustainability more broadly.

Finally, phase 3 considered the implications of the findings from phase 1 and 2 on green building policy and the role of third-party rating systems in advancing green building and sustainability objectives identified by the Province.

7 The hypothesis being that if the energy related components of both rating systems are equivalent, one can expect that building performance for a LEED EB:O&M building to be equivalent to a BOMA BESt certified building. While it is recognized that this approach has its limitations, the assessment is important from a policy development perspective as governments seek to determine which, if any, rating system will support its energy performance objectives for buildings.

2. METHODOLOGY

The study employed an extensive and rigorous effort to collect and analyze performance data from buildings across British Columbia. Steps taken during the study are detailed below.

Task 1: Assembled BOMA BESt Building Data

The first step was to assemble building performance data for BOMA BESt certified buildings. At the time the study was undertaken, there were 246 buildings certified under BOMA BESt in British Columbia. Table 1 provides a breakdown of all BOMA BESt certified buildings in the Province by city.

Table 1: BOMA BESt Certified Buildings in British Columbia by City

City	Level 1	Level 2	Level 3	Level 4	Sub-Total
Vancouver	26	31	30	3	90
Burnaby	18	39	4	1	62
Richmond	6	11	5	0	22
North Vancouver	1	6	2	0	9
New Westminster	2	0	0	0	2
Surrey	0	1	0	0	1
Delta	2	0	0	0	2
Port Moody	1	0	0	0	1
Langley	2	1	1	0	4
Coquitlam	0	0	2	0	2
Pitt Meadows	0	0	1	0	1
Maple Ridge	0	0	1	0	1
Victoria	6	13	5	0	24
Nanaimo	0	1	1	0	2
Courtenay	1	2	0	0	3
Kamloops	0	1	2	0	3
Prince George	0	3	0	0	3
Terrace	0	1	0	0	1
Fort St. John	0	1	0	0	1
Abbotsford	1	0	1	0	2
Chilliwack	1	0	0	0	1
Cranbrook	1	0	0	0	1
Kelowna	1	0	1	0	2
Langford	2	2	0	0	4
Vernon	0	0	1	0	1
Port Alberni	0	1	0	0	1
Total	71	114	57	4	246

Performance data from 2009 to 2013 for level 2,3 and 4 certified buildings was provided by BOMA BC from their online assessment database. Of these buildings, six were missing energy data and an additional 22 were missing gas/steam data leaving147 BOMA BESt buildings with complete energy data.

BOMA BESt level 1 certified buildings were excluded from the study sample because they are not required to submit detailed performance data and to be consistent with the approach taken by BOMA Canada in its reporting on the performance of BOMA BESt certified buildings across Canada.[8] As an aside, partial energy data was available for 37 of the 71 level 1 certified buildings, however 14 of these were missing gas data and 2 were missing electric data, leaving 21 level 1 certified buildings with complete energy data.

The remaining 147 BOMA BESt certified buildings were segmented according to BOMA's building type classifications, including Offices, Enclosed Shopping Centres, Open Air Retail, Light Industrial, and Multi-Unit Residential Buildings.[9]

Task 2: Assembled Non-Certified Building Data

Building owners and property managers from across British Columbia were approached to have their buildings participate in the study. Those who agreed to participate were offered three methods of providing energy data for whole buildings:

(1) By providing utility data or receipts for a 12-month period or alternatively, signing a permission form authorizing BC Hydro and Fortis BC to release their utility consumption data;
(2) Through BOMA BESt report cards self-reported by building owners; and
(3) From BC Hydro and Fortis BC online billing statements with access provided by the building owner.

Despite significant efforts, Fortis BC was unable to provide gas utility data for approximately 200 buildings that provided signed authorization forms under option 1. Natural gas consumption data for 51 of these buildings was ultimately gathered manually or through online billing records. However, 149 buildings that had initially offered to participate were ultimately left out of the study because neither Fortis BC nor the owners of these buildings were able to provide amalgamated gas data.

Buildings that were not able to confirm both electric and gas utility data or confirm that the building only used electricity were also excluded, resulting in the removal of an additional 66 buildings from the data set:

- 15 BOMA BESt buildings (3 retail, 1 industrial, and 10 office buildings) which could not confirm if the buildings used and reported steam or natural gas use for heating or domestic hot water;
- 31 multi-unit residential buildings from one property manager who could not confirm if the buildings had natural gas meters for heating or domestic hot water; and
- 20 buildings (3 MURBs, 5 industrial, and 11 offices) from another property manager that could also not confirm if the buildings used natural gas for heating or domestic hot water.

MURB data represented whole building data, including tenant data. Electricity data for most of the 110 non-certified MURBs in the study was obtained from BC Hydro, while building owners provided

[8] BOMA Canada, *BOMA BESt Energy and Environment Report 2013*. Available at http://www.bomabest.com/wp-content/uploads/BBEER-2013-Full-Report.pdf.
[9] See *BOMA BESt Version 2 Content: Module Definitions and Performance Benchmarks* for definitions of building typologies at http://www.bomabest.com/wp-content/uploads/Module-Definitions-and-Performance-Benchmarks.pdf. Accessed May 24, 2013.

the gas data. In some instances, owners provided both electricity and gas data. This data was cross-checked for reasonableness (i.e., was the data a reasonable reflection of the energy consumption for a building of that size or more representative of a single tenant's utility bill.) BC Housing building stock represented 65% of the buildings in the MURB sample with the rest of the sample coming from six other owners.

In addition, participants were asked to voluntarily complete an online survey on their water and waste consumption and environmental practices. Most participants were only able to provide energy data and opted not to complete the online survey. Consequently, very limited waste and water data was available for non-certified buildings in the study sample.

The key performance indicators requested for this study and their sources are set out in Table 2 below:

Table 2: Building Performance Indicators and Data Sources

Indicator (Unit of Measure)	Data Required	
	BOMA BESt Data set	non-BOMA BESt Data Set
Energy & Carbon		
Total Annual Energy Use Per Building* (kWh)	BOMA BC	(PF and U) or S
Energy Use Intensity (EUI) Per Building (kWh/m2)	BOMA BC	(PF and U) or S plus M, GE, and/or BCA
Total Onsite Annual Electricity Generation Per Building (kWh)	BOMA BC	S
Annual GHG Emissions Per Building (tonnes eC02/y)	BOMA BC	(PF and U) or S
GHG Emissions Intensity Per Building (tonnes eCO2/m2)	BOMA BC	(PF and U) or S plus M, GE, and/or BCA
Green Energy Purchased (Y/N)	BOMA BC	S
Energy Policy / Mgmt Plan (Y/N)	BOMA BC	S
Energy Audit Completed within last 3 years (Y/N)	BOMA BC	S
Energy Training Program ((F)ormal, (I)nformal, N)	BOMA BC	S
Lighting Types (qualitative)	BOMA BC	S
Major HVAC Equipment (qualitative)	BOMA BC	S
Controls (qualitative)	BOMA BC	S
Hot Water System (qualitative)	BOMA BC	S
Financial		
Annual Energy Costs Per Building ($)	BOMA BC	(PF and U) or S
Normalized Energy Costs Per Building ($/m2)	BOMA BC	(PF and U) or S plus M, GE, and/or BCA
Annual Water Costs Per Building ($)	BOMA BC	S or M
Normalized Water Costs Per Building ($/m2)	BOMA BC	S, MGE or BCA
Annual Solid Waste Management Costs Per Building ($)	BOMA BC	S
Normalized Solid Waste Management Costs Per Building ($/m2)	BOMA BC	S plus M, GE and/or BCA
Planned expenditures for energy efficiency for the 5 years following certification / current year ($)	BOMA BC	S
Green Leases with Tenants (Y/N)	BOMA BC	S
Water & Waste		
Total Annual Water Consumption Per Building (m3)	BOMA BC	S or M
Normalized Water Consumption Per Building (m3/m2)	BOMA BC	S or M, plus M,GE and/or BCA

Water Conservation Features (qualitative)	BOMA BC	S
Water Audit Completed in Last 3 Years	BOMA BC	S
% Waste Diverted from Landfill Per Building	BOMA BC	S
Written Waste Management Policy (Y/N)	BOMA BC	S
Waste Audit Completed in Last 3 Years (Y/N)	BOMA BC	S
Refrigerant Management Plan (Y/N)	BOMA BC	S
ODS Phase Out Plan (Y/N)	BOMA BC	S
Green Cleaning Purchasing Policy (Y/N)	BOMA BC	S
Building / Site Characteristics		
Height (Low, Mid, High)	BOMA BC	S or M or BCA
Type (Small / Large Office, Institutional, Retail, Multi-Unit Residential, Industrial)	BOMA BC	S or M or BCA
Year Built	BOMA BC	S or M or BCA
Year Major Renovations	BOMA BC	S or M or BCA
Green Building Certifications (BOMA BESt Level, LEED-NC, LEED-EBOM, Other)	BOMA BC, research	S, research
Documented Environmental Policy / Mgmt Plan (Y/N)	BOMA BC	S
Construction Method (concrete, wood frame)	BOMA BC	S or MGE or BCA
Number of Occupants / Users	BOMA BC (v.2)	S
Envelope (qualitative)	BOMA BC	S
Documented Operating Instructions (Y/N)	BOMA BC	S
Access to Public Transportation (qualitative)	BOMA BC	S
Bike Racks for > 5% of occupants (Y/N)	BOMA BC	S
LID Stormwater Management (qualitative)	BOMA BC	S

*Notes

1. Neither BOMA BESt nor utility data will allow for the distinction between energy used for particular uses, such as space heating, lighting, or domestic hot water. More detailed building inspections, energy modeling, and other building specific technical work far beyond the scope of this study would be required to break down energy use in this manner.
2. BOMA BESt baseline indicators will be calculated for the year in which the buildings were certified. BOMA BESt buildings are required to recertify every 3 years. For those buildings (17 as of Sep 2012), changes from the baseline will also be calculated.

Following the approach taken by one of the City of New York's review teams in its 2012 Benchmarking Report[10], the building data underwent extensive "cleaning", including the elimination of buildings with unreasonably high and low energy usage intensities. A total of ten buildings (3 MURBs, 1 office, 3 retail, and 3 industrial) were excluded from the study that reported energy use intensity values of less than 15.8 ekWh/m2/yr or more than 3,155 ekWh/m2/yr.

Task 3: Entered Building Data into Energy Star Portfolio Manager

All buildings were assigned a unique identification code and monthly performance data was entered confidentially into EnergyStar™ Portfolio Manager[11] to generate site energy use intensity (site EUI) and total GHG emission intensity for all buildings, as well as Energy Star scores for offices only.

[10] See Plan NYC, New York City Local Law 84 Benchmarking Report (August 2012) at pg. 30. Available at http://www.nyc.gov/html/gbee/downloads/pdf/nyc_ll84_benchmarking_report_2012.pdf. The New York City benchmarking report was referenced solely to assist in formulating this study's methodology. Its findings were not used as a basis for comparison with the outcomes of this study.

[11] EnergyStar™ Portfolio Manager is an energy benchmarking software widely used in the United States and now available in Canada for benchmarking buildings energy use. The software automatically compares and normalizes building energy usage based on building location, number of occupants, vacancy rates, hours of operation and type of usage. Portfolio Manager is most commonly used as a tool to normalize building energy data for the variables discussed above, it is also used to generate an energy star score for how well a building is performing in terms of energy usage compared to similar buildings. An Energy Star rating is a number between 0 – 100 which indicates which percentile a building is performing in compared to its peers in terms of energy consumption. For example a score of 75 indicates the buildings is in the top 25 percent of all similar typology buildings. As of October 2013, Energy Star scores were only only available for office buildings and K-12 schools in Canada.

In calculating site EUI and GHG emission intensity, Portfolio Manager normalizes building data to account for a variety of variables, including climate, weather, occupancy, hours of operation, number of computers, percentage of space heated and cooled and number of fridges and freezers.[12] Unless directly provided by the owner and/or received from the BOMA BESt report card, default values provided by Portfolio Manager were used for these variables (see Table 3 for a summary of Portfolio Manager defaults). Normalization of the study data resulted in a change in Site EUI values between -0.55% and +1.54% from non-normalized values. While comparable energy benchmarks (e.g., NRCan) do not normalize energy data, the nominal impact of normalizing the data in this instance was not considered significant enough to preclude comparisons with other referenced energy benchmarks. The authors foresee the use of Portfolio Manager and the normalizing of building data for weather and other factors to become standard practice in future benchmarking studies and industry reporting.

Table 3: Default values used in Portfolio Manager

Indicator	Default Values
Weekly Operating Hours	Retail & Office: 65 hours Warehouse: 60 hours
Workers on Main Shift	Office: 2.3 workers/1,000 sf Retail: 1 worker/1,000 sf Warehouse: 0.59/1,000 sf
Number of PCs	Office: 2.2 PCs/1,000 sf Retail: 0.2 PCs /1,000 sf
Percent Heated/Air Conditioned	Office: 50% or more Retail: 100 Multifamily: 100 Unrefrigerated Warehouse: 50% Heated/ 20% AC
Number of cash registers	Retail: 0.3 per 1,000 sf
Walk-In Refrigeration/ Freezer Units	Retail: 0 unit Unrefrigerated Warehouse: 0 unit
Open & Closed Refrigeration/Freezer Cases	Retail: 0 unit
Exterior Entrance to the Public	Retail: Yes

Task 5: Analyzed Building Performance Data

Data for both certified and non-certified buildings was amalgamated and compared against the identified benchmarks. The study adopted a number of existing energy, waste and water benchmarks for comparison purposes (see discussion of benchmarks in Appendix B below). Benchmarks cited throughout the study are provided for the purposes of comparison, recognizing that each is context specific and subject to its own limitations. In specific, energy benchmarks from other studies did not use Portfolio Manager to normalize their data.

[12] *See* Energy Star Portfolio Manager, *Technical Reference on Climate and Weather* (July 2013) at https://portfoliomanager.energystar.gov/pdf/reference/Climate%20and%20Weather.pdf. Portfolio Manager data is normalized against itself (building level) for weather and occupancy. In contrast, Energy Star scores are normalized relative to similar buildings from different locations (i.e., a building in Prince George will report a higher site EUI than a similar building in Vancouver, however they could have the same Energy Star score once climate variations are taken into account.)

Performance data was analyzed in relation to building age, square footage, number of floors, building class, climatic zone and level of certification where applicable. Despite efforts to provide a balanced sample of certified and non-certified buildings, the study had a disproportionate number of certified office buildings and non-certified MURBs. The unequal representation of certified and non-certified buildings is shortcoming of the study and identified as a challenge throughout the report. As a result, the study focused primarily on analyzing building performance generally with minimal attention to the distinction between certified and non-certified buildings. Caution should be exercised in using the study's findings to compare the performance of certified and non-certified buildings.

BOMA BESt certification requires the submission of 12 months of data prior to certification. Buildings are not required to provide performance data post-certification. Consequently, in most instances the study was not able to compare the performance of buildings pre- and post-certification. The question of whether certification does support improvement in building performance was addressed to a limited extent by considering the performance of buildings that had recertified under BOMA BESt. Of the 147 BOMA BESt buildings in the study sample, seven were identified as having a corresponding recertification numbers (i.e., the buildings had applied for recertification). An additional 15 recertified buildings were manually correlated using building names and addresses for a total of 22 recertified buildings. Additional research on this question would is encouraged.

Unfortunately, at the time of the study only 3 buildings had been certified in British Columbia under LEED EB:O&M. Consequently, no direct comparisons could be made between LEED EB:O&M and BOMA BESt certified buildings, or between LEED EB:O&M certified and non-certified buildings. Further study in this area is recommended as more existing buildings are certified under LEED EB:O&M.

Task 6: Aligned Rating Systems with Public Policy Objectives

The first step in assessing the alignment of third-party rating systems with public policy objectives was to complete a scan of public policy targets with respect to GHG, energy, waste and water at both the community and building level. BOMA BESt was reviewed and each credit was grouped under its appropriate policy objective (e.g. energy reduction and credit for energy audits). Credits under LEED EB:O&M were similarly assigned to the appropriate policy objective. Each Credit requirements under each rating system were then analyzed to determine their degree of comparability, as well as their alignment with policy objectives. Finally, credit uptake values were obtained from BOMA Canada and the Canada Green Building Council to determine the popularity of various credits. All of this amassed in a matrix detailed in Appendix C of this report.

The matrix was then analyzed to assess the degree of comparability between rating systems, alignment of specific credits with public policy objectives, and the degree of uptake. Study findings associated with BOMA BESt credits were extended to LEED EB:O&M credits that demonstrated a high degree of comparability. Credits that showed a high degree of alignment with policy objectives were identified and associated performance enhancements identified where possible. Credit uptake levels were then considered in relation to these credits to determine whether voluntary compliance was sufficient to support public policy objectives.

3. THE BUILDINGS

The 281 buildings included in this study, including 147 BOMA BESt certified buildings and 134 non-BOMA BESt buildings, represent 42.2 million square feet (3.9 million square metres) of real estate from across British Columbia (see Figure 3).

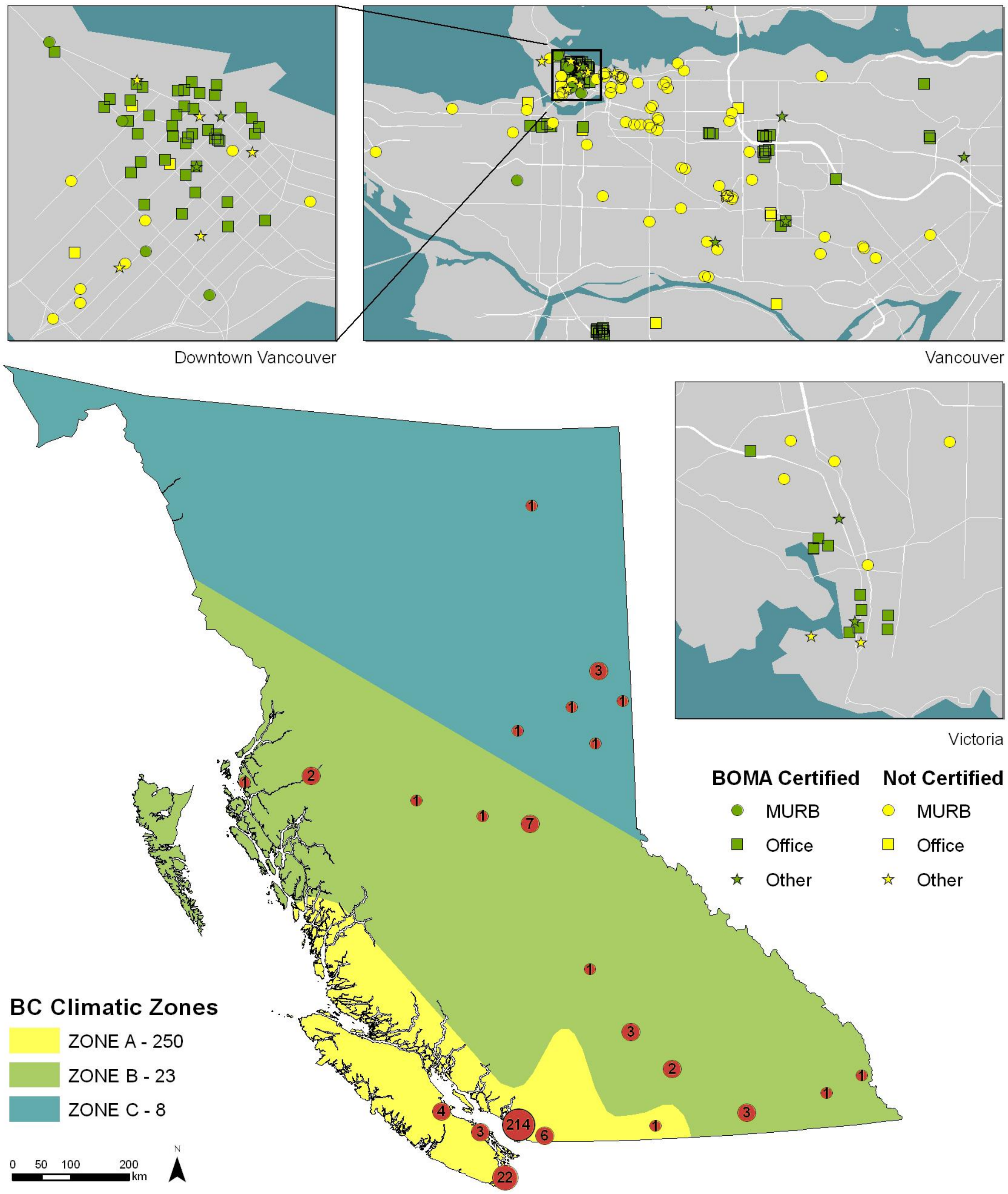
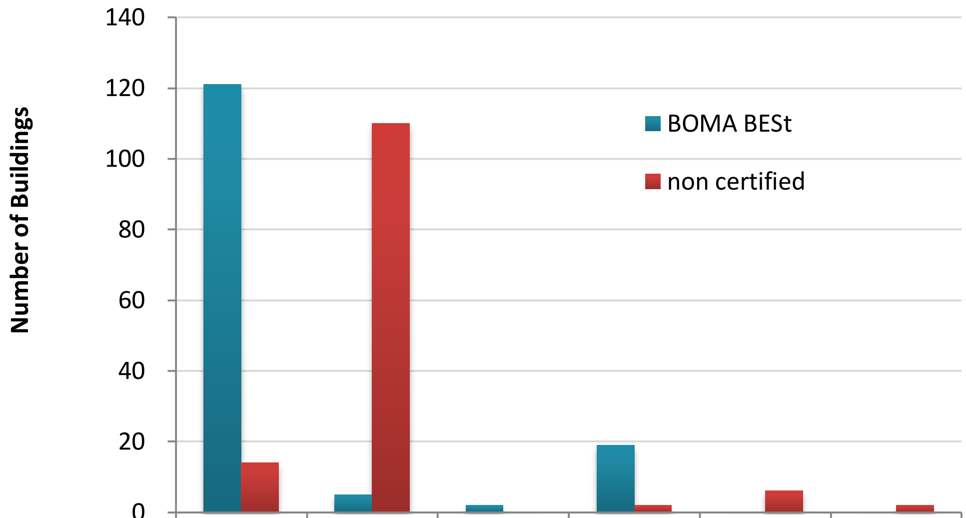


Figure 3: Distribution of Sample Buildings in Study

The majority of buildings in the study were classified as office and multi-unit residential buildings. Extensive efforts were made to identify equal numbers of BOMA BESt certified and non-certified buildings for each building type, however the sample ultimately contained a disproportionate number of BOMA BESt certified office buildings and an equally disproportionate number of non-certified MURBs.[13] The majority of certified buildings were office buildings (121), followed by retail (19), multi-unit residential (5) and industrial (2).[14] In contrast, the vast majority of non-certified buildings were multi-unit residential buildings (110), followed by office (14), hotels (6), retail (2) and other buildings (2). Table 4 provides the distribution of BOMA BESt certified and non-certified buildings in the study sample. The relatively small number of retail, hotel and industrial buildings, prevented independent consideration of these typologies. Caution should be exercised in extending the findings for office and MURBs to these other building types.



	Office	MURB	Industrial	Retail	Hotel	Other*
BOMA BESt	121	5	2	19	0	0
non certified	14	110	0	2	6	2

* The two “Other” buildings in the sample were community centres.

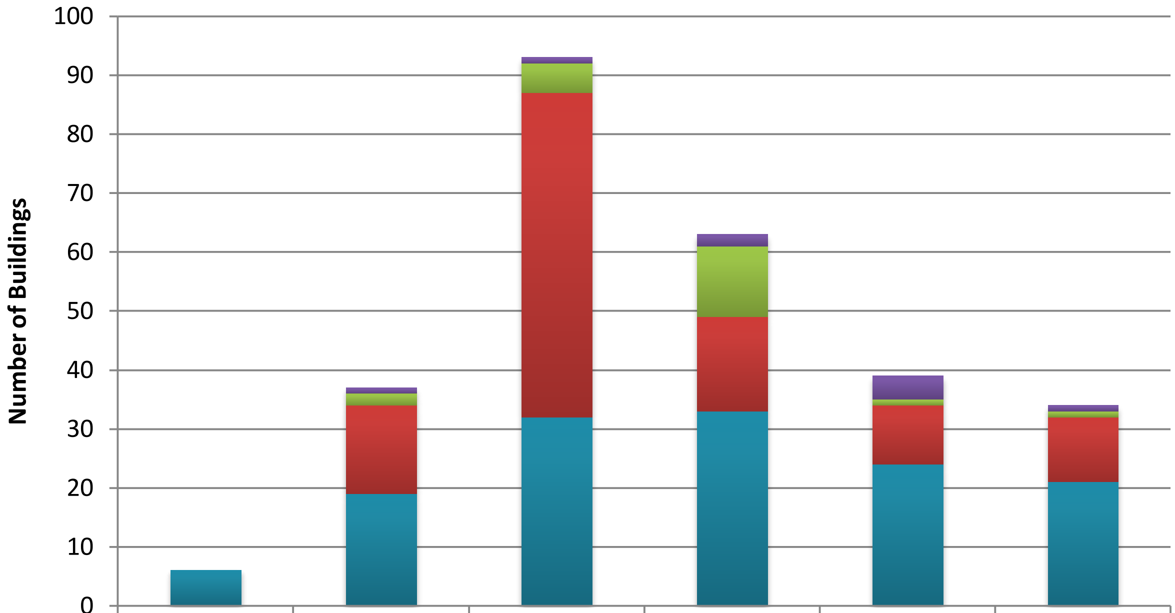
Table 4: Distribution of BOMA BESt certified and non-certified buildings by building type

3.1. Building Age

Buildings ranged in age with the highest proportion built in the 1970s. The majority of office buildings were constructed in the 1970s and 1980s, while the vast majority of multi-unit residential buildings date back to the 1970s. The oldest MURB in the study was from 1894 and the oldest office building is from 1973.

[13] The lack of office buildings in the non-BOMA BESt building is attributable to149 office buildings being excluded from the study due to the inability to obtain natural gas data from Fortis BC. Obtaining utility data from building owners was equally difficult to obtain. Many challenges were encountered in the course of trying to obtain data and running quality control on available data.
[14] BOMA BESt only introduced a certification for multi-unit residential buildings in 2012, which accounts for why there were only five such buildings in the study.

Table 5 summarizes the breakdown of buildings by age.



	Before 1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010
Other	0	1	1	2	4	1
Retail	0	2	5	12	1	1
MURB	0	15	55	16	10	11
Office	6	19	32	33	24	21

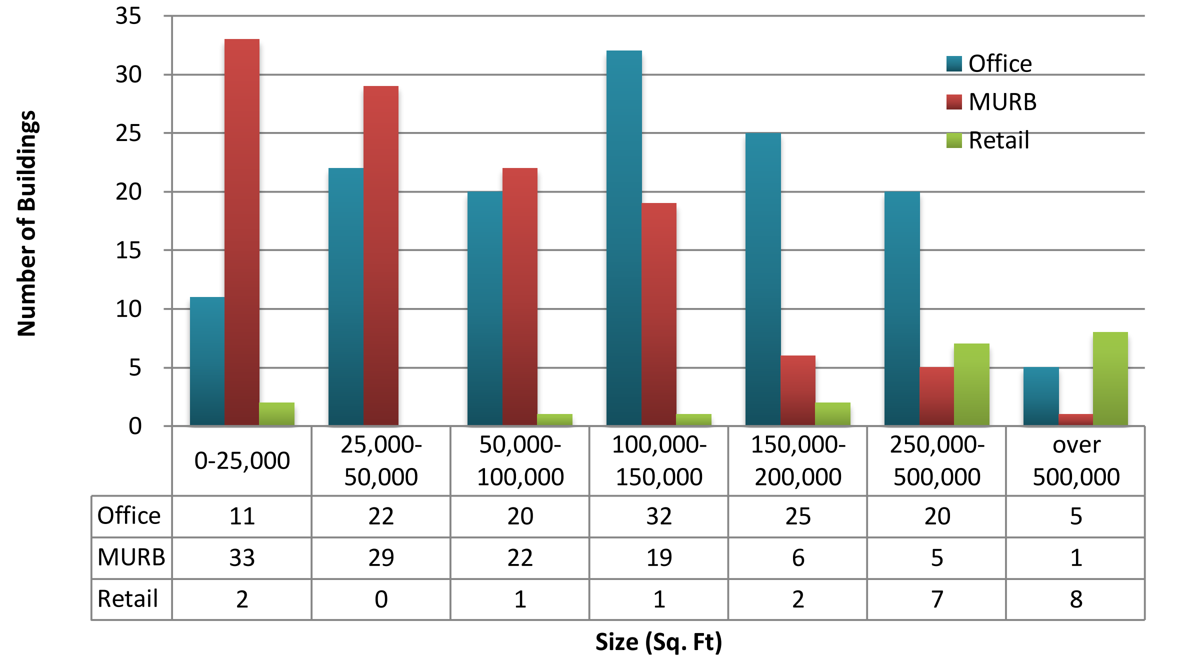
Table 5: Distribution of buildings by age

Again, the small number of industrial, retail and hotel buildings in the study prevented comparisons of these building types based on age.

3.2. Floor Area

The distribution of buildings in the sample was representative of current building inventory with a bell shape distribution for office buildings and a majority of MURBs under 150,000 sq. ft. (see Table 6).

Table 6: Building Distribution by Size



	0-25,000	25,000-50,000	50,000-100,000	100,000-150,000	150,000-200,000	250,000-500,000	over 500,000
Office	11	22	20	32	25	20	5
MURB	33	29	22	19	6	5	1
Retail	2	0	1	1	2	7	8

3.3. Building Class

Office buildings are grouped into three classes providing the market with a subjective rating of a building's ability to attract tenants. The tiered rating is based on a number of factors, including rent, building finishes, system standards and efficiency, building amenities, location/accessibility and market perception.

Class A	Most prestigious buildings competing for premier office users with rents above average for the area. Buildings have high quality standard finishes, state of the art systems, exceptional accessibility and a definite market presence.
Class B	Buildings competing for a wide range of users with rents in the average range for the area. Building finishes are fair to good for the area. Building finishes are fair to good for the area and systems are adequate, but the building does not compete with Class A at the same price.
Class C	Buildings competing for tenants requiring functional space at rents below the average for the area.

Table 7: Building Class Definitions[15]

Building class has not generally been given consideration in previous energy benchmarking studies. For the purposes of this study, the class of a building was obtained from publicly available ratings on Altus InSite – a leading provider of national office market data for Canada's commercial real estate sector.

[15] Source: BOMA International website. Accessed October 30, 2013. Available at http://www.boma.org/research/pages/building-class-definitions.aspx.

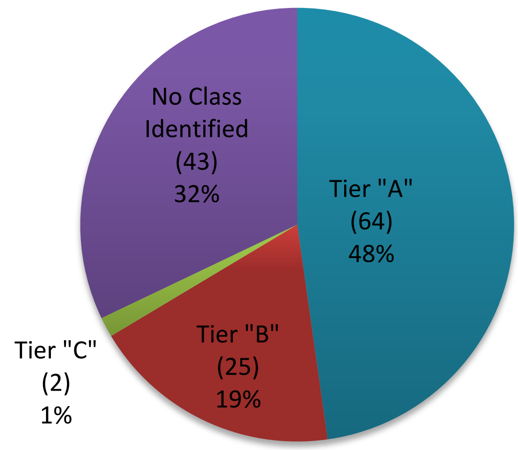


Figure 4: Sample Commercial Buildings by Building Class

3.4. Energy Sources

Findings revealed interesting trends in energy sources for different building types. Office buildings in the study consumed relatively more electricity than other fuel sources compared with NRCAN's national average. In contrast, MURBs were more reliant on natural gas, but still consumed less than the national average. These trends may due in some degree to the relatively low price of electricity in British Columbia.

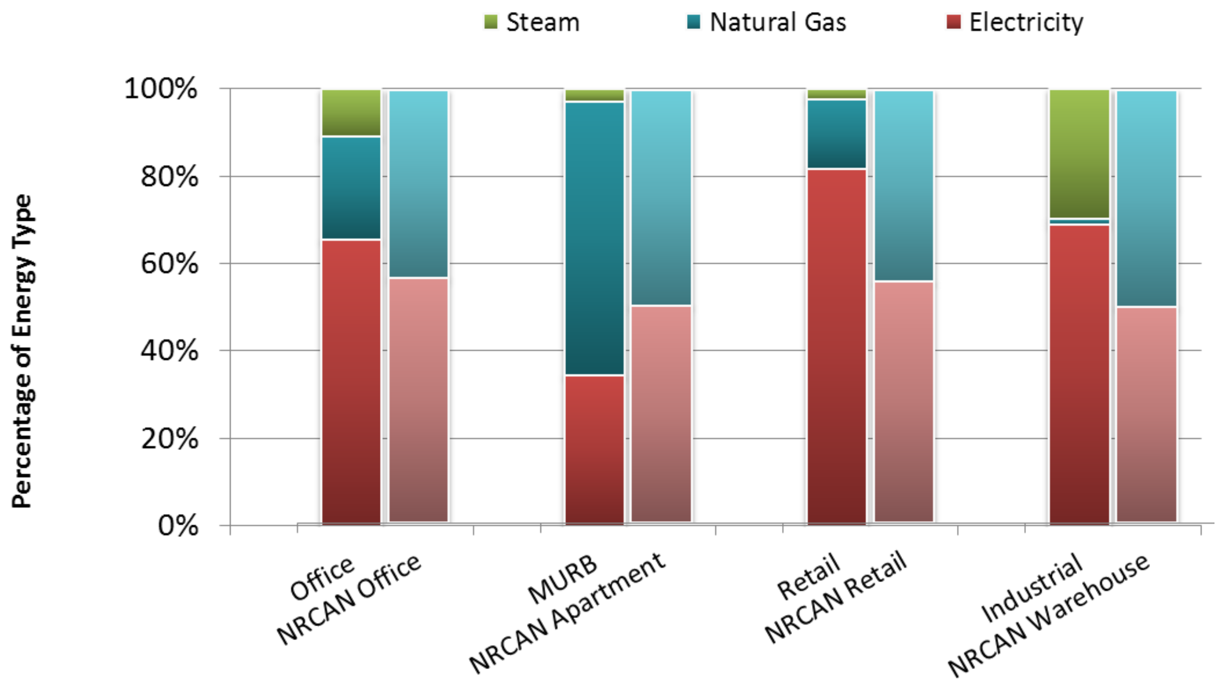


Figure 5: Distribution of Energy Sources by Building Type

Both BOMA BESt certified and non-certified offices and retail buildings used 10 to 20 percent more electricity on average than the NRCAN BC provincial average[16]. This is likely attributable to the fact that 89% of buildings in the study were located in the Lower Mainland climate zone A where average annual heating degree days are approximately 2,600 per year, compared to the rest of the Province, which has between 4,000 – 6,000 annual heating degree days.[17] The relatively low demand for heating energy amongst buildings in climate zone A likely accounts for the greater percentage of electricity consumed by these buildings relative to total building energy use.

3.5. Certification Level

Of the 147 BOMA BESt certified buildings in the study, the vast majority were level 2 and 3 certified office buildings. Table 8 shows the number of buildings by type and certification level in the study. Again, the relatively small number of certified buildings in other building categories made it difficult to draw general conclusions about building performance for those categories.

Certification Level	Level 2	Level 3	Level 4
Office	80	38	3
MURB	1	3	1
Retail	10	9	0
Other	1	1	0
Total	92	51	4

Table 8: Number of BOMA BESt certified buildings by level of certification

Twenty-two buildings indicated that they had undergone recertification of which 9 initially certified at level 2 or higher offering two points of data for comparison purposes (see section 4.1.6 of this report for consideration of recertified buildings). BOMA BESt level 1 certified buildings were excluded entirely from the study (see section 2 of the report for detailed discussion of the study's methodology).

[16] http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/query_system/querysystem.cfm?attr=0
[17] http://www.rdhbe.com/projects/index/projects/291.php

4. HOW DO BC BUILDINGS PERFORM?

The primary objective of the study was to explore the state of building performance in British Columbia and the extent to which performance correlates with various building characteristics. This section benchmarks building performance of all buildings in the sample set grouped by building type and evaluates energy, waste and water performance based on floor area, age, class, energy source, and climatic zone (location) to provide a better picture of how BC buildings are performing overall.

4.1. Office Buildings

4.1.1. ENERGY PERFORMANCE

In the context of exploring the relationship between rating systems and building performance, the area of most interest at present related to energy performance. Energy performance sample set was analyzed with respect to building type, age and size. General energy performance trends were compared with those identified in New York City's 2013 building benchmarking report, one of the first jurisdictions in North America to mandate tracking of building energy performance and the first to publicly report out on overall performance trends.[18]

As detailed in section 2 ("Methodology"), buildings were excluded that reported energy performance that deviated significantly from the rest of the data set (i.e., buildings that reported a site EUI of less than 15.8 kWh/m^2/yr or more than 3,155 kWh/m^2/yr). This resulted in 10 buildings being removed from the data set sample.

The study data set included 135 office buildings (i.e., 48% of all buildings in the study), including 121 BOMA BESt certified and 14 non-certified office buildings. Weather normalized site EUI values for BOMA BESt levels 2,3 and 4 certified office buildings and non-certified buildings were compared against NRCAN's EUI benchmarks for Canada (2009 and 2010 values) and BC and the Territories, as well as benchmark data from the BOMA BESt Energy and Environment Report (BOMA BEER) and the Real Property Association of Canada's building energy performance target of 215.8 ekWh/m^2/year by 2015.[19]

Figure 6 shows the distribution curve of energy intensity for both BOMA BESt certified and non-certified office buildings in the study. Site EUI varied considerably across both certified and non-certified office buildings, although not to the degree found amongst NYC buildings.

[18] New York City Local Law 84 Benchmarking Report (September 2013) available at http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/ll84_year_two_report.pdf. Comparison with the NYC report were limited to trends. Average values were not compared because of the many differences in the two studies, notably climatic conditions.
[19] Ian Jarvis, *REALpac 20 by '15* (2009) available at http://c.ymcdn.com/sites/www.realpac.ca/resource/resmgr/industry_sustainability_-_research_reports/20-by-15final18sept09.pdf. See summary of benchmarks in Appendix A.

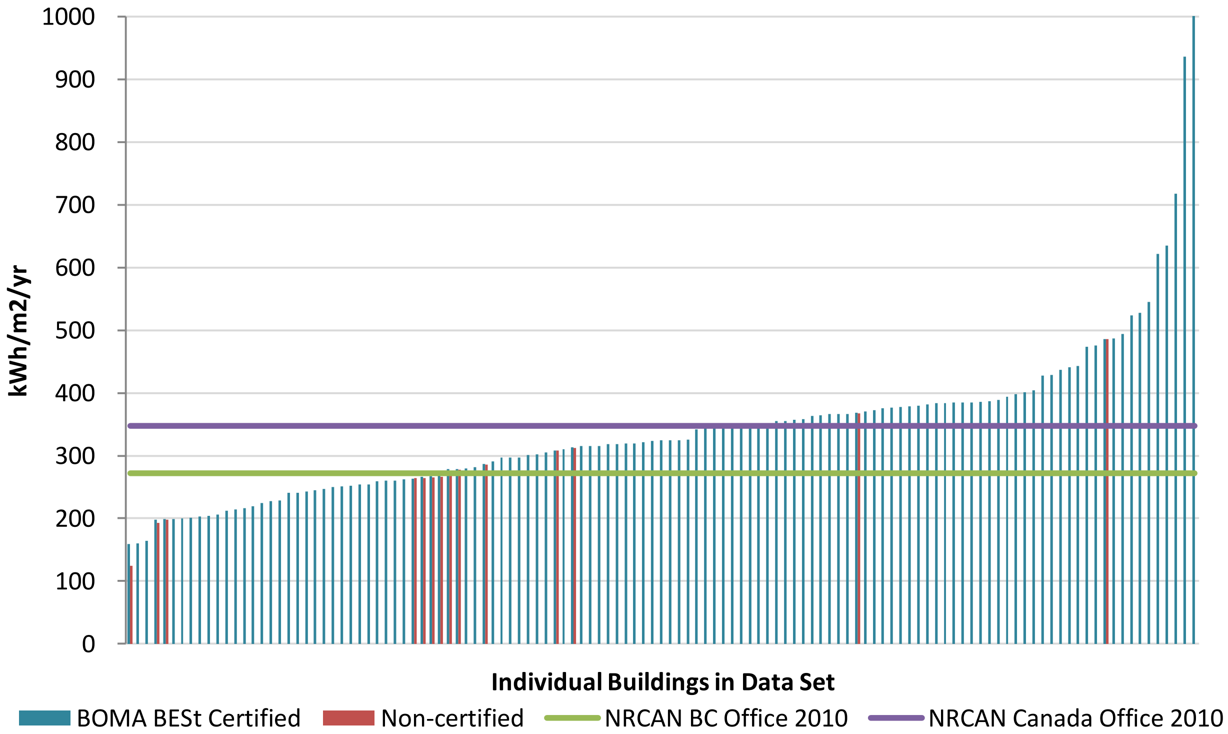


Figure 6: Energy Use Intensity of Office Buildings by Building

The sample of office buildings reveals a significant opportunity for energy savings amongst office buildings in British Columbia.[20] The average site EUI for all 135 office buildings was 335 kWh/m^2/yr. The top 25th percentile had an average EUI of 261 kWh/m^2/yr compared with 378 kWh/m^2/yr for the bottom quartile. In terms of total energy consumption, the top 25th percentile of office buildings consumed 17% of the total energy consumed, while the bottom 25th percentile consumed 30% (see Table 9). Extrapolating these findings, bringing the bottom quartile of office buildings up to the median EUI for all office buildings in the study would result in a potential reduction of 5% of total energy consumption by all office buildings in the Province.

	Average kWh/m^2/yr	Total kWh/m^2	% of Total Energy Consumed
Top Quartile	261	112,124,624	17%
Bottom Quartile	378	194,603,000	30%
Median	319	650,502,080	

Table 9: Top and Bottom Quartile Energy Consumption for Office Buildings

[20] The NYC Study found that bringing the lowest 25th percentile up to median levels would energy consumption by 18% and if they could bring those lowest 25th percent up to the top 25th percent they would reduce energy consumption by 31 percent.

4.1.1.1. By Building Age

It is unclear whether the year a building was built has a material impact on its current energy performance. The NYC Benchmarking Report found that older buildings were on average outperforming their newer counterparts and attributed this to increased ventilation in newer buildings, better building envelopes in older buildings (less glazing) and higher energy intensity users in newer buildings.[21] However, while the findings from this study are inconclusive, the trend suggests that newer buildings in British Columbia are performing better on the whole than older ones.

For the 121 BOMA BESt certified office buildings, the study found a very slight correlation between the age of a building and energy performance (see Figure 7). The trend line suggests that on average the newer the building the better its energy performance. More specifically, the best performing buildings were built between 1980 – 1990, while the lowest performing buildings were built between 1960 – 1970. This last finding could possibly be attributed to the fact that the systems in the older buildings are nearing end of life and are in need of recommissioning, or possibly, replacement.

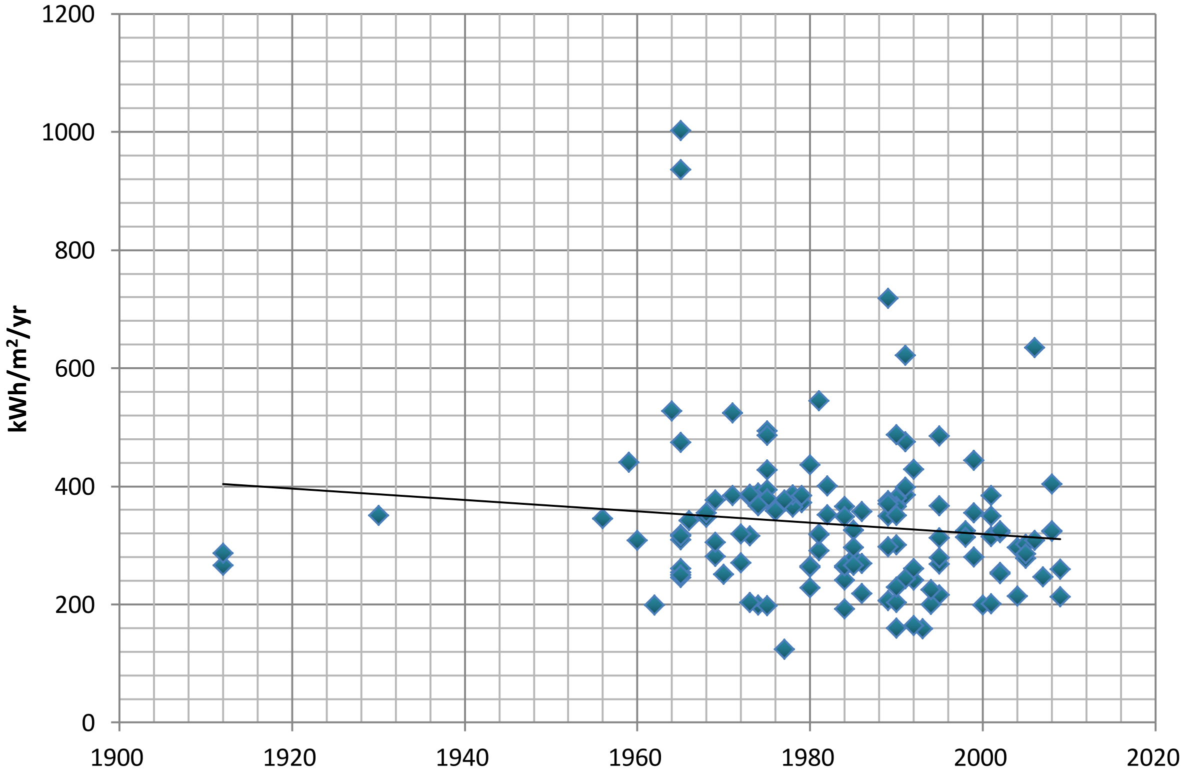


Figure 7: Average EUI for BOMA BESt Office Buildings by Building Age

4.1.1.2. Number of Floors

Energy use intensity also did not correlate with the number of floors in an office building (see Figure 8).

[21] See footnote 18 above.

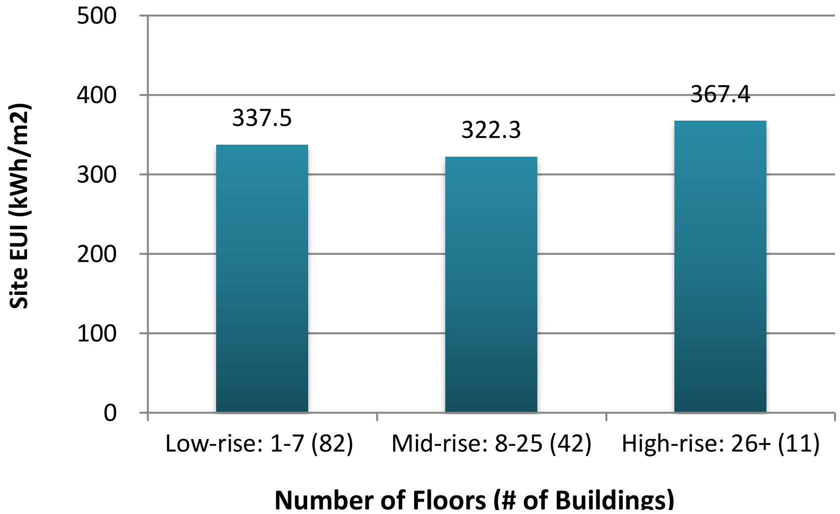


Figure 8: Energy Use Intensity of Office Buildings by Number of Floors

4.1.1.3. Floor Area

For the purpose of comparing energy use intensity and building size, all 281 certified and non-certified buildings were assessed together because there were insufficient non-certified buildings on their own in each size category. While the findings are not conclusive, the data does show a slight overall negative correlation between building size and EUI amongst office buildings.

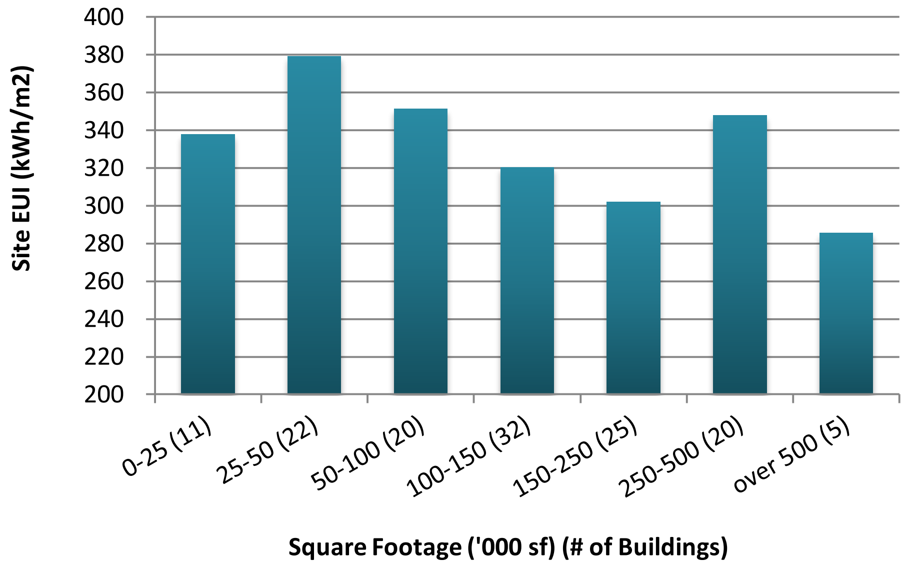


Figure 9: Site EUI for Office, Retail and MURBs by Floor Area

4.1.1.4. By Certification Level

While BOMA BESt does not prescribe minimum energy performance requirements, there is an expectation that buildings with a higher certification level will perform better than those with a lower level of certification. Indeed, BOMA BESt Level 4 certified office buildings performed 15% better than the NRCAN BC average, while level 2 and level 3 certified buildings performed 32% and 15% worse than the NRCAN BC average respectively. In contrast, level 2, 3 and 4 BOMA BESt office buildings performed 4%,10% and 34% better respectively than the NRCAN Canada benchmark. Interestingly, non-certified office buildings performed almost identically to the NRCAN BC average and better than BOMA BESt level 2 and 3 certified office buildings. The average performance of the non-certified office buildings was virtually the same as NRCAN's BC average lends a degree of confidence to the findings (see **Figure 21**).

4.1.1.5. Building Class

One of the criticisms leveled against historical studies looking at the energy performance of commercial buildings is that they have included a disproportionate number of higher performing class "A" buildings providing a skewed picture of overall building performance. Indeed, the same observation has been made with respect to the performance of certified buildings relative to non-certified buildings generally. This study included 64 class A buildings, 25 class B buildings and 2 class C buildings. Results indicate that class A buildings outperformed class B and C buildings with respect to energy performance, however the number of class C buildings considered was not large enough to make valid comparisons.

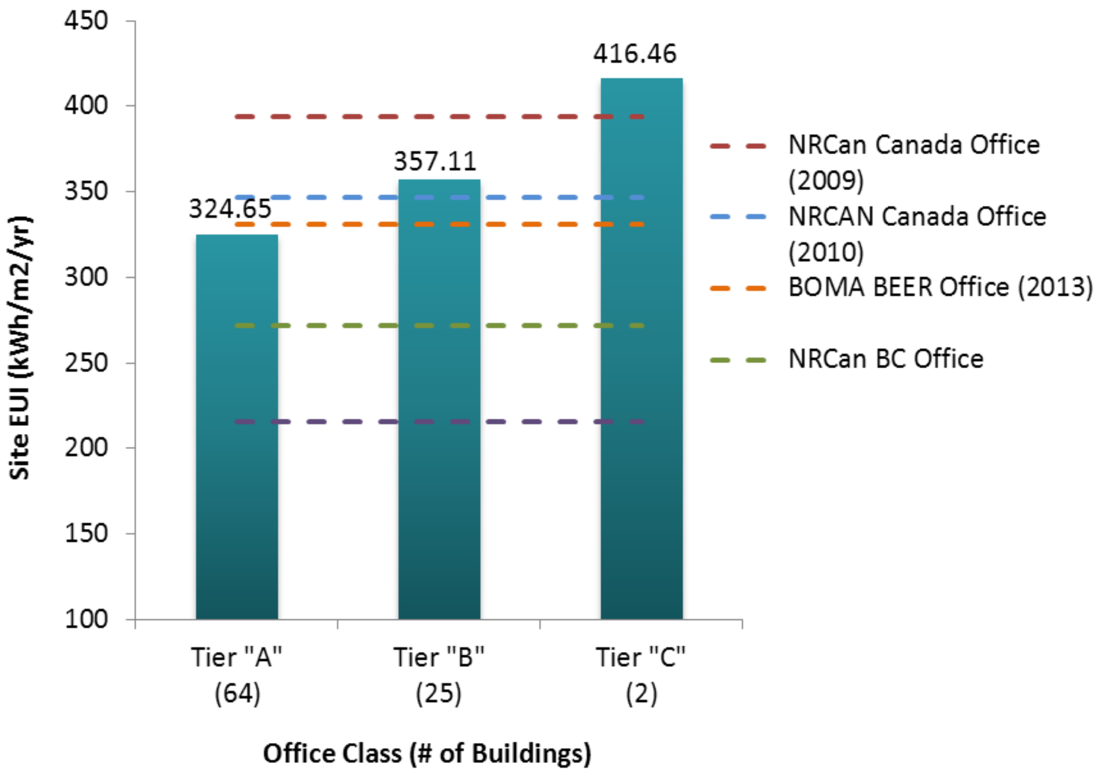


Figure 10: Average EUI of Office Buildings by Building Class

4.1.1.6. Climatic Zone

British Columbia has three climate zones. The geographic location of a building impacts a building's design and operation in a myriad of ways, including design standards, the availability and use of materials, and even the availability of qualified individuals to operate and maintain the building. The vast majority of the buildings in the study were located in climate zone A, performing better than the NRCan and BOMA Canada averages, but underperforming with respect to NRCan's benchmark for BC and the Territories. Unfortunately, the insufficient number of buildings in climate zones B and C did not allow for a comparison of building performance across different climate zones.[22]

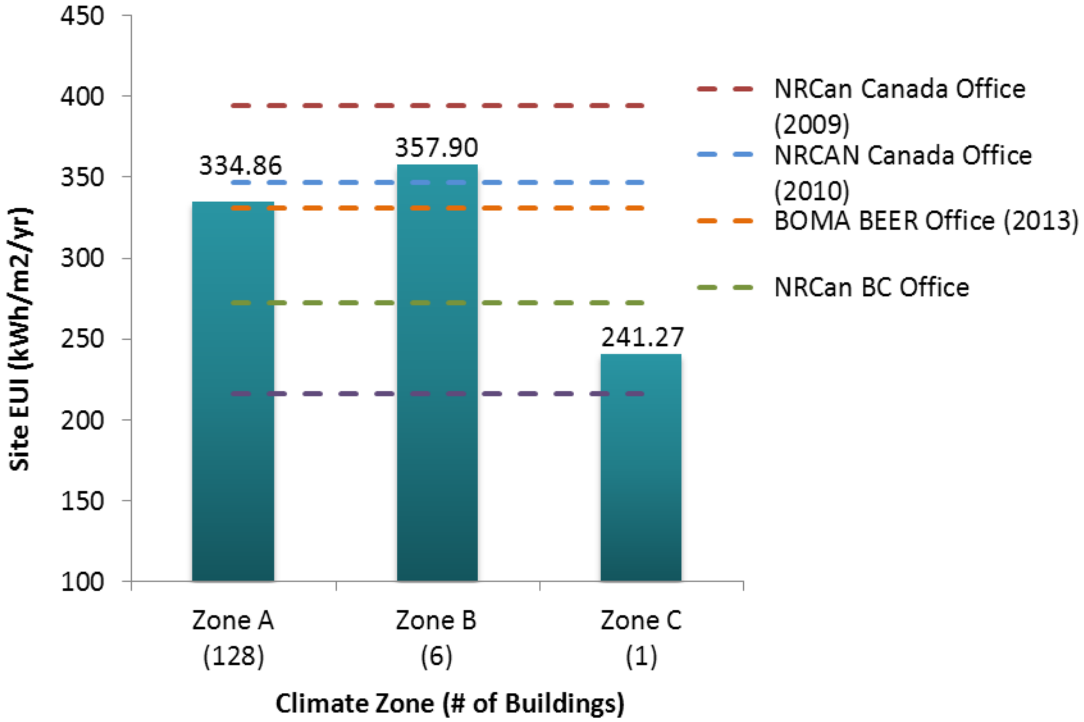


Figure 11: Average EUI for Office Buildings by Climatic Zone

4.1.1.7. Energy Star Score

Energy Star is an American-based rating system for products and buildings. Buildings that use Portfolio Manager to track their energy performance can also obtain an Energy Star rating by benchmarking their performance relative to other buildings across Canada. Energy Star scores are expressed on a scale of 1 to 100. Buildings must obtain a score of 75 or greater to get an Energy Star rating, which indicates that the building is in the top quartile of its class.

Portfolio Manager was only introduced in Canada in July 2013. Currently, only two classes of buildings are eligible to obtain an Energy Star rating in Canada (i.e. offices and K-12 schools). Consequently, only 134 of the 281 buildings in the study would be eligible at this time. Figure 12

[22] The one office building in Zone C was a BOMA BESt Level 2 building.

shows a distribution curve of the average Energy Star scores for qualifying buildings. Of those, 27 office buildings (15%) obtained a score higher than 75 points.

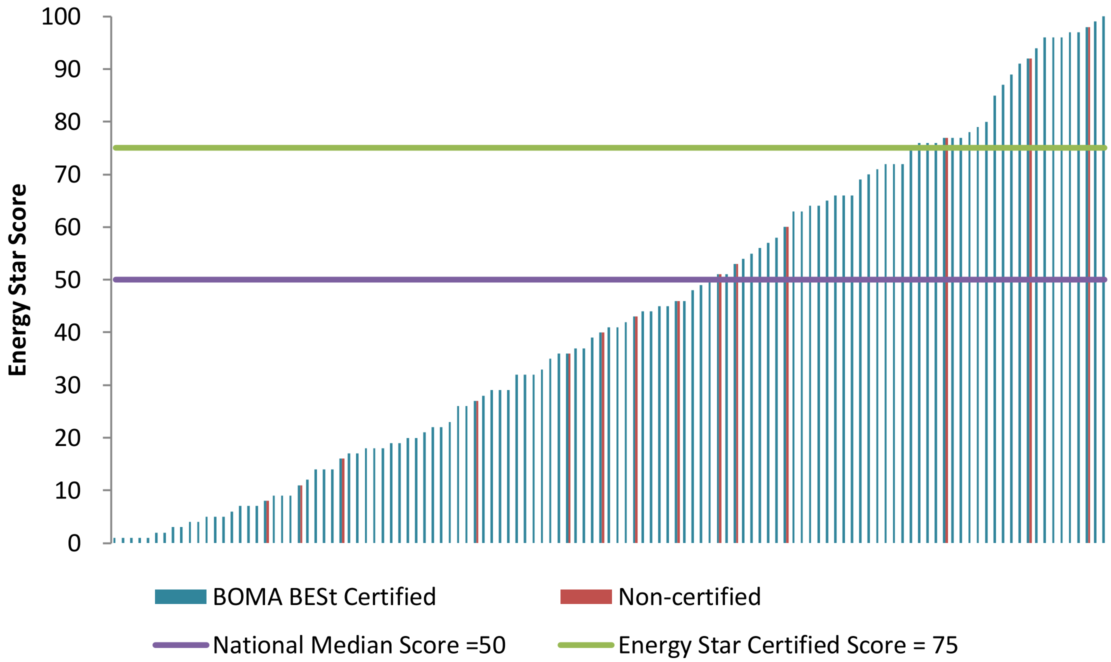


Figure 12: Average Energy Star Scores for Office Buildings

4.1.2. GHG Emissions

With the current focus of governments on meeting greenhouse gas reduction targets, findings regarding GHG emissions from office buildings present some interesting results. GHG emission factors were calculated using Portfolio Manager using its methodology for calculating and tracking greenhouse gas emissions.[23] However, benchmarking building performance is not meaningful in this context because fuel sources and associated emissions vary depending on location.

As with energy performance, newer office buildings showed a slight reduction in GHG emissions, although the findings are not statistically significant (Figure 13).

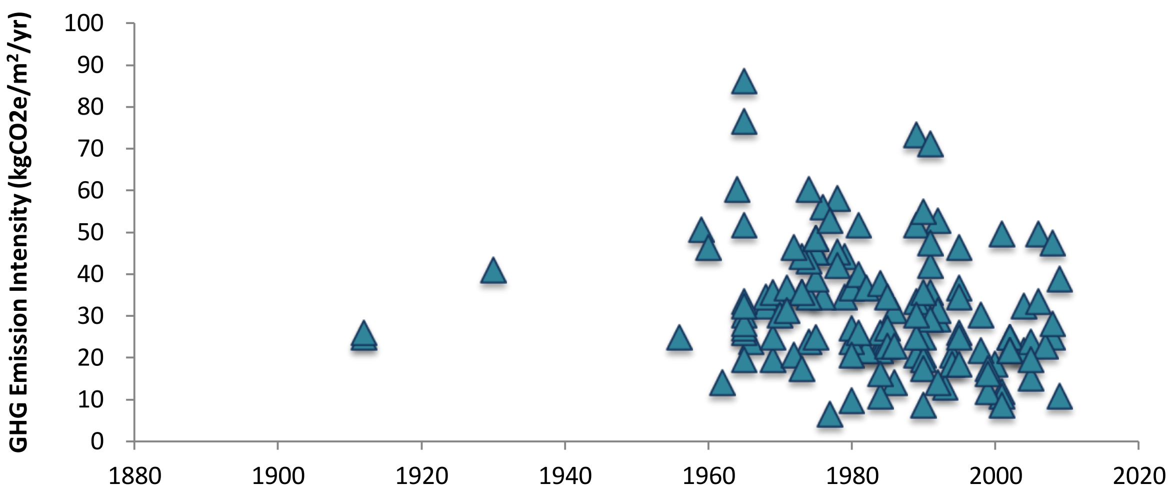


Figure 13: GHG Emissions for Office Buildings by Building Age

The study's findings do show a positive relationship between the number of floors in a building and its GHG emissions. Figure 14 shows that high-rise buildings (i.e., buildings with more than 26 floors) emit roughly 25% more GHG per square metre than low-rise buildings.[24] Interestingly, this trend observed with respect to GHG emissions is not observed when looking at energy consumption (see Figure 8 above).

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[23] *See* www.energystar.gov/ia/business/evaluate_performance/Emissions_Supporting_Doc.pdf.
[24] Building height classifications come from BOMA.

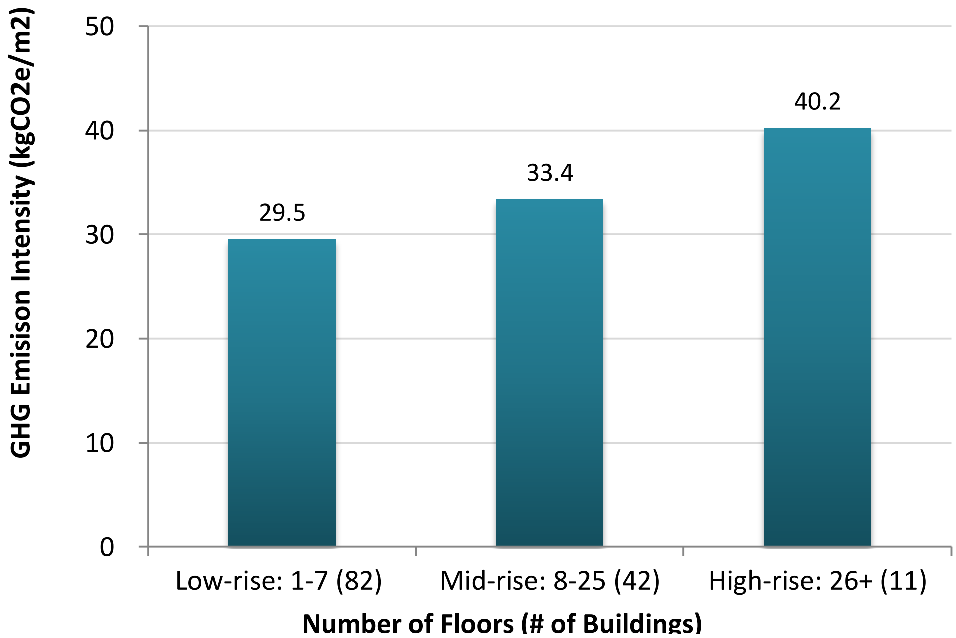

Figure 14: GHG Emission Intensity of Office Buildings by Number of Floors

There are several possible explanations for this. The higher average GHG emission intensity amongst mid-rise buildings is likely due to higher relative gas usage. Low-rise buildings tend to use relatively more electricity, which in British Columbia comes from hydroelectric sources with significantly lower emissions. High-rise buildings are also more likely to have a greater percentage of glazing and curtain walls filled with windows, which decrease their energy efficiency and increase their emissions.

However, the relationship is not sustained when looking at office buildings by square footage. In that case, no clear trend is observed (see Figure 15). Both very small buildings (<25,000 sq. ft.) and large office buildings (250,000 – 500,000 sq. ft.) showed the highest levels of GHG emission intensities.

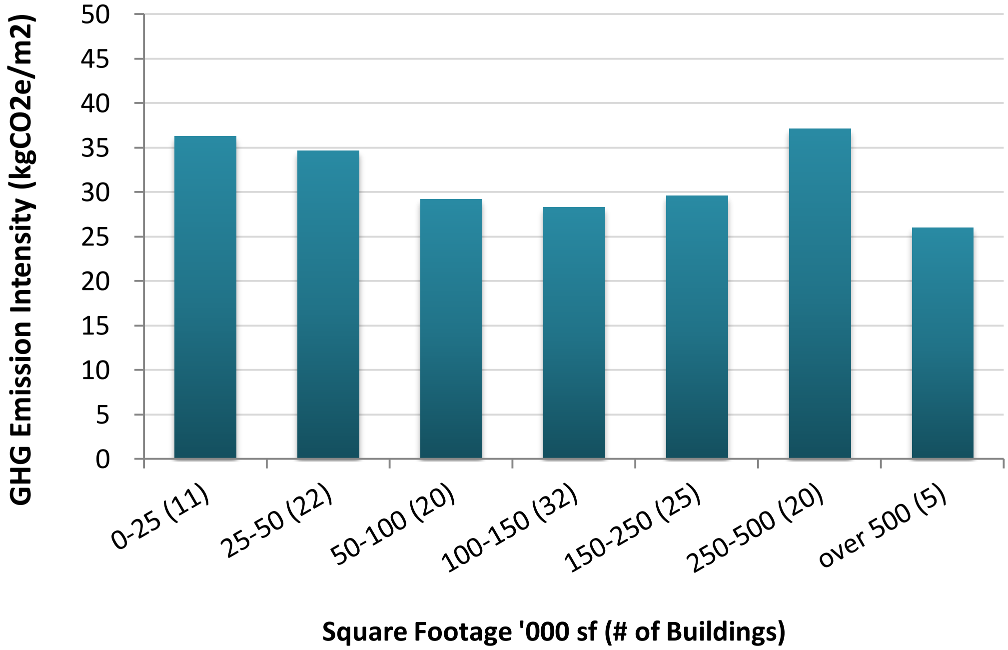

Figure 15: GHG Emission Intensity for Office Buildings by Square Footage

While the data is not conclusive, findings suggest that high-rise buildings represent the greatest potential for GHG emission reductions per building amongst office buildings. However, given the larger number of low-rise and mid-rise buildings in British Columbia, policy targeting those buildings might achieve greater overall reductions in GHG emissions.

4.1.3. Water Usage

British Columbia has one of the highest water consumption rates (based on bulk water consumption) of any province in Canada.[25] This is largely due to extremely low water rates and lack of metering which makes it very difficult to charge for domestic water consumption. The residential sector in BC accounts for 65% of the province's total water consumption, while the commercial sector accounts for 16% (see Figure 16). Metro Vancouver's distribution is similar with the residential sector accounting for 60% of the region's water consumption and the remaining 40% used by business and industry.[26] The City of Vancouver's building sector accounts for approximately 12% of total potable water consumption for the municipality.

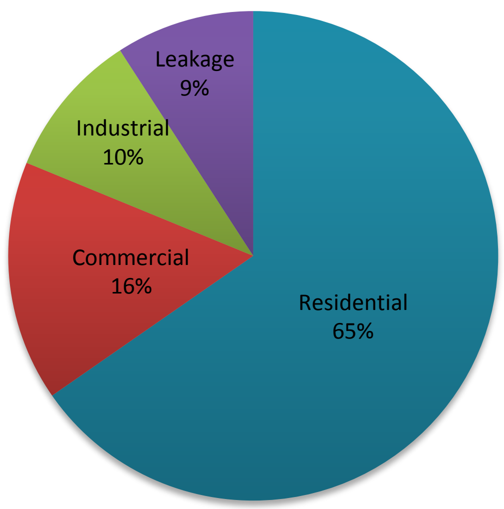

Figure 16: Water Consumption in BC by Sector

[25] Environment Canada, *2011 Municipal Water Use Report* available at http://www.ec.gc.ca/Publications/B77CE4D0-80D4-4FEB-AFFA-0201BE6FB37B/2011-Municipal-Water-Use-Report-2009-Stats_Eng.pdf. The survey (based on 2009 data) shows that municipalities with volume based water charges have an average residential consumption rate of 229 Lcd compared with municipalities without metering or volume based pricing with 376 Lcd; an increase of 65%.

[26] Metro Vancouver, source?

There have been several benchmarking studies on office building water consumption in Canada. REALpac's *Water Management: A Benchmark for Canadian Office Buildings* issued in May 2011 analyzed water usage for 74 buildings using 2009 water usage data.[27] The study found the best practice range for office buildings across Canada, representing first quartile performers, was 128 to 535 L/m^2/yr. Best performing (i.e., top quartile) buildings in BC and the prairies consumed less than 407 L/m^2/yr. Similarly, the median consumption for buildings in BC and the prairies was 642 L/m^2/yr, significantly less than the 984 L/m^2/yr for Ontario buildings. BOMA Canada's 2011 Energy and Environmental Report on BOMA BESt buildings (the majority of which were office buildings) found national average water consumption intensity for BOMA BESt certified buildings was 600 L/m^2/yr,.[28]

For the purposes of this study, water consumption data was limited to 115 BOMA BESt certified buildings in BC. Non-certified buildings were asked to provide this information through an online survey, but were either unable or unwilling to provide it. Three buildings were excluded based on reporting significantly higher consumption levels than the rest of the data set. Despite this, the results still showed a wide range of water use intensity values across buildings, similar to findings in the REALpac water benchmarking study.[29] The average water use intensity for the study's office buildings was 1,032 L/m2, significantly higher than both comparative benchmarks. More than 60% of the buildings had higher water use intensity values than the average value reported by REALpac and the bottom quartile of buildings had values exceeding 190 L/m2.

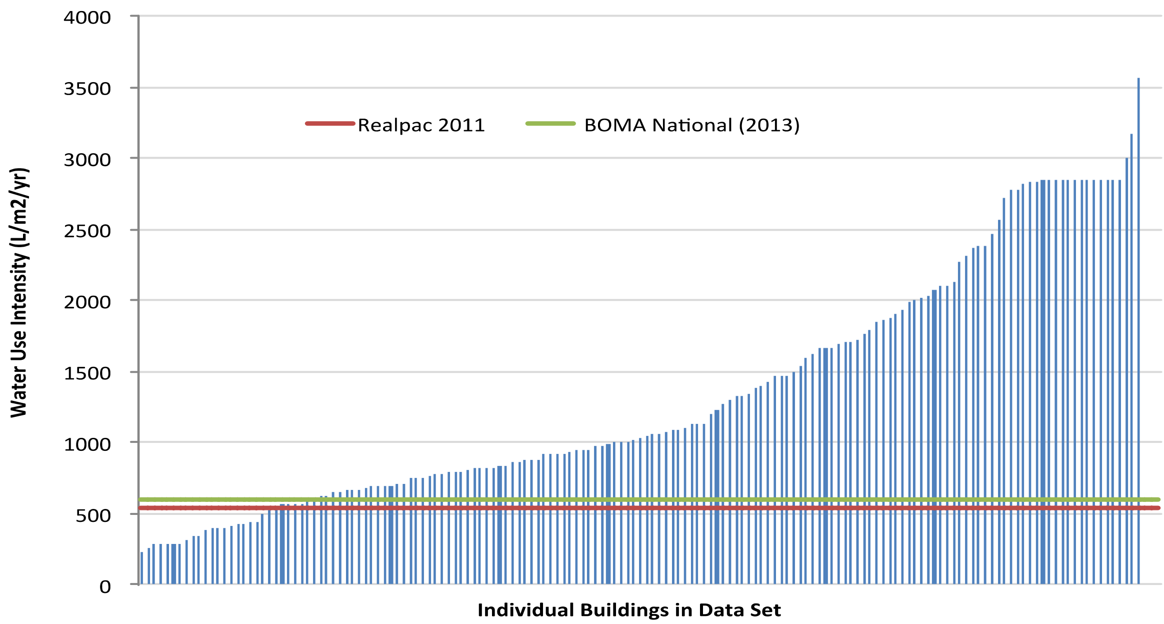

Figure 17: Water Use Intensity Distribution for Office Buildings

The findings indicate that there is considerable opportunity to improve water efficiency and reduce consumption among BC buildings. This includes commissioning existing infrastructure and addressing occupant behaviour. Further segmentation of water use intensity data is recommended to better identify the bottom quartile of buildings and focus the design of water conservation policy and programs.

[27] REALpac, *Water Management: A Benchmark for Canadian Office Buildings* (May 2011) at p.18. Available at http://c.ymcdn.com/sites/www.realpac.ca/resource/resmgr/industry_sustainability_-_water_benchmarking/rp-water-management-and-benc.pdf.
[28] BOMA Canada, *BOMA BESt Energy and Environment Report 2013*. Available at http://www.bomabest.com/wp-content/uploads/BBEER-2013-Full-Report.pdf.
[29] REALpac, *supra* note 27.

Water delivery and treatment also requires significant energy and can result in considerable emissions. Actual indirect energy requirements for water delivery and wastewater treatment can vary considerably depending on a jurisdiction's infrastructure, as well as each building's location and total water consumption. Other studies have reported significant indirect energy use intensity levels from water delivery and wastewater treatment, not including water heating.[30] These indirect values are not commonly incorporated into energy consumption values for buildings and have not been included for the purposes of this study, however their impacts warrant further study.

4.1.4. Waste

Waste diversion considers the amount of non-hazardous materials that are diverted from going to landfill through recycling or reuse. Office buildings generally report diversion rates based on receipts provided by the waste disposal company that services the building.

There are no recent benchmarking studies on waste diversion in Canada, however the 2013 BOMA BEER found that 45% of BOMA BESt certified buildings diverted between 30% and 60% of their waste from landfill.[31] A number of jurisdictions have set overall waste diversion targets, such as Metro Vancouver's objective of diverting 70% of all wastes from landfill by 2020.

BOMA BESt only requires buildings to report diversion rates in percentage increments of ten. Furthermore, BOMA BESt assigns a default diversion rate of 10% to buildings that do not report waste diversion values. These buildings are represented in Figure 18, but were excluded for the purposes of calculating the sample's median and mean. Assuming all buildings reporting 10% diversion rates did not provide waste data, this represents a significant opportunity to engage property owners and managers in reporting waste data.

Of the 121 BOMA BESt certified office buildings in this study that reported waste diversion data, the average diversion rate was 59% and the median was 55%, reflecting the upper range for BOMA BESt certified buildings nationally as reported in the 2013 BOMA BEER.

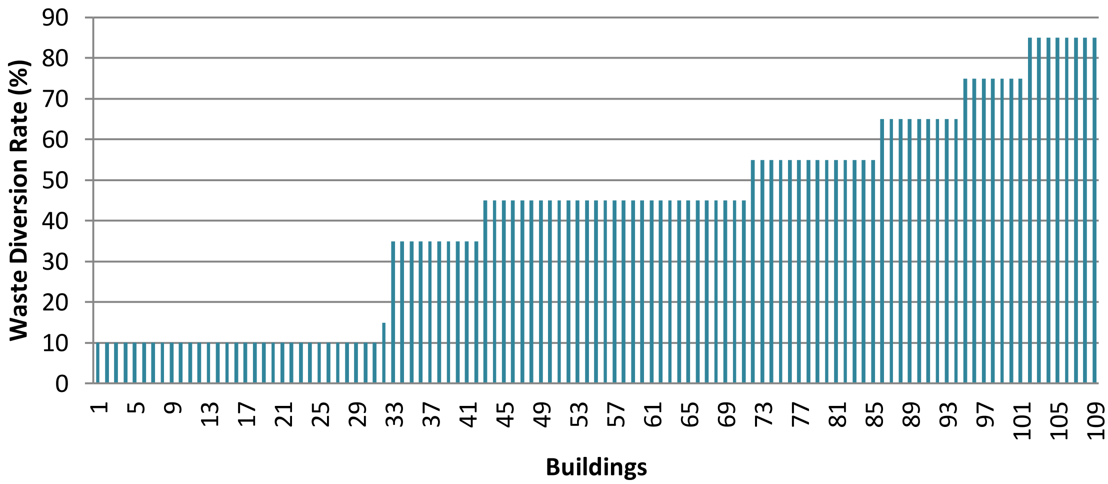

Figure 18: Waste Diversion Distribution for Office Buildings

[30] See e.g., Carol Mass. 2009. *Greenhouse Gas and Energy Co-Benefits of Water Conservation.* Polis Project. Table 1 at pg. 9. Available at http://poliswaterproject.org/sites/default/files/maas_ghg_.pdf.
[31] BOMA Canada. 2013. BOMA BESt Energy and Environment Report. Page 42. Available at http://www.bomabest.com/wp-content/uploads/BBEER-2013-Full-Report.pdf

4.1.5. ENVIRONMENTAL MANAGEMENT ACTIVITIES

The BOMA BESt program creates an incentive for building operators to focus on environmental management activities such as conducting energy, water, and waste audits, creating targets and reduction goals and surveying occupants on comfort and their ideas to increase building performance and reduce environmental impacts. Up to 11% of total points are available under the BOMA BESt rating system for environmental management best practices. Unlike data obtained on resource consumption, the information on environmental management activities was pulled from BOMA BESt audits conducted on 169 BOMA BESt buildings. The results indicated that while some building owners, managers and operators were taking advantage of these points, it is an area where there is room for improvement (see Figure 19).

Specifically, the results indicated that managers and operators of BOMA BESt certified buildings are diligently creating energy management policies (99.3%), which include tracking annual energy use, creating reduction targets and working towards continual improvement. BOMA BESt certified buildings are often using green leases with tenants (76.9%), which include a section on energy and environmental responsibilities. The results indicated that 75.7% of building owner / operators were also conducting staff training on energy and building management systems. Further, 81.1% stated that they had an environmental policy manual, which included sections dealing with energy conservation and GHG emissions reduction, water conservation, waste reduction and recycling, environmental purchasing, and proper handling and the reduction in use of hazardous products. Finally, just over half (55%) of the 169 buildings reported conducting waste audits every three years. These results indicate that BOMA BESt is a useful tool in driving improvements at the policy and program level for many buildings.

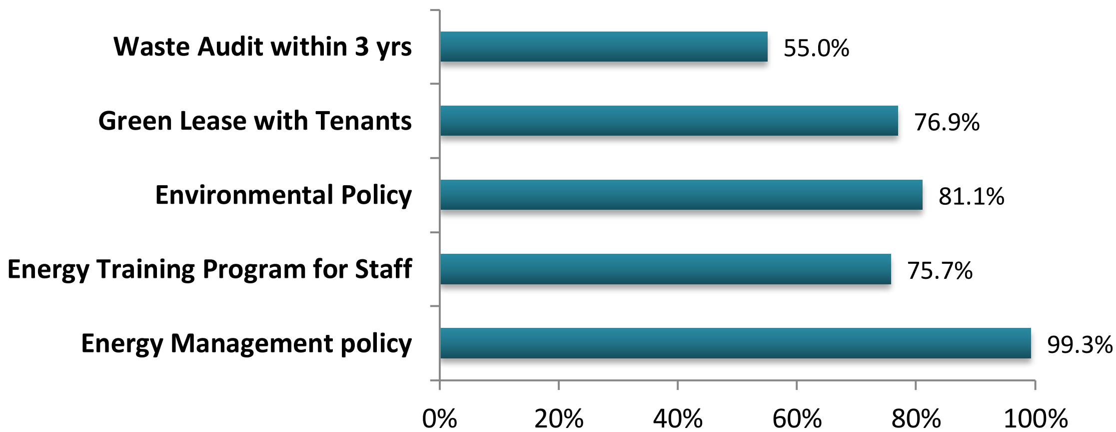

Figure 19: Management Activities of BOMA BESt Certified Buildings

4.1.6. RECERTIFICATION

The majority of buildings in British Columbia were built in the 1960s and 1970s and most of their systems are nearing the end of life. This highlights the need for ongoing monitoring and maintenance of existing buildings to ensure that building systems are operating as efficiently as possible. The combination of benchmarking, auditing and retro-commissioning is recognized as an essential part of building management and the most effective means of reducing costs and improving a building's performance.

As mentioned previously, both BOMA BESt and LEED EB:O&M recognize the importance of ongoing building assessment and require buildings to recertify every 3 years in order to maintain their rating status. However, the two rating systems have different approaches to engaging buildings. LEED EB:O&M sets performance requirements that buildings must meet to attain certification. BOMA BESt does not set minimum performance requirements, but rather encourages all building owners and operators to start to benchmark where they are at in terms of building environmental performance and then work on continual improvement. The BOMA BESt program is therefore more inclusive of all buildings and not solely seeking the top performers. It is through the process of recertifying that improvements in building performance can be identified.

Of the 147 BOMA BESt buildings in the study, 22 were identified as having recertified, 7 of these were identified by referencing BOMA BESt report cards and another 15 were manually identified by matching building addresses and names (see Figure 20). Since the data was analyzed a further 139 BOMA BESt buildings and 28 additional recertified buildings were discovered in a third BOMA database, however no energy data was available for these buildings and they could not be included in the result. Performance improvements could only be evaluated on buildings that provided original and recertified energy data. Consequently, only 9 buildings were ultimately considered. These nine buildings were all office buildings larger than 75,000 sq. ft., with the exception of one retail shopping centre. All were built after 1977.

Recertification Path	Total # of Buildings
Level 1 to 2	9
Level 1 to 3	4
Level 2 to 2	2
Level 2 to 3	4
Level 3 to 3	2
Level 3 to 4	1

Figure 20: Recertification Pathway for BOMA BESt Buildings

As **Figure 21** illustrates, BOMA BESt certified office buildings that had only certified once reported an average site EUI of 367.88 kWh/m^2/yr; poorer than any individual level of certified buildings. In contrast, buildings that had recertified experienced a 25% improvement in energy performance with an average site EUI of 280.70 kWh/m^2/yr, in line with the NRCAN BC benchmark. With the exception of one building (that certified and recertified level 2), all buildings reported at least a 20% reduction in EUI (see Figure 22).[32]

[32] Some of these buildings recertified under the more stringent BOMA BESt v.2, however for the purposes of energy performance, both versions of BOMA BESt are identical.

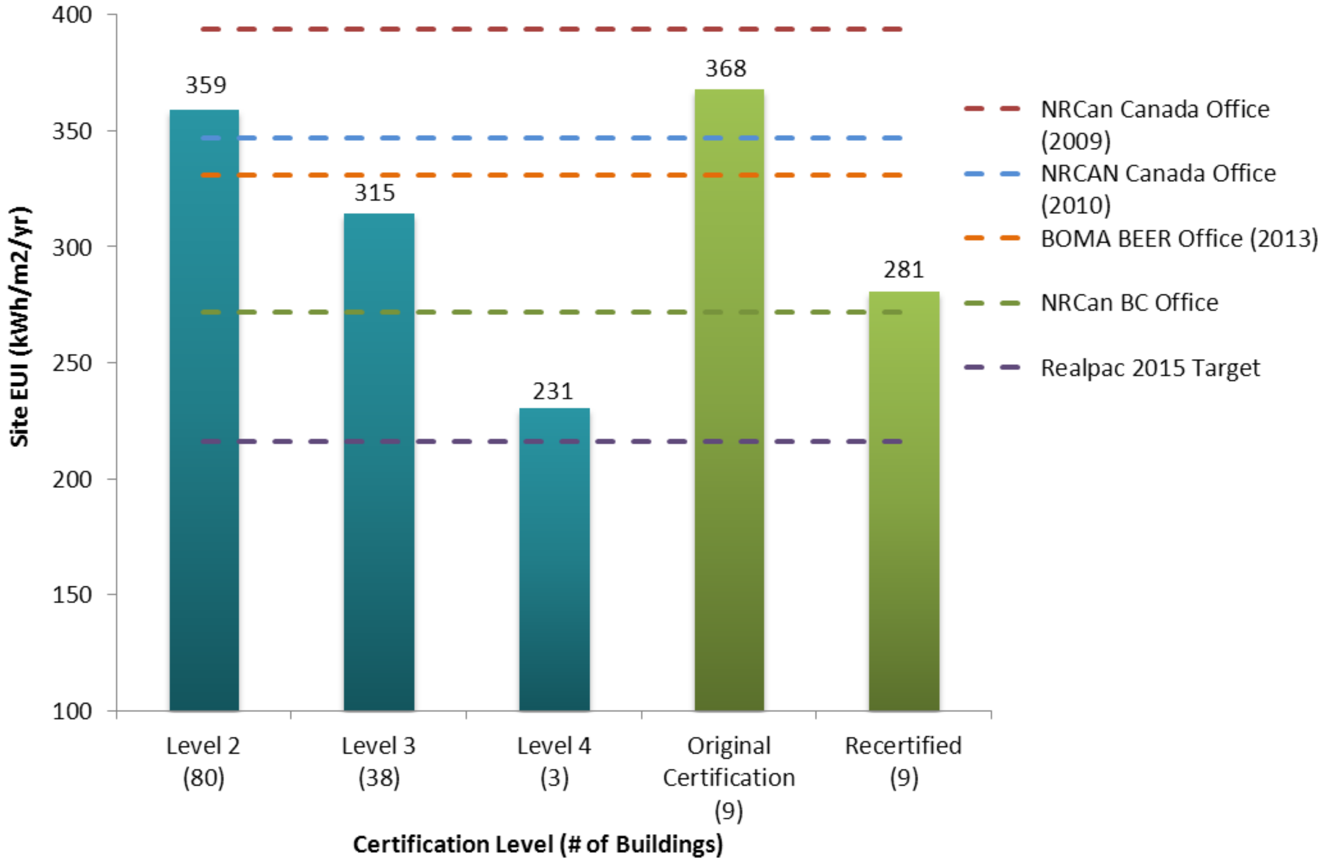

Figure 21: Average Site EUI for BOMA BESt Certified and Recertified Office Buildings

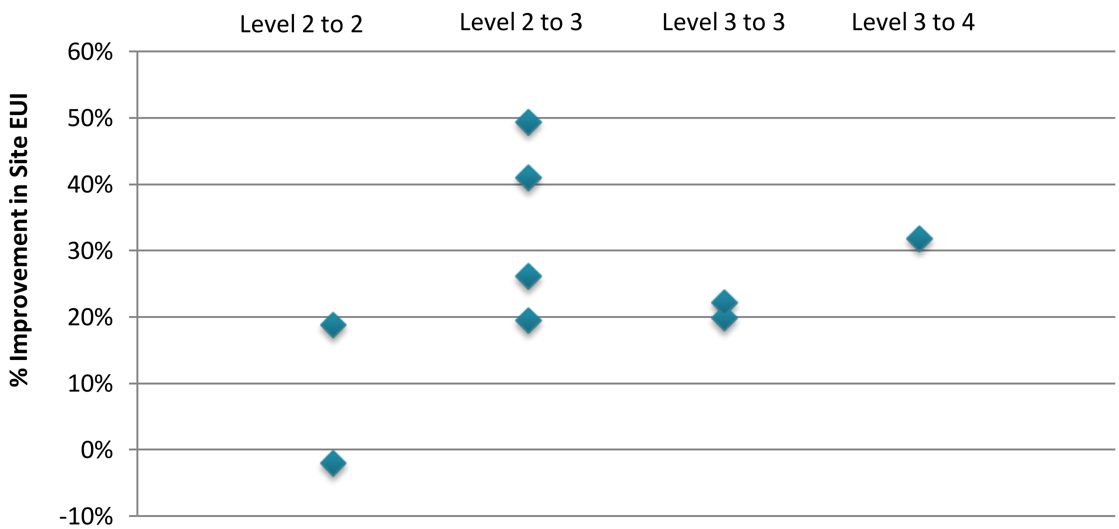

Figure 22: Percentage Improvement in EUI Among BOMA BESt Buildings That Recertified

The eight recertified buildings that reported water consumption data during their original certification and at the time of recertifying achieved an average 30% reduction in annual building water usage per square meter (see Figure 23: Percentage improvement in Water Use Intensity for BOMA BESt Buildings That Recertified).

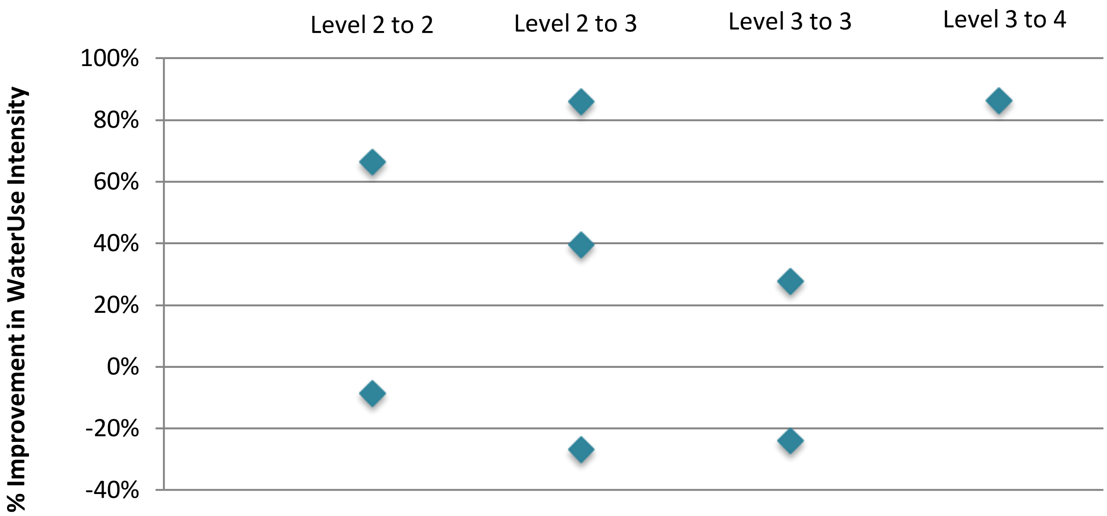

Figure 23: Percentage improvement in Water Use Intensity for BOMA BESt Buildings That Recertified

With respect to waste diversion, all 22 BOMA BESt buildings that recertified provided waste diversion rates at the time they certified originally and when they recertified, thus providing a stronger sample set. The 22 buildings reported an average increase of 24% in their diversion rates, going from an average diversion rate of 43.7% during their original certification to 67% upon recertification. However, those buildings that originally certified at level 2 or higher achieved a more modest average increase of 8% (see Figure 24).

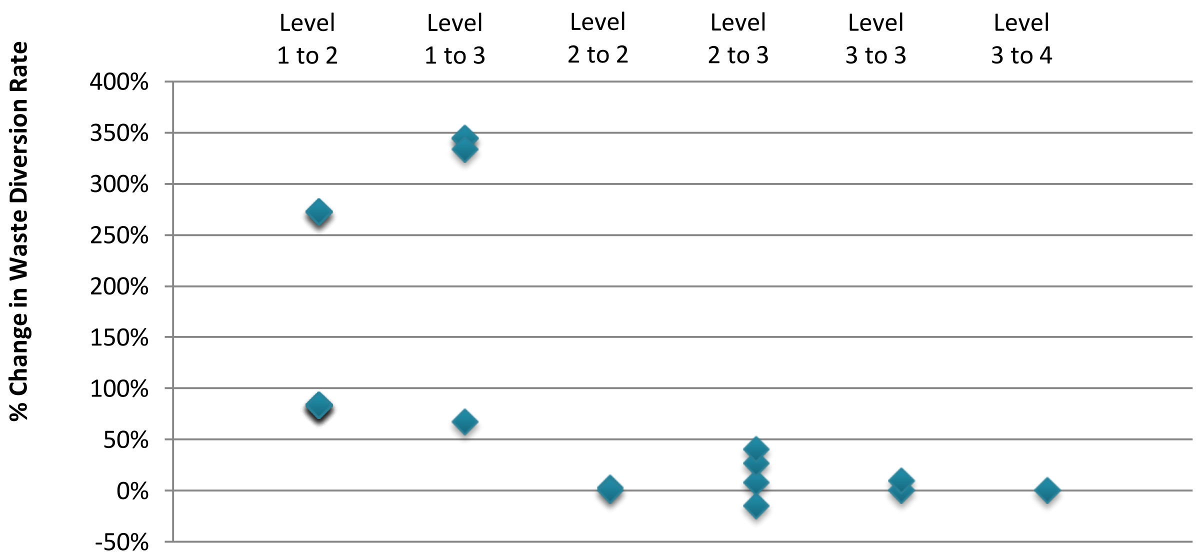

Figure 24: Percentage Change in Waste Diversion Rates for BOMA BESt Buildings That Recertified

Despite the relatively small sample set, the results suggest that the recertification process offers an effective tool for stimulating performance improvements in buildings, including reductions in EUI and water usage and increased waste diversion rates. The results also indicate that BOMA BESt attracts all types of buildings and performers and is a useful tool not just for high performing buildings but is being used by many lower performing buildings as a means to start benchmarking environmental performance and work towards continual environmental improvement.

4.2. Multi-Unit Residential Buildings

The study included 115 multi-unit residential buildings comprising 41% of the total data set, including 110 non-certified and 5 BOMA BESt certified buildings[33]. As with office buildings, ten buildings representing the top and bottom 2% of all MURBs were excluded from the study. The small number of BOMA BESt certified buildings is, in part, a consequence of BOMA BESt only introducing a rating framework for MURBs in 2012. There were no MURBs in the study group that recertified.

4.2.1. Energy Performance

Findings were compared with three different benchmarks for residential buildings, including the NRCAN BC 2005 benchmark for low-rise MURBs and benchmarks from two research studies looking at 41 MURBs in Metro Vancouver (FRESCo)[34] and 39 MURBS from Vancouver and Victoria (RDH)[35]. As discussed in the methodology section the benchmark studies did not use a weather normalized approach to benchmarking. However the authors of this study feel strongly that weather normalized benchmarking will become more common for benchmarking studies in the future with the introduction of Portfolio Manager in Canada.

The distribution curve for multi-unit residential buildings was similar to that observed for office buildings with significant variances in performance (see Figure 25).

[33] Certified buildings broke down further into one level 2 certified building, three level 3 certified buildings and one level 4 certified building.

[34] FRESCo. (February 2013). *Energy Labelling in Multi-Unit Residential Buildings* (February 2013). The study surveyed the performance of 41 multi-unit residential facilities comprised of 52 buildings in Metro Vancouver with a total floor area of approximately 4.7 million square feet. Source EUI values of the 41 facilities ranged from 226 to 741 kWh/m2/yr, with an average of 434 kWh/m^2/yr.

[35] RDH Building Engineering. (2012). *Energy Consumption and Conservation in Mid and High Rise Residential Buildings in British Columbia.* The RDH study determined an average site EUI of 213 kWh/m^2/yr for 39 multi-unit residential buildings in Vancouver and Victoria.

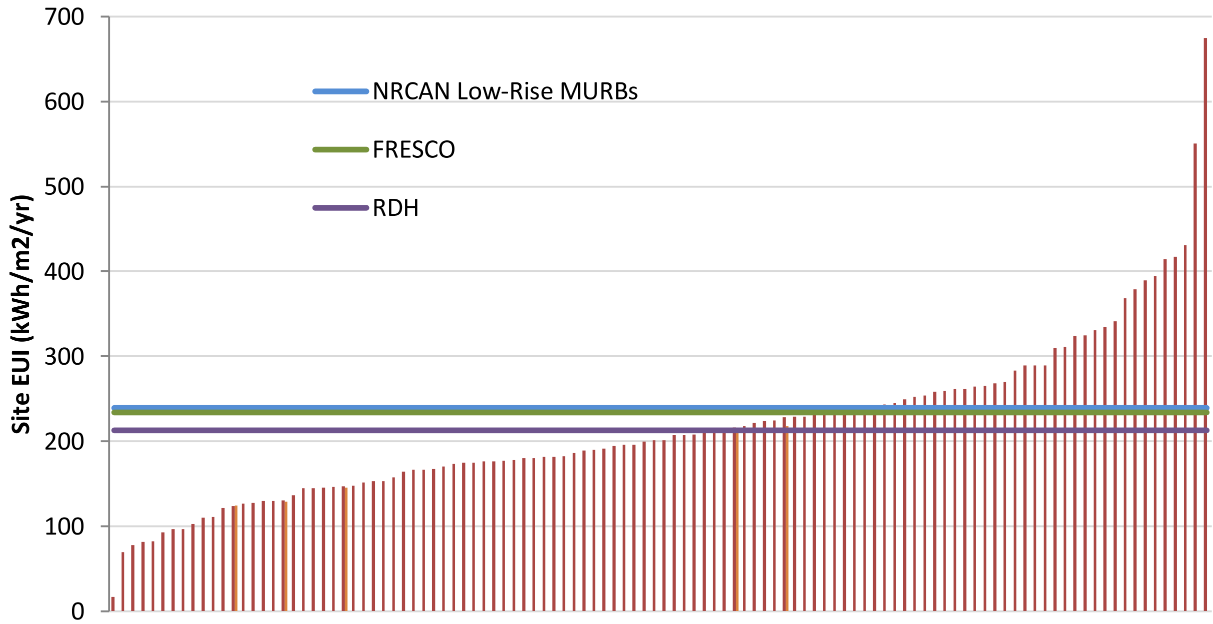

Figure 25: Distribution Curve of Site EUI for Multi-Unit Residential Buildings

The average site EUI for all MURBs was 215 kWh/m^2/yr with the top quartile achieving an average site EUI of 153 kWh/m^2/yr and the bottom quartile averaging 259 kWh/m^2/yr (see Table 10). In terms of total energy consumption the top quartile consumed 13% of the total energy consumed by all MURBs in the data set, whereas the bottom quartile used 30% -- two and a half times as much energy as the top 25th percentile. As with office buildings, the study's findings indicate that bringing the bottom 25th percentile of MURBs up to the median EUI would result in a 5% reduction in total energy consumption for all MURBs.

	Average kWh/m^2/yr	Total kWh/yr	% of Total Energy Consumed
Top Quartile	153	22,669,013	13%
Bottom Quartile	259	51,198,703	30%
MURB Median	201	172,626,559	

Table 10: Top and Bottom Quartile Average Site EUI for Multi-Unit Residential Buildings

4.2.1.1. By Building Age

Findings for MURBs were similarly inconclusive when considering site EUI and the age of the building. For all 115 MURBs in the study, a slight trend was observed between building age and energy performance suggesting that the newer the building the better its energy performance, although it is important to stress that the findings were not statistically significant (see Figure 26).

Figure 26: Energy Use Intensity v. Building Age for All MURBs

4.2.1.2. By Number of Floors

Unlike office buildings, the data showed no correlation between energy use intensity and the number of floors in MURBs (see

Figure 9 and **Figure 18**).

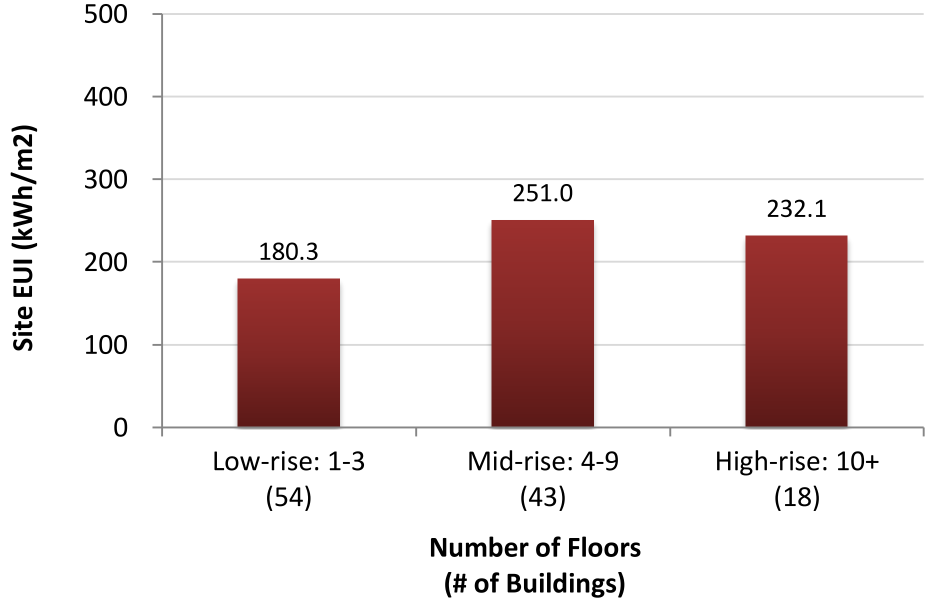

Figure 27: Average Energy Use Intensity of MURBs by Number of Floors

According to the MURBs in the study's sample, low-rise MURBs performed 28% better than mid-rise MURBs and 22% better than high-rise MURBs. The performance of low-rise MURBs is again likely due to their predominantly wood construction compared to their taller counterparts that feature concrete structures with thermal bridging and higher percentages of glazing. More surprising is the fact that GHG emission intensities for large buildings were 8% better than for mid-rises. This could be because 37 (86%) of the mid-rises were built before 1990 and 56% of the high rises were built after 1990. The mid-rises are therefore slightly older and the high-rises slightly newer.

4.2.1.3. By Floor Area

MURBs showed a similar distribution to office buildings when considered by size. Referencing the findings based on the number of floors, the results confirm that the size of a building is not related to the number of floors.

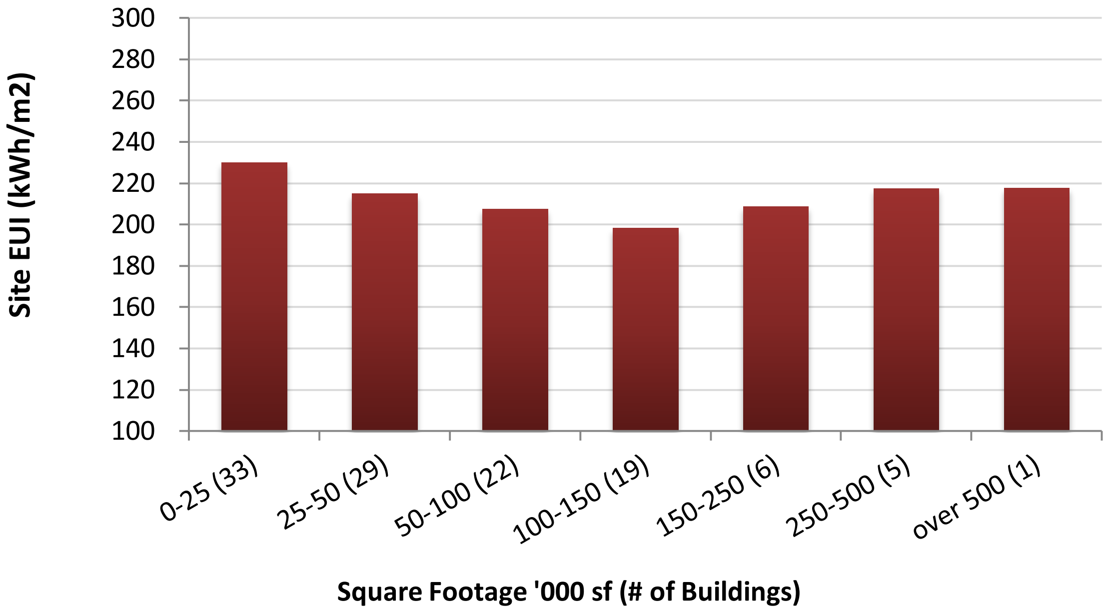

Figure 28: Average Site EUI for MURBs by Floor Area

4.2.2. GHG Emissions

GHG emission intensity values for MURBs mirrored energy use intensities whether segmented by building age, number of floors and total square footage (see **Figure 29**, **Figure 30**, and **Figure 31**).

The rationale for the variations in average GHG emission intensity values is presumably similar to that described in relation to energy use intensity values above. In addition, the fact that low-rise MURBs use proportionately higher percentages of electricity generated from hydroelectric power contributes to their lower average value (see Figure 5).

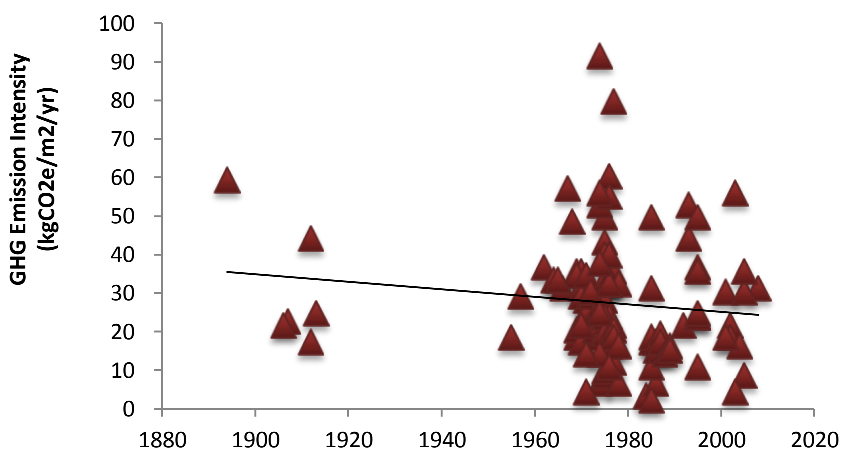

Figure 29: GHG Emission Intensity of MURBs by Building Age

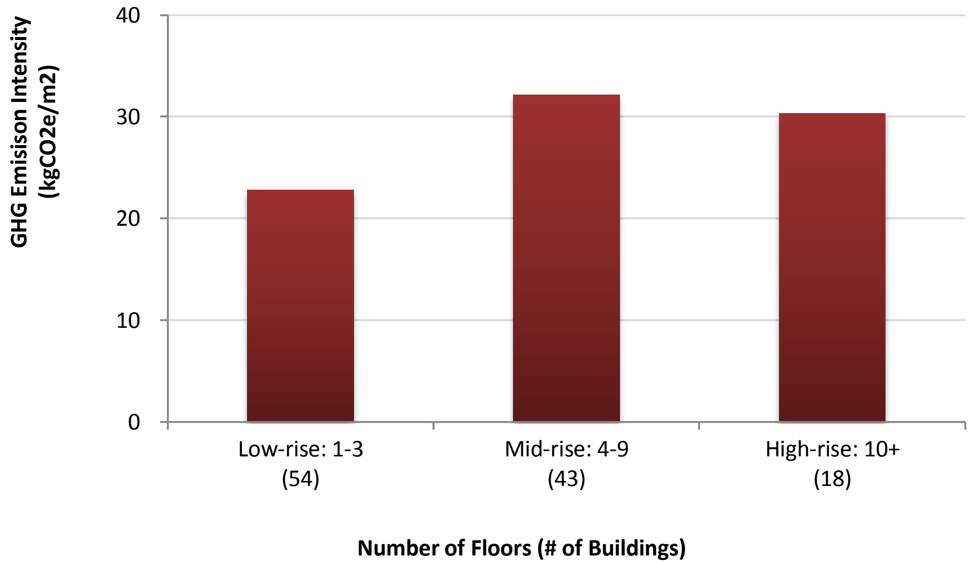

Figure 30: Average GHG Emission Intensity of MURBs by Number of Floors

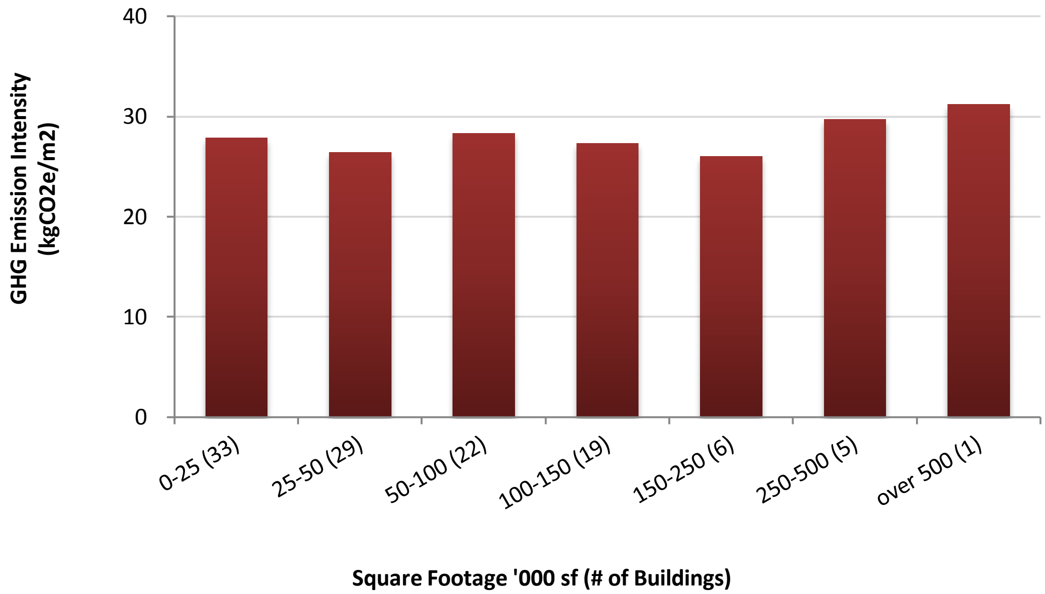

Figure 31: Average GHG Emissions for MURBs by Floor Area

5. THIRD-PARTY RATING SYSTEMS AND GREEN BUILDING POLICY

This section explores the second and third questions posed at the outset of this study, namely, can third-party certification systems for existing buildings help governments in BC to meet their green building and related policy objectives? And if so, what else can / should governments in BC do to require / encourage / incentivize the pursuit of third-party certification systems for existing buildings?

5.1. BC's Policy Framework

The Province of British Columbia, as well as regional and local governments within the Province, have established a number of targets aimed at addressing climate change and resource consumption issues. As indicated in the introduction to this study, achieving these targets is heavily dependent on the contribution of buildings. Many question whether the Province's existing policy framework is adequate to achieve these legislated targets.[36] Table 11 references the existing legislation and regulation in British Columbia and their key objectives. With the exception of the City of Vancouver, the Province has jurisdiction over setting performance requirements for buildings. Despite their limited ability to influence policy with respect to buildings, regional and local governments are active in the implementation of Provincial policy, including the adoption of provincial requirements into local policy and permitting requirements and the development of educational tools. Accordingly, this section references Provincial policy targets recognizing that regional and local targets are similar.

Table 11: Provincial Policy Instruments and Key Policy Objectives

Category	Policy Documents	Key Objectives
Energy & GHGs	BC Greenhouse Gas Reductions Act (2007)	▪ Reduce GHG emissions by 33% by 2020 from 2007 levels ▪ Reduce GHG emissions by 80% by 2050 from 2007 levels
	Local Government Statutes Act	▪ Local and regional governments must identify greenhouse gas emission reduction targets as part of Official Community Plans and Regional Growth Strategies with supporting policies, plans and actions to achieve those stated targets.
	BC Energy Efficient Buildings Strategy	▪ Reduce average energy demand per home by 20% by 2020 ▪ Reduce the energy demand at work by 9% per sq. metre by 2020. Make government buildings carbon neutral by 2010.
	BC Energy Efficiency Act	▪ Specifies efficiency performance for appliances and products (including windows, furnaces, fluorescent ballasts).

[36] Dirk Meissner, "Greenhouse Gas Emissions in B.C. Meet Targets, For Now" (September 25, 2013). *Huffpost British Columbia.* Available at http://www.huffingtonpost.ca/2013/09/25/bc-greenhouse-gas-emissions_n_3991140.html; Ellen Post, "British Columbia needs local government innovation to meet its climate targets" (Pembina Institute, September 13, 2013). Available at http://www.pembina.org/blog/749.

Category	Policy Documents	Key Objectives
	BC Building Code	▪ Commercial, institutional and larger residential buildings must meet the ASHRAE 90.1 (2004) standard. (AHSRAE 90.1 (2010) as of December 31, 2010).
Water	BC Living Water Smart Water Act Modernization Project	▪ Reduce water use by 33% by 2020 ▪ 50% of municipal water requirements to be met through conservation by 2020
Waste	The Environmental Management Act (previously Waste Management Act)	▪ Require all Regional Districts prepare and submit solid waste management plans setting out regional waste targets.
	Metro Vancouver Integrated Solid Waste and Resource Management Plan (2010)	▪ Reduce quantity of waste generated per capita within the region to 90% or less of 2010 volumes by 2020 ▪ Increase diversion rate to 70% by 2015 and 80% by 2020. The 70% diversion is divided by sector: ▪ Multi Family 30% ▪ Single Family 65% ▪ ICI 70% ▪ Demo and Construction 80%
Local Planning	***Official Community Plans (OCPs)***	Sets the long-term vision for a community through overarching policies and objectives that apply to land use and development within a defined community area. The OCP can be a powerful decision making tool for municipalities around climate change, energy and water efficiency initiatives as well as waste reduction. Local government may adopt language within their OCPs that set targets with respect to sustainability in the built environment.
	Development Permit Area (DPAs)	Pursuant to the Local Government Act, local municipalities have expanded authority to address climate change through energy and water conservation and reduction of green house gas emissions. DPAs apply to elements that are **exterior** to single`` family, multi-family residential, commercial and industrial developments.
	Local Improvement Area Charges (LICs)	(LIC) provides a financial mechanism to recoup the costs associated with providing capital improvements within a defined area, a site or building. The costs are typically recovered using property taxes to owners that benefit from the improvements being made in the area.

5.2. Rating Systems for Existing Buildings

Third party rating systems have emerged through the private an non-profit sectors as an effective tool to rank or classify the comparative performance of buildings, thereby providing owners/operators with an incentive to improve existing building performance around key criteria such as energy, water and waste. A number of third party rating systems have been initiated in Canada focused specifically on the performance of existing buildings, most notably BOMA BESt and LEED for Existing Buildings (LEED EB:O&M). This section describes each rating system's approach and the implications on building performance improvement.

BOMA BESt is an industry-led third party environmental standard for building operations and maintenance, designed to help building owners and managers benchmark and manage improvements in building performance and environmental management. The rating system offers four levels of certification for a range of building types, including office, shopping centre, light industrial and open air retail, as well as a new module for multi-unit residential buildings (MURBs)[37]. Buildings seeking Level 1 certification must have established a series of 14 existing processes with respect to energy, water, waste, emissions, site, indoor environment and environmental management, but does not require reporting on specific performance measures. Levels 2 through 4 require buildings to provide performance data and all levels of BOMA are third-party verified. This voluntary certification system has seen considerable growth since its initial launch in 2005 with 1,668 buildings certified as of October 2013 and more than 2,900 having participated through certification and recertification since the program's inception.

BOMA BESt takes an inclusive approach, encouraging the participation of all buildings in performance improvement using a points-based system. As such, BOMA BESt does not set minimum performance thresholds, but rather awards a higher number of points for higher levels of performance. A building's environmental performance is based on six key areas of environmental performance and management including:

- Energy
- Water
- Waste Diversion
- Site Enhancement
- Emissions and Effluents
- Indoor Environment
- Environmental Management Systems

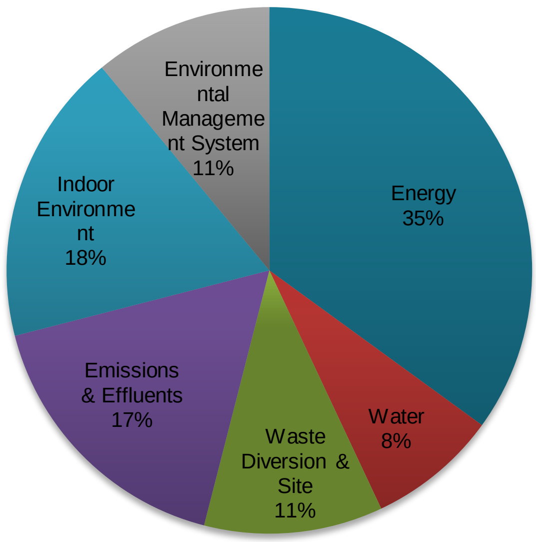

Figure 32: BOMA BESt Credit Breakdown for Office Buildings

BOMA BESt awards points for performance and for meeting certain criteria such as having high efficient lighting or LED exit signs and low-NOx boilers. The framework scores buildings out of 1,000 based on their performance in the six key areas (see **Figure 32** for a breakdown of points under BOMA BESt). A level 2 BOMA BESt building must score between 70 – 79% on the BOMA BESt survey, a level 3 building between 80 – 89% and a level 4 building must achieve a score of 90% or higher. The energy section for Office Buildings in BOMA BESt is worth 35% of total points, with 8% of this directly related to how a building performs. Specifically, buildings can score up to 8% (80 points) for having a low energy usage intensity (i.e., less than 10 ekWh/ft^2/yr). **Figure 33** provides a chart showing the allocation of points associated with a building's energy performance.

[37] Since MURBs have just recently been included in the certification process there are only 6 residential buildings in the data set; most of which were constructed after 2000.

ENERGY PERFORMANCE BENCHMARK SCALE

Office	
Energy Use Intensity	Points
< 36 kWh/ft^2/yr	8
< 32 kWh/ft^2/yr	16
< 28 kWh/ft^2/yr	24
< 24 kWh/ft^2/yr	32
< 20 kWh/ft^2/yr	40
< 18 kWh/ft^2/yr	48
< 16 kWh/ft^2/yr	56
< 14 kWh/ft^2/yr	64
< 12 kWh/ft^2/yr	72
< 10 kWh/ft^2/yr	80

"<" = Less than

Figure 33: BOMA BESt Points for Energy Use Intensity for Office Buildings

Key to the BOMA BESt framework is that certification only remains valid for three years. To foster an orientation towards continual improvement in building performance, buildings are required to recertify after three years and are encouraged to achieve higher levels of performance and certification in the process.

LEED for Existing Buildings Operation and Maintenance (LEED EB:O&M) is similar in its basic structure, offering four levels of certification using a point-based system that covers six aspects of building performance. However, LEED EB:O&M is fundamentally different in that it takes an exclusive approach, rewarding leaders in environmental performance by setting minimum performance requirements in six areas at each level of certification. As such, first-time certification implies that a building is performing at a certain level with respect to energy, waste and water consumption.

5.3. Credit Level Comparison of BOMA BESt and LEED EB:O&M

The findings with respect to BOMA BESt buildings suggest that the process of recertification under that regime can facilitate significant improvements in the building performance of existing buildings. Questions remain, however, as to whether these observations can be extended to other rating systems, specifically LEED EB:O&M, and the degree to which both rating systems align with British Columbia's policy objectives and by extension, those of regional and local governments.

LEED EB:O&M was introduced in Canada in 2009. Thus far, only 7 buildings have certified under that framework in British Columbia; too small a sample to provide any meaningful observations. In the absence of empirical data, the study attempted to extrapolate findings beyond BOMA BESt certified buildings by evaluating the comparability of the two rating systems. The assumption being that if the frameworks are similar then they should yield similar results in terms of building performance.

In attempting to evaluate the equivalency of the two rating systems, a credit-level comparison was conducted for the sections of each rating systems dealing with energy, waste and water. The relative distribution of points for each credit was considered along with the performance requirements for achieving those points and the average uptake of specific points amongst certified projects. The results were limited to some degree by the variance and degree of completeness of the reporting across the two systems. Based on information available, the study assessed whether there was a low, medium or high level of correlation between specific credits in both rating systems.

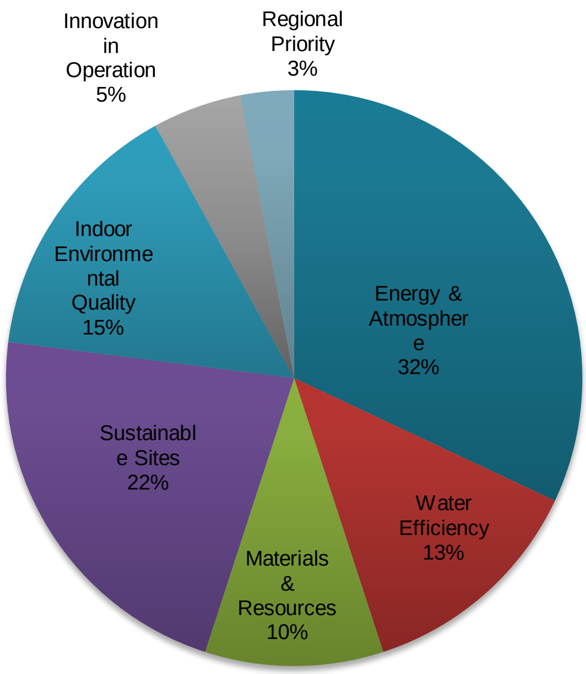

Figure 34: LEED EB:O&M Credit Breakdown

Both frameworks assign approximately the same relative percentages to the three key performance areas. As noted earlier, BOMA BESt awards a maximum of 1,000 points distributed across six areas; 56% covering energy, waste and water (see **Figure 32** above). Points for LEED EB:O&M are distributed in six categories with a maximum of 110 points; 55% covering energy, waste and water (see Figure 34). However, as noted previously, LEED sets minimum performance thresholds, whereas BOMA BESt awards points for difference levels of performance.

Sections pertaining to energy, GHG emissions, water and waste were compared to assess the degree of alignment between the basic credit requirements. Quantifying the potential overall impact of the various credits in terms of energy, GHG emissions, water and waste reduction was beyond the scope of this study. The study also identified the popularity of various credits to gain an understanding of the potential uptake in the voluntary context.

Generally speaking, BOMA BESt and LEED EB:O&M are not comparable. BOMA BESt is highly prescriptive with some focus on performance-based measures. In contrast, LEED EB:O&M is highly performance-based. It is relatively difficult to measure outcomes of prescriptive measures because buildings are a complex combination of interacting systems making it difficult to isolate the performance impacts of specific prescribed measures. By definition, performance based approaches are easier to measure in terms of outcomes. In short, with the exception of certain specific credits, while both rating systems recognize many of the same aspects of building performance, their different approaches make them difficult to compare with each other and in relation to broader policy objectives. A detailed series of charts summarizing the credit-by-credit analysis undertaken are provided in Appendix C. Additional study is required to evaluate the net quantitative impact of specific credits in order to better assess their alignment with policy objectives. Unfortunately, this exercise was beyond the scope of this study. Regardless, it is clear that given the discretion in point and credit selection in the respective systems, it would be necessary to mandate fulfillment of specific points/credits to ensure that the use of either rating system meets environmental targets. Despite data on credit preferences amongst certified buildings, the ability of users to cherry-pick credits makes it impossible to assess with any certainty whether certification will support achievement of broader environmental policy objectives.

The ability to compare rating systems exists at the credit-level with respect to specific practices, if at all. Accordingly, the remainder of this section looks at the comparability of the key performance areas at a credit level under both rating systems.

5.3.1. Energy and GHG Emissions

With respect to energy and GHG emissions, BOMA BESt and LEED EB:O&M show a high degree of comparability in coverage, including environmental management systems, energy auditing, use of renewable energies, and building systems. These credits are also, for the most part, closely aligned with the Province's energy and GHG emission reduction objectives. However, the majority of non-mandatory energy and GHG emission related credits have experienced only low to medium uptake under the current voluntary approach, particularly with respect to buildings certified at lower levels, suggesting that voluntary application of these credits will only provide limited support towards achieving policy objectives.

5.3.2. Water

With respect to water, both rating systems again show a high degree of comparability between them in terms of coverage, including stormwater management, site enhancement practices, water conservation features and requirements for water conservation policies. With the notable exception of requirements to measure water consumption (i.e., metering and annual water audits), alignment with the province's objective of reducing water consumption by 33% by 2020 is not as clear. Requirements to measure water consumption show a high degree of correlation with rating system requirements and strong voluntary uptake by accredited buildings.

5.3.3. Waste

BOMA BESt and LEED EB:O&M have a high degree of commonality with respect to credits dealing with waste reduction, including requiring waste audits and waste reduction programs for ongoing consumables and construction and demolition wastes. However, it is estimated that these requirements would only have moderate impact on helping to achieve the Province's waste diversion targets, in part because a number of credits only require tracking of wastes and provision of storage areas, but do not set diversion targets. Only the credit associated with the recycling of ongoing consumables has received universally strong uptake to date amongst certified buildings.

6. POLICY RECOMMENDATIONS

The study presents a number of unique findings with respect to the performance of BC buildings. This section summarizes the important findings from the sample set of buildings and makes recommendations with respect to building policy development and related issues around building performance for consideration by governments and industry. While the results of this study are tentative, they do point to several conclusions that have implications for the future development of green building policy and the attainment of sustainability targets at the provincial, regional and local levels.

1. Improve access to energy consumption data from utilities

A common challenge for studies of this nature has been the difficulty in obtaining building data. In the case of this study, an inordinate amount of time and effort was expended attempting to access data from utilities and building owners. Similarly, policy makers are hampered in their efforts to develop targeted policy initiatives because of the lack of quality building performance data.

Public access to building data in British Columbia is made difficult by a number of legal and technical barriers, although the exact nature of these barriers is not entirely clear. Provincial privacy legislation and internal corporate policy is the primary reason cited by utilities for not being able to provide building data. Maintaining the privacy protections is an important principle, however the privacy of buildings, building owners and managers can be upheld while still providing utility data in aggregate form or in a way that removes building-specific identifiers. The interpretation and application of privacy law has been inconsistent across and within various utilities depending on the department or individual consulted. Some utilities, such as BC Hydro, did provide aggregate data for this study suggesting that privacy legislation is not a bar to accessing aggregate data or building-specific data in a manner that does not disclose the identification of individual buildings. However, others still cite privacy legislation as the grounds for not being able to release building data at all. In the context of this study, Fortis BC stated that it was unable to release natural gas data on the grounds that it would violate privacy legislation. Fortis BC directed the study team to its online customer portal where account holders can access data. Unfortunately, obtaining account information for each building is too costly and impractical for a study, let alone a municipality.

In addition to privacy issues, there are a number of technical barriers that make access to building data difficult. For example, it is difficult to obtain consolidated data for whole buildings, particularly MURBs. Utility accounts are tied to individual meters and civic addresses, but buildings often contain multiple addresses (e.g., main residential address and unique commercial addresses) and utilities do not appear to have a means of coding accounts so that all accounts associated with a building can be easily grouped together. There also appears to be no clear line of authority within some utilities to authorize the release of building data. These are just some of the technical challenges facing access to aggregate or anonymous building data.

The inability to obtain building performance data is handicapping the efforts of local governments to develop effective building policy. Without having accurate data on how buildings are performing, policy makers are not able to identify which types of buildings require government support and the nature and scope of that support. Municipalities, such as the City of New York, have worked closely with local utilities to devise direct means of importing utility data into Portfolio Manager under its mandatory reporting and disclosure requirements, which is already having a tremendous influence on policy development in this area.[38]

[38] See New York City Local Law 84 Benchmarking Report, note 18 above.

Based on the experience of this study and other research requiring access to building energy consumption data, we make the following recommendations as a starting point to facilitate greater and easier access to aggregate and anonymous building energy consumption data:

- Have the Province provide a legal interpretation on the application of privacy legislation to building data. This would provide utilities and industry associations with greater comfort in the sharing of building utility data.
- Grant an exemption under Provincial privacy legislation for the release of aggregate or anonymous utility data for buildings on public interest grounds.
- Alternatively, consider having utility account holders sign a blanket disclosure granting permission at the time an account is established authorizing sharing of consumption data in aggregate form or without the building being identified. This would facilitate utilities bypassing the privacy issue entirely.
- Create a common codification system to tie accounts to a building to allow for reporting of whole building data.
- Identify one individual within each utility responsible for handing data requests to ensure consistent interpretation and application of privacy legislation and internal corporate policy in handling such requests.
- Work with and learn from the many US jurisdictions who have successfully established electronic methods for utilities to submit building utility data directly to local governments through Portfolio Manager (Chicago, Seattle, Portland, New York, etc.).

2. Mandate and incentivize reporting of building energy, waste and water data.

Having current building consumption data is an essential first step in achieving resource reduction and GHG emission reductions in buildings. The experience of this study reflects that of many other previous efforts, namely, voluntary efforts to obtain data are extremely costly and time consuming and don't achieve the desired results. While local utilities are making efforts to provide building data, emerging best practice points towards placing the onus on building owners to disclose and report building consumption data.

Leading jurisdictions across North America and Europe recognize that any effective strategy for addressing building performance requires an understanding of how buildings are currently performing. In the United States, nine cities and two states have mandated that all buildings (or those meeting a prescribed size threshold) disclose and report building energy data. Generally, building owners submit utility data online to Energy Star Portfolio Manager or retain a third-party consultants to do it for them. In two years, the City of New York has achieved 75% compliance with its disclosure requirements providing a rich database of building energy data.[39] Jurisdictions that have implemented mandatory reporting and disclosure of energy data for buildings are able to focus policy initiatives more effectively and realize significant savings (see e.g., New York City's 2013 benchmarking report).

The City of Vancouver is currently considering the introduction of mandatory disclosure for all buildings. An unprecedented gathering of representatives from jurisdictions across North America that have implemented mandatory disclosure requirements was hosted by the City in 2013. This benchmarking summit provided a unique opportunity for policymakers and practitioners to share their experiences and identify means of improving their programs. Many of the challenges facing implementation were explored, including bundling whole building data, data accuracy, automatic data uploading from utilities, Portfolio Manager's ability to respond to the diversity of building types, and compliance.

[39] See New York City Local Law 84 Benchmarking Report, note 18 above.

For municipalities looking to implement mandatory benchmarking requirements, the greatest challenge is industry resistance. Building owners and managers are most concerned about privacy issues and the additional cost and time required to provide the data. These are valid concerns, but ones that can be addressed with current technologies and best practice. What is important is to provide building owners and managers with ample notice of the pending requirements, stagger implementation of the policy over successive years, guarantee anonymity of building data in any public reporting, and ensure a level playing field for all buildings. Specific recommendations to enable energy benchmarking in British Columbia, include:

- The Province should amend legislation as required to give local governments the authority to require disclosure and reporting of building consumption data.
- Work with utilities and Energy Star Portfolio Manager to facilitate automatic uploading of building data into Portfolio Manager. This is particularly important in the context of stratas and multi-unit residential buildings where each unit is metered separately.
- Work with Assessment BC and utilities to develop a common codification system for grouping addresses tied to a specific building to facilitate whole building reporting.
- Whether under a voluntary or mandatory scheme, consider offering incentives to the poorest performing buildings based on energy usage intensity performance thresholds as a means of fostering higher compliance rates.. Incentives should be subject to the building entering energy data into Portfolio Manager and making it available to the municipality and Province.

3. Mandate and/or incentivize auditing and retro-commissioning of all buildings

Benchmarking building performance through disclosure and reporting of building energy, water and waste data is an important first step in improving existing buildings by raising awareness of the current state of building performance. However, building owners and managers must maintain and upgrade building systems if significant improvements in building performance are to be achieved. Currently, there are no requirements for buildings to maintain or upgrade building systems, except to the extent that they may constitute a threat to public health and safety. For the most part, building maintenance and optimization is market driven to attract and retain tenants.[40]

The study's findings underscore the potential gains that can be achieved through ongoing maintenance and upgrading of building systems. Buildings in the study that underwent recertification showed significant improvements in performance. This was likely attributable to a number of factors, including heightened awareness about a building's environmental performance and potential cost savings through the process of certifying and a desire to improve on that performance and the building's market profile when recertifying.

However, despite the noticeable improvements achieved amongst BOMA BESt recertified buildings, these buildings represent a very small fraction of buildings in the Province. While market forces should encourage building owners and managers to undertake these activities voluntarily, issues such as split incentives and short-term ownership strategies, result in many buildings failing to undertake these measures, or at best, doing them on an ad-hoc, system-specific basis to address urgent problems. Findings for the rest of the buildings in the study support findings from previous studies and reports that buildings are not performing optimally and there is significant room for improvement in building performance. This consistent finding across the literature suggests that a strictly voluntary market-driven approach will be insufficient to achieve the policy

[40] Fortis BC has been offering free energy assessments for medium sized businesses and small industrial/manufacturing operations. See Fortis BC Commercial Energy Assessment Program at http://www.fortisbc.com/NaturalGas/Business/SavingEnergy/CommercialEnergyAssessmentProgram/Pages/default.aspx.

objectives identified by the Province with respect to GHG emission reductions, and energy, waste and water conservation.

A building energy audit allows a building owner or manager to identify the specific source of any underperformance observed through benchmarking. ASHRAE provides three levels of energy with the first level involving a building walk through and high level recommendations.[41] Level 1 audits typically identify major problems. A level 2 energy audit includes payback calculations on all major energy consuming equipment and systems including the building envelope, while a level 3 energy audit includes full scale building energy modelling and simulation using approved modelling software. Retro-commissioning (RCx) is the process of recalibrating or replacing building systems to ensure they are performing optimally. While best practice suggests that building audits should be undertaken annually followed by RCx, jurisdictions that have mandated audits and retro-commissioning (e.g., New York City and Austin, Texas) generally require audits be undertaken every 5 or 10 years. Austin's Energy Conservation Audit and Disclosure (ECAD) Ordinance (2009, revised in 2011) establishes tenant energy disclosure and audit requirements for residential multi-family buildings, as well as benchmarking requirements for commercial buildings. In its first year of implementation (2011), the City of Austin reported that its audit requirement achieved a 53% compliance rate (574 apartment communities comprising 4,309 individual apartment buildings). Audits identified an average rate for duct leakage of approximately 40% evidencing the importance of auditing and RCx.[42] These requirements are also anticipated to generate significant employment opportunities for energy auditors and commissioning agents.

Similar challenges identified for building benchmarking exist with respect to implementing policy on building audits and RCx requirements. Experience points to the need for a level playing field for all buildings and standardized approaches to undertaking audits and reporting findings, as well as an incremental and supportive approach to introducing these approaches to the building sector.

Similar to the recommendations for disclosure and reporting, the study recommends the following steps to advance building auditing and retro-commissioning across the Province:

- Have the Province amend legislation as required to give local governments the authority to require building owners to undertake building energy audits and retro-commission buildings.
- Through the cooperation of the Province, local governments and utilities, begin by augmenting incentives for energy audits of all buildings.
- Introduce graduated requirements for buildings to undergo audits and retro-commissioning. Increase scope of buildings captured over time by size or performance level as determined through mandatory reporting.

4. Consider rating systems at the credit level

As noted in the discussion on green building rating systems in this study (see section 5.2 above), both the Province and local governments across British Columbia have followed a trend initiated in the United States, adopting green rating systems, particularly LEED for New Construction, as part or all of the their green building policy pertaining to new construction. While this approach has raised the profile of green building and engendered greater acceptance of green building principles into the construction process, it has resulted in inconsistent levels of improvement in building

[41] American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), *Procedures for Commercial Building Energy Audits* (2nd ed.). 2011.

[42] Commission on Environmental Cooperation, *Recipes for the Redensification of Cities and the Growth of Green Buildings in North America* (Anticipated publication date 2014). Copy available from Light House.

performance. This, in turn, has resulted in buildings that may or may not meet specific building performance targets set by government.

Many factors contribute to these inconsistent outcomes. One reason is that third party rating systems allow significant discretion in the selection of credits and the credits selected on a project may not yield performance outcomes that accord with policy priorities. Furthermore, while specific credits within both BOMA BESt and LEED EB:O&M are strongly aligned with government targets for GHG emission, energy, waste and water reduction, others are not. In short, as long as building owners and managers have the ability to select the credits or points they wish to pursue with no prerequisites or minimum mandatory requirements, it is not possible to rely on third party rating systems to guarantee a certain level of performance from a building.

In response to this, the City of Vancouver has made a number of optional LEED NC credits mandatory in the context of new construction to ensure that projects are meeting municipal objectives.[43] Specifically, all new construction projects are required to achieve 6 optimized energy performance credits, 1 water efficiency credit, and 1 stormwater credit, all of which would otherwise be optional for a LEED NC project.

Preliminary findings suggest aligning public policy with specific rating system requirements can provide a streamlined approach to achieving desired performance outcomes while also minimizing administrative burdens for municipalities and the building sector. However, regardless whether a jurisdiction is considering the adoption of a rating system for existing buildings, such as BOMA BESt or LEED EB:O&M, or developing its own unique set of requirements and merely looking to align its policy with third-party rating systems, the findings of this study and the experience of many local governments is that consideration of third-party rating system requirements must take place at the *credit level*. Appendix C assesses the degree of alignment between specific BOMA BESt points and LEED EB:O&M credits with Provincial policy objectives. The results show significant variations in the degree of alignment between specific credits and Provincial targets for energy, waste, water and GHG emissions. For example, optional credits/points for optimizing and upgrading HVAC, lighting and other systems under both rating systems are considered to be highly aligned with the Province's objectives to reduce average energy demand per home by 20% by 2020 and energy demand at work by 9% per sq. metre by 2020, whereas credits/points associated with light pollution reduction are not. Therefore, governments considering the incorporation of third-party rating systems into their green building policy framework for existing buildings are best served by taking a credit-level approach.

In considering the adoption of third-party rating systems, governments also need to consider whether the specific aspect of building performance is best served by a performance-based or prescriptive standard. Rating systems offer a combination of performance-based and prescriptive elements which vary across systems. Again, each government must evaluate which approach is appropriate given its unique context.

5. Focus attention and support on Class B and C office buildings and residential buildings

The study's findings highlight the challenge that many governments have in identifying building owners and managers of tier B and C office buildings and residential buildings, and supporting performance improvements amongst these classes of buildings. There have been many barriers to engaging owners and managers of these buildings, including the lack of any public registry of building owners and managers, challenges in providing a convincing business case for improving building performance, high turnover rates in ownership, low energy prices, and the "split incentive" dilemma where tenants bear the costs for tenant improvements and utilities.

[43] City of Vancouver, *Green Buildings Policy for Rezonings* (adopted July 22, 2010). Available at http://former.vancouver.ca/commsvcs/guidelines/G015.pdf.

In addition, local governments are limited by legislation in terms of the type of support they can offer businesses. Specifically, regional governments and municipalities are limited in the type of direct financial incentives they can provide to businesses to support performance improvements (see e.g., section 25.1 of the *Community Charter* with respect to municipal corporations).

The experience compiling data for this study bears out the experience of local governments and industry associations in British Columbia generally, namely, that efforts to address building performance to date have focused on class A and, to a lesser extent, class B buildings. However, the fact is that many class A buildings are already considered high-performing buildings. Furthermore, most are owned by larger property owners or institutional investors that have rigorous operating maintenance programs in place and have received recognition for their efforts under BOMA BESt and LEED EB:O&M. Accordingly, governments, utilities, industry associations and others advocating for efficient buildings need to focus policy initiatives at addressing the performance of class B and C office buildings, as well as residential buildings, many of which are older and managed by smaller entities.

7. Appendix A: Benchmarks

This appendix will set out the various benchmarks referenced in this study and provide a brief summary of their scope and approaches.

NRCAN. National Comprehensive Energy Use Database Query System for Office, Retail and Industrial energy usage intensity values (2012). [44]

Natural Resources Canada conducts an annual survey on energy use in buildings across Canada, the results of this survey are published in the NRCAN Comprehensive Energy Use Database[45]. For commercial buildings, the Database relies on data from the following sources:

- Statistics Canada, *Report on Energy Supply-Demand in Canada, 1990-2010*, Ottawa, 2012.
- Natural Resources Canada, *Commercial/Institutional End-Use Model*, Ottawa, 2012.
- Statistics Canada, *Electric Power Generation, Transmission and Distribution, 2006-2010*, Ottawa, 2012 (Cat. No. 57-202-X).

For residential buildings, the Database relies on the following data sources:

- Statistics Canada, *Report on Energy Supply-Demand in Canada, 1990-2010*, Ottawa, 2012.
- Natural Resources Canada, *Residential End-Use Model*, Ottawa, 2012.

For the purpose of this study, the national and BC and Territories average EUI values were used as primary benchmarks to evaluate building energy performance (see Table 12).

EUI measured in ekWh/m^2/yr	All buildings	Offices	Retail Trade	Accommodation and Food Services	Transportation and Warehousing	Other Services
Canada	406	347	425	622	336	381
Atlantic	306	264	331	464	206	253
Quebec	461	378	467	733	383	428
Ontario	414	353	428	617	358	403
Manitoba	433	375	469	708	339	411
Saskatchewan	494	450	578	661	372	450
Alberta	436	383	486	706	375	383
BC and Territories	**308**	**272**	**294**	**486**	**247**	**306**

Table 12: NRCAN Building Energy Use Intensity Benchmark Values for Commercial and Institutional Buildings (2010)

[44] http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/query_system/querysystem.cfm?attr=0
[45] http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/list.cfm?attr=0

BOMA Canada. BOMA BESt Energy and Environmental Report (2013).[46]

BOMA Canada conducts an annual building performance survey for BOMA BESt certified buildings. The 2013 BOMA BESt Energy and Environment Report (BOMA BEER) analyzed aggregate energy, water and waste data for 455 buildings certified under BOMA BESt levels 2,3, and 4 in 2012. Level 1 certified buildings were not included. BOMA BEER used NRCAN's national average for energy use intensity in evaluating the performance of certified buildings across the country.[47]

NRCAN. Survey of Household Energy Use (2007).[48]

The 2007 Survey of Household Energy Use survey single family homes and multi-unit residential properties on a variety of energy related information, including:

- the use of selected energy-consuming equipment and appliances
- energy-related characteristics of dwellings
- household demographics
- patterns of behaviour related to consumption
- amounts of energy consumed during the reference period

Data on the age and size of the dwelling, dwelling conditions, improvements and types of heating and cooling equipment were also collected. The survey was administered between October 2007 to February 2008 to 9,776 dwellings.

RDH Building Engineering. Energy Consumption and Conservation in Mid and High Rise Residential Buildings in British Columbia (2012). [49]

This study surveyed data for 39 MURBs in Vancouver and Victoria representing approximately 4,400 suites with 4.6 million square feet of gross floor area. The study obtained 10 years of utility data for each building to account for climatic variations, including at least 2-3 years of data post-retrofit.

FRESCo. *Energy Labelling in Multi-Unit Residential Buildings (2013).* [50]

This study evaluated the performance of 41 MURB facilities comprising 52 buildings in Metro Vancouver. The sample included a diverse range of buildings ranging in age (5 to 62 years) and height (low, mid and high rise), as well as low-income and non-profit housing to high-end condominiums and MURBS owned by a single entity and independent unit ownership. Energy Star Portfolio Manager was used to provide normalized site and source EUIs.

REALpac. Water Benchmarking Study (2011).

This study analyzed water utility data for 74 commercial and administrative buildings from across Canada.

New York City Benchmarking Report September 2013[51]

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[46] BOMA Canada, *supra.*
[47] BOMA Canada, *BOMA BESt Energy and Environment Report 2013*. Available at http://www.bomabest.com/wp-content/uploads/BBEER-2013-Full-Report.pdf.
[48] http://oee.nrcan.gc.ca/Publications/statistics/sheu07/index.cfm
[49] http://www.hpo.bc.ca/sites/www.hpo.bc.ca/files/download/Report/MURB-EnergyStudy-Report-Executive-Summary.pdf
[50] Fresco, *supra.*
[51] See New York City, Local Law 84 Benchmarking Report (September 2013) at footnote 18 above.

New York City's Benchmarking Report documents the performance of all buildings in the City over 10,000 sq. ft. under the City's mandatory benchmarking requirements. The 2013 report captured data for 7,505 multi-family, 1,150 office and 1,226 "other" properties. Data was analyzed using Portfolio Manager.

New York City's Benchmarking Report for 2013 was considered in developing the study's methodology. NYC's findings were not used for comparison purposes because of the differences in the report's building stock.

8. Appendix B: Alignment of Third-Party Rating Systems with Policy Objectives

Energy

Indicator	Policy Objectives	BOMA BESt Credit	Points	% of total points	LEED EB:O&M Credit	Points	% of total points	Alignment between BOMA BESt & LEED EB:O&M	Alignment with Policy Objective	BOMA BESt Credit Popularity			LEED EB:O&M Credit Popularity			
										Level 2	Level 3	Level 4	Cert	Silver	Gold	Platinum
Energy & CO2	Reduce GHG emissions by 33% by 2020 from 2007 levels. Reduce GHG emissions by 80% by 2050 from 2007 levels. Make government buildings carbon neutral by 2010	Environmental Management System (Energy conservation policy)	7	0.70%	EAc6: Emissions Reduction Reporting (Annual reporting of GHGs)	1	0.90%	high	high	N/A	N/A	N/A	<33%	<33%	33-66%	>66%
		Public Transportation Cycling Facilities Innovation (Proximity to alternative commuting options, carshare parking, bike parking.)	60	6.00%	SSc4: Alternative Commuting Transportation (Alternative commuting survey).	15	13.64%	high	high	33-66%	>66%	>66%	<33%	33-66%	>66%	>66%
		Green Leases	5	0.50%	N/A	N/A	N/A	low	med	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Renewable Energy (Purchase green power or generate renewables on-site).	12	1.20%	EAc4: On-Site And Off-Site Renewable Energy (Purchase green power or generate renewables on-site).	6	5.50%	high	high	N/A	N/A	N/A	<33%	<33%	<33%	>66%
	Reduce average energy demand per home by 20% by 2020. Reduce the energy demand at work by 9% per sq. metre by 2020	Site enhancement (Outdoor lighting is shielded).	3	0.30%	SSc8: Light pollution reduction.	1	0.90%	high	low	N/A	N/A	N/A	>66%	<33%	33-66%	>66%
		Documented Operating Instructions (Operating instructions manual).	5	0.50%	EAp1: Energy Efficiency Best Management Practices. (Building operating plan).	P	P	high	high	N/A	N/A	N/A	Mandatory			
		Energy Training (Operator energy training).	5	0.50%	EAc2.2: Commissioning: Implementation (Operating training).	2	1.80%	high	med	>66%	>66%	>66%	>66%	33-66%	33-66%	>66%

Indicator	Policy Objectives	BOMA BESt Credit	Points	% of total points	LEED EB:O&M Credit	Points	% of total points	Alignment between BOMA BESt & LEED EB:O&M	Alignment with Policy Objective	BOMA BESt Credit Popularity			LEED EB:O&M Credit Popularity			
										Level 2	Level 3	Level 4	Cert	Silver	Gold	Platinum
		Energy Efficiency Features: Lighting (Upgrade lighting & lighting controls).	26	2.60%	EAc1: Optimize Energy Performance (Energy Star rating above 69).	18	16.40%	high	high	>66%	>66%	>66%	Avg 6 points	Avg 8 points	Avg 11 points	Avg 13 points
		Major HVAC Equipment (Upgrade mechanical equipment: boilers, chillers, vent dampers).	25	2.50%	EAc1: Optimize Energy Performance (Energy Star rating above 69).	18	16.40%	high	high	33-66%	33-66%	>66%	Avg 6 points	Avg 8 points	Avg 11 points	Avg 13 points
		Other Energy Efficiency Systems (VSD, VFD, HRV, economizers on boilers).	8	0.80%	EAc1: Optimize Energy Performance (Energy Star rating above 69).	18	16.40%	high	high	33-66%	33-66%	>66%	Avg 6 points	Avg 8 points	Avg 11 points	Avg 13 points
		Controls (BAS)	11	1.10%	EAc3.1: Building Automation System	1	0.90%	high	high	>66%	>66%	>66%	>66%	33-66%	33-66%	33-66%
		Q1: Energy Audit (ASHRAE Level 1 energy audit).	P	P	EAp1: Energy Efficiency Best Management Practices. (ASHRAE Level 1 energy audit).	P	P	high	med	Mandatory for both rating systems						
		Q2: Energy Management Plan & Reduction Targets.	P	P	EAc2.1: Commissioning: Investigation & Analysis (Retro-commissioning low-cost & capital cost energy efficiency measures).	2	1.80%	high	med	Mandatory			>66%	33-66%	>66%	>66%
		Q14: Environmental Communication With Tenants	P	P	N/A	N/A	N/A	low	low	Mandatory			N/A	N/A	N/A	N/A
		Envelope (Building envelope optimization measures: windows, reflective film, air sealing).	32	3.20%	N/A	N/A	N/A	low	med	>66%	>66%	>66%	N/A	N/A	N/A	N/A
		Financial Resources (Energy efficiency budget).	5	0.50%	N/A	N/A	N/A	low	low	N/A	N/A	N/A	<33%	<33%	med 33-66%	med 33-66%

Indicator	Policy Objectives	BOMA BESt Credit	Points	% of total points	LEED EB:O&M Credit	Points	% of total points	Alignment between BOMA BESt & LEED EB:O&M	Alignment with Policy Objective	BOMA BESt Credit Popularity			LEED EB:O&M Credit Popularity			
										Level 2	Level 3	Level 4	Cert	Silver	Gold	Platinum
		N/A	N/A	N/A	EQp1: Minimum IAQ Performance (Ventilation volumes to meet ASHRAE 62.1-2007).	P	P	low	high	N/A	N/A	N/A	Mandatory			
		N/A	N/A	N/A	EQc1.2: IAQ Best Management Practices: Outdoor Air Delivery Monitoring (Monitor outdoor air delivery via CO2 sensors & BAS monitoring).	1	0.90%	low	med	N/A	N/A	N/A	<33%	>66%	>66%	>66%
		Sub-Metering (Energy sub-metering).	10	1%	EAc3.2 & 3.3: Performance Measurement (Energy sub-metering) Energy sub-metering.	2	1.80%	high	med	33-66%	33-66%	>66%	<33%	<33%	33-66%	>66%
		Maintenance And Commissioning.	33	3.30%	EAc2.3: Ongoing Commissioning.	2	1.80%	high	high	N/A	N/A	N/A	<33%	<33%	33-66%	33-66%
		Environmental Purchasing (HVAC & appliance environmental purchasing).	5	0.50%	MRc2.1: Sustainable Purchasing Policy: Durable Goods - Electric Equipment (Appliance environmental purchasing).	1	0.90%	high	med	N/A	N/A	N/A	>66%	>66%	<33%	>66%

* N/A = Not available.

WATER

Indicator	Policy Objectives	BOMA BESt Credit	Points	% of total points	LEED EB:O&M Credit	Points	% of total points	Alignment between BOMA BESt & LEED EB:O&M	Alignment with Policy Objective	BOMA BESt Credit Popularity			LEED EB:O&M Credit Popularity			
										Level 2	Level 3	Level 4	Cert	Silver	Gold	Platinum
Water	Reduce water use by 33% by 2020 & 50% of new municipal water needs addressed through conservation by 2020	Site Enhancement (Low-impact site & exterior building cleaning).	4	0.40%	SSc2: Building Exterior & Hardscape Management Plan (Low-impact site & exterior building cleaning).	1	0.90%	high	low	N/A	N/A	N/A	<33%	>66%	>66%	>66%
		Site Enhancement (Stormwater management).	3	0.30%	SSc6: Stormwater Quantity Control.	1	0.90%	high	high	N/A	Not Avail	N/A	<33%	<33%	<33%	>66%
		Water Consumption (Measuring water consumption).	30	3%	WEp1: Water Metering And Minimum Indoor Plumbing Fixture & Fitting Efficiency (Annual water audits).	P	P	high	high	>66%	>66%	>66%	Mandatory			
		N/A	N/A	N/A	SSc3: Integrated Pest Management, Erosion Control And Landscape Management Plan (Low-impact landscape management).	1	0.90%	low	low	N/A	N/A	N/A	>66%	>66%	>66%	>66%
		Water Conserving Features (Low-flow plumbing fixtures).	30	3%	WEc2: Additional Plumbing Fixture And Fitting Efficiency (Low-flow plumbing fixtures).	5	4.50%	high	med	33-66%	>66%	>66%	>66%	>66%	33-66%	>66%
		Water Conserving Features (Non-potable water in cooling towers).	3	0.30%	WEc4.2: Cooling Tower Water Management: Non Potable Water Source	1	0.90%	high	med	N/A	N/A	N/A	<33%	<33%	<33%	<33%
		Water Conserving Features (Cooling tower automated controls).	4	0.40%	WEc4.1: Cooling Tower Water Management: Chemical Management	1	0.90%	high	med	N/A	N/A	N/A	<33%	>66%	>66%	<33%
		Q4: Required Water Conservation Policy	P	P	WEc1: Water Performance Measurement (Water sub-meters).	2	1.80%	high	med	>66%	>66%	>66%	>66%	<33%	33-66%	>66%
		Water Conserving Features (Non-potable water for irrigation & high-efficiency equipment).	6	0.60%	WEc3: Water Efficiency Landscaping (Non-potable water for irrigation & high-efficiency equipment).	5	4.50%	high	med	N/A	N/A	N/A	>66%	33-66%	<33%	>66%

WASTE

Indicator	Policy Objectives	BOMA BESt Credit	Points	% of total points	LEED EB:O&M Credit	Points	% of total points	Alignment between BOMA BESt & LEED EB:O&M	Alignment with Policy Objective	BOMA BESt Credit Popularity			LEED EB:O&M Credit Popularity			
										Level 2	Level 3	Level 4	Cert	Silver	Gold	Platinum
Waste	Require Regional Districts to prepare & submit solid waste management plans. Reduce quantity of waste generated per capita within the region to 90% or less of 2010 volumes by 2020. Increase diversion rate to 70% by 2015 and an aspirational target of 80% by 2020. The 70% diversion is divided by sector: Multi family 30%, single family 65%, ICI 70%, and D&C 80%.	Hazardous Materials Survey (Includes management plans).	45	4.50%	MRp2: Solid Waste Management (Appropriate disposal of hazardous waste).	P	P	low	low	Mandatory for both rating systems						
		Q11: Required Hazardous Products Management Plan	P	P	No equivalent credit	N/A	N/A	low	low	Mandatory			N/A	N/A	N/A	N/A
		Recycling, Storing & Handling Recyclable Materials (Waste reduction program & facilities).	25	2.50%	MRp2: Solid Waste Management (Appropriate disposal of hazardous waste).	P	P	high	low	>66%	>66%	>66%	Mandatory			
		Waste Reduction Program (Annual waste audit).	5	0.50%	MRc6: Waste Audit	1	0.90%	high	med	33-66%	>66%	>66%	>66%	>66%	>66%	>66%
		Waste Reduction Program (Ongoing waste monitoring).	15	1.50%	MRc7: Solid Waste Management: Ongoing Consumables	1	0.90%	high	med	>66%	>66%	>66%	>66%	>66%	>66%	>66%
		No equivalent credit	N/A	N/A	SSc3: Integrated Pest Management, Erosion Control And Landscape Management Plan (Landscape waste tracking).	1	0.90%	low	med	N/A	N/A	N/A	>66%	>66%	>66%	>66%
		Recycling, Storing & Handling Recyclable Materials (Composting).	5	0.50%	MRc7: Solid Waste Management: Ongoing Consumables	1	0.90%	low	med	33-66%	33-66%	>66%	>66%	>66%	>66%	>66%
		Q7: Construction Renovation And Demolition Waste	P	P	MRc9: Solid Waste Management: Facility Alterations & Additions (Plan & tracking).	1	0.90%	high	low	Mandatory			>66%	<33%	<33%	33-66%

* N/A = Not available.