2014 GCS Project Report

Energy Benchmarking

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Executive Summary

Energy benchmarking is the process of quantifying and recording energy consumption data from building operations. The overarching aim of an energy benchmarking initiative is to allow for performance comparisons. Governments and utilities can use benchmarking information to inform targeted policy and program development facilitating energy use reductions. Energy benchmarking can also catalyze owner action, and measure impacts of policy and programs. Mandated annual reporting of energy benchmarking data is becoming common practice in the USA. In ten US cities, building owners are required to energy benchmark their buildings with EPA's Portfolio Manager software and report benchmarking data back to the City.

The City of Vancouver is considering the role energy benchmarking of large commercial and institutional buildings could play in supporting energy reductions targeted in existing policy.

Looking first to their own buildings, a portfolio consisting of 112 City owned and operated buildings has been benchmarked in Portfolio Manager. These buildings cover the range of use types including offices, community centres, and service buildings, among others. The building characteristics were determined through consultation with City staff. The building performance data includes energy consumption from January 2010 to April 2014.

This initial benchmarking process has been used to identify potential difficulties for a city-wide benchmarking initiative. Challenges encountered and lessons learned have been identified in this document. Examples include methods of obtaining data and data reliability as well as challenges associated with multi-use or multi-building properties.

An investigation of the sensitivity of Energy Star Score (1-100 normalized rating) to input parameters was performed to determine the need to collect detailed building use information such as hours of operations and occupant density. The results showed that the Energy Star Score can vary by over 50 points if real operation characteristics are considered in place of default values. Investigation in to the impact of parking data alone showed Energy Star Score variance of up to 13 points (i.e. when not entered into Portfolio Manager while present in real operation).

The current version of Portfolio Manager is limited to providing Energy Star Scores for Offices, K-12 Schools, and Hospitals only. Of those building types only offices apply to the City of Vancouver Portfolio which limits the Energy Star Score availability to 5 buildings. The remaining buildings are compared based on energy use intensity. Future versions of the program will provide Energy Star Scores for additional building types including upcoming additions for Food Retail.

The City of Vancouver Energy Benchmarking portfolio has been updated and used to improve the City's understanding of benchmarking needs. The potential for future expansion of the portfolio and additional investigation in to energy efficiency of City owned and operated buildings have been identified herein.

1   Introduction

1.1   Energy Benchmarking

Energy benchmarking is the process of documenting and comparing the energy consumption of a building or group of buildings [1]. This can be performed for a single building to allow for comparison of historical energy performance or performance against similar buildings within the same portfolio, externally against other buildings, or against national metrics. Energy benchmarking allows for building owners to identify highest and lowest energy performers to improve resource allocation for energy retrofit projects, and to quantify outcomes of those retrofits. It can be used on the local, regional, or national scale to allow for normalized comparisons of building energy consumption to develop targeted energy improvement incentives.

A number of US cities have implemented energy benchmarking legislation to track the energy consumption of public and private buildings. The size and type of buildings required to be benchmarked as well as the disclosure policy varies by city. A summary of current benchmarking legislation is provided in Table 1 (modified from the Institute for Market Transformation [2]). The largest dataset of benchmarked buildings is in New York City with over 26,000 buildings benchmarked in 2012 [3]. The City of Vancouver is investigating opportunities for energy benchmarking of commercial and residential buildings. Energy Benchmarking is listed as a primary action within the Existing Building Retrofit Strategy, established to support the Greenest City Action Plan. Energy benchmarking would allow for quantification and comparison of the energy consumption of large buildings within Vancouver and assist in developing future policy and programs to address the GCAP target to "Reduce energy use and greenhouse gas emissions in existing buildings by 20% over 2007 levels" [4]. The chosen benchmarking software is the USEPA Energy Star Portfolio Manager.

Table 1: Current Energy Benchmarking Initiatives. Modified from the Institute for Market Transformation [2]

		Legislation		Building Type and Size			Diclosure	
		Jurisdiction	Enacted	Municipal	Commercial	Multifamily	To Gov't	On Public Website
Cities		Austin	Nov 2008	All	> 10k SF	Audits	Y	N
		Boston	May 2013	All	> 35k SF	35+ units or >35k SF	Y	Y
		Chicago	Sept 2013	> 50k SF	> 50k SF	> 50k SF	Y	Y
		District of Columbia	July 2008	> 10k SF	> 50k SF	> 50k SF	Y	Y
		Minneapolis	Jan 2013	> 25k SF	> 50k SF		Y	Y
		New York City	Dec 2009	> 10k SF	> 50k SF	> 50k SF	Y	Y
		Philadelphia	June 2012	> 50k SF	> 50k SF		Y	Y
		San Francisco	Feb 2011	> 10k SF	> 10k SF		Y	Y
		Seattle	Jan 2010	> 20k SF	> 20k SF	> 20k SF	Y	N
		Vancouver	TBD	TBD	TBD	TBD	TBD	TBD
County		Montgomery County, MD	Apr 2014	All	> 50k SF	-	Y	Y
State		California	Oct 2007	All	> 5k SF	-	Y	N
		Washington	May 2009	> 10k SF	> 10k SF	-	N	N

The objective of the Greenest City Scholar Energy Benchmarking project is to assist the City of Vancouver Sustainability group in understanding and developing an energy benchmarking program for Vancouver. The project includes:

- Gathering, compiling, and verifying energy benchmarking data for select city buildings including occupancy, floor area, use type, and electricity, natural gas and water usage as required for Portfolio Manager.
- An investigation of the energy management tools currently used by the City's facility management team and recommendations for how these can be augmented by the use of Portfolio Manager's benchmarking capabilities.
- Documenting a process for updating the City's energy benchmarking portfolio and estimations of the time required to maintain proper benchmarking information.
- Assisting the Sustainability Group staff in developing the framework required to set-up a citywide energy benchmarking program.

This report will provide details of the project outcome and deliverables including:

- An updated energy benchmarking building portfolio (to April 2014) for 112 City of Vancouver owned buildings.
- Process details for the procedures required to obtain benchmarking data from City documents and databases, and methods for portfolio upkeep.
- A comparison of the impact of select building characteristics on the Energy Star Score and variability in performance comparisons with choice of energy metric.
- Recommendations on how Portfolio Manager can complement the City's (and other owner's) existing energy management tools.
- Analysis of the energy performance of City owned buildings.
- Lessons learned from development of the City of Vancouver's energy benchmarking portfolio.

1.2 City of Vancouver Building Portfolio

A summary of the City of Vancouver building portfolio is shown in Figure 1. The City of Vancouver's building portfolio consists of 533 buildings of which 56 are over 50,000ft^2. The benchmarking effort to date consists of 112 buildings of which 31 are over 50,000ft^2. The benchmarked buildings represent 56% of the floor area of City of Vancouver owned building stock. Those buildings greater than 50,000ft^2 not currently included in the benchmarking program are buildings leased out to other users by the City for which energy data is not available within the City of Vancouver organization. A list of all buildings in the City of Vancouver Benchmarking Portfolio can be found in Appendix A.

A breakdown of the number of buildings by type currently benchmarked is provided in Figure 2. The largest group is classified as Other – Recreation and consists of Community Centres and Swimming Pools. Other large groupings of buildings owned by the City include Fire Stations, Libraries, and Multifamily Housing units. The decade of construction of buildings in the Energy Benchmarking portfolio is shown in Figure 3. The majority of buildings were constructed after 1970 with the median year of construction being 1976.

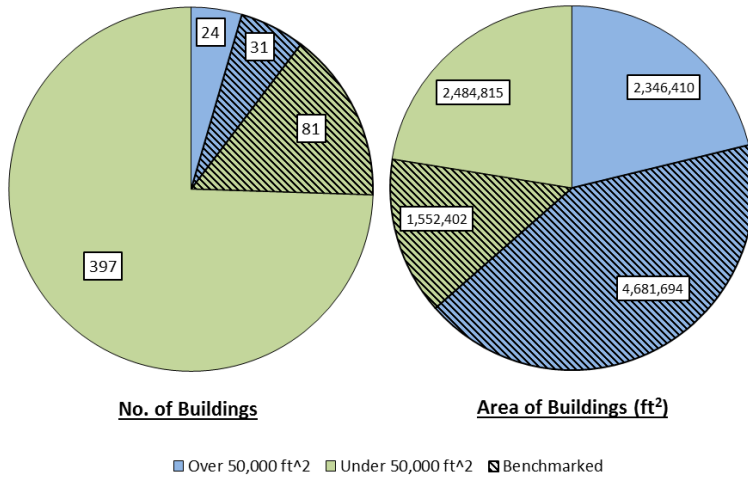**Legend:** ☐ Over 50,000 ft^2   ☐ Under 50,000 ft^2   ☒ Benchmarked

Figure 1: Summary of City of Vancouver owned building stock
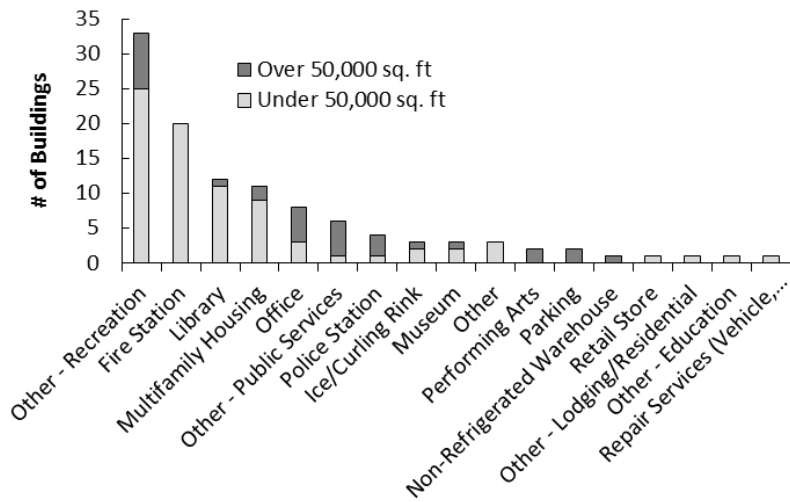

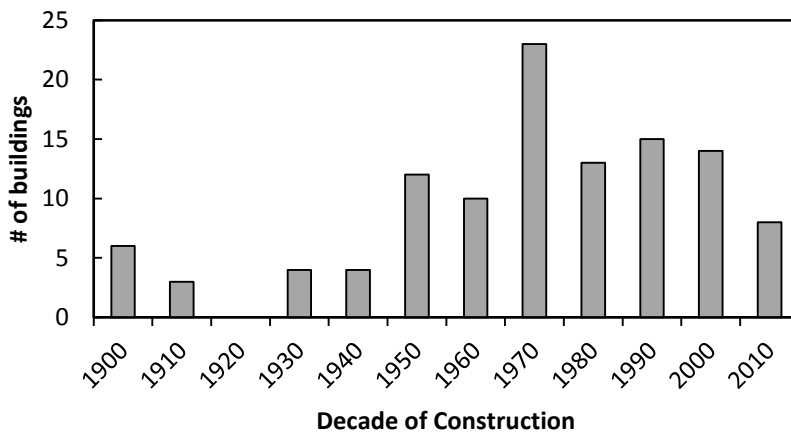**Figure 2: City of Vancouver Energy Benchmarking portfolio building types**

Figure 3: Age of buildings in City of Vancouver Energy Benchmarking Portfolio

2   Developing the Energy Benchmarking Portfolio

The Energy Benchmarking Portfolio requires information regarding building use. The details for how this information has been obtained and how it can be obtained for new buildings is provided in Section 2.1. The Portfolio will need to be maintained and added to in order to reflect changes in operation. This will include adding new Properties (Section 2.2) and updating energy use information (Appendix B). Details of these procedures are provided for reference in the sections below.

2.1   Methods for Determining Benchmarking Information

2.1.1   Building Use Details

Gross Floor Area: The Total Gross floor area and floor area of each Use Type within a building (ie offices, retail, etc.) is required to determine energy performance. The floor area is determined for each building based on the data contained in the Ameresco Facilities database as determined by site inspection. The building floor area can otherwise be determined by architectural floor plans when available.

Computer Counts: Computer counts are required for most building types to determine the Energy Star Score. The number of computers in the City of Vancouver buildings is maintained by the IT department and has been used directly to populate the portfolio.

Occupancy: The number of occupants in the buildings is accounted for through the Number of Workers on Main Shift detail in Portfolio Manager and is required to receive an Energy Star Score. For offices this value has been assumed equal to the number of computers in the space. For all other building types this has been determined by contacting the building managers directly. Other automated methods were attempted but found to be unsuccessful such as: employee phone lists, security and emergency response data, and payroll services.

Operating Hours: The operation hours for each building were determined based on IT services data or by review of operating hours posted on the internet when appropriate (ie. Library and Community Centre hours).

Other Use Detail Information: A number of building types require additional use details such as the Number of Bedrooms in Multifamily Housing. This information is highly variable between properties and was determined by contacting the building managers.

2.1.2   Energy Use

The building energy use data is determined from the City of Vancouver's Ameresco Energy database. The energy data is determined from billing information and is currently only available for buildings for which the City pays for the utilities. Data is provided for each utility meter and is aggregated for properties that contain multiple meters. Energy use data is provided for Electricity, Natural Gas, Biomethane, and Steam data depending on the building connections.

Energy use information must be updated periodically to keep the energy benchmarking current. The energy (electricity, natural gas, steam, or biomethane) use is extracted from monthly utility bills. The data is determined for each calendar month by interpolating between utility bill cycles and is therefore subject to change until approximately 3 months after the designated calendar month. A detailed procedure for future updates to the City of Vancouver Energy Use data is provided in Appendix B.

2.1.3   Water Use

Water meter data is in the process of being transferred to the City of Vancouver's Ameresco Energy database. Water meter data can be imported in a manner similar to energy meter data.

2.2   Adding a new property

Buildings can be added to the existing building portfolio in two ways; manually adding individual buildings, or adding multiple buildings at once using spreadsheet uploads. A description of the steps required to add buildings in each manner is provided in Appendix C.

2.3   Energy Benchmarking How-To Guides

As part of each of the benchmarking initiatives set up by cities in the U.S. (see Table 1) a How-To Guide has been created to guide the user through the reporting process. Examples of these guides can be found for Boston [6], Seattle [9] and San Francisco [10], among others. A review of these guides from the user perspective has identified a number of key characteristics that are present in successful How-To benchmarking guides and often absent from those guides found to be more difficult to navigate.

Key sections include:

Introduction: providing background on energy benchmarking and why it is required in that city.

Get Started: providing an overview of the data required to benchmark and how it can be obtained.

Adding utility data: providing details of how the user can add consumption data to Portfolio Manager and (if available) instructions for connecting to utilities to allow for automatic consumption updates.

Connecting/sharing with the city: providing instructions on how the energy benchmarking data should be reported.

Frequently Asked Questions: to supplement the online Portfolio Manager Frequently Asked Questions and to clarify issues specific to the city's benchmarking efforts.

3   Challenges and Lessons Learned

A number of challenges were encountered while developing the City of Vancouver Energy Benchmarking portfolio. These challenges are likely to be present during energy benchmarking efforts for other building owners and operators and are documented in the sections below.

3.1   Data Availability

The biggest challenge encountered during this project was the availability of data required to complete the portfolio. The main building characteristics; energy use and building area were readily available from existing facilities management databases. There is no central repository at the City of Vancouver that contains all data required to complete the Property Use Details section of energy benchmarking portfolio. This data includes occupancy, number of computers, laundry connections, etc. The best practice developed to obtain this information was to contact the building manager for each of the buildings to obtain the required information.

Similar challenges are expected to be present during benchmarking of private buildings when being performed by offsite personnel. Obtaining data relies upon knowledge and accuracy of

numerous parties and is subject to error and estimation that can impact the final portfolio accuracy.

3.2   Data Accuracy

Data accuracy has been identified as a challenge for other energy benchmarking efforts [3] and has also factored in to the development of the City of Vancouver portfolio. The most critical data for which to ensure accuracy is the building energy consumption and floor area as these form the basis of the benchmarking comparison. The additional Property Use Details (eg. # Workers on Main Shift) are used in the normalization of the energy use data when providing the Energy Star Score. The Energy Star Score is not currently available for all building types and is not a direct indication of energy consumption. Therefore, though accuracy of all building details is encouraged, the main emphasis should be on energy use and building area.

Data accuracy has been ensured for the energy consumption by use of the City of Vancouver's existing energy consumption database. Comparison of energy metrics from the final Portfolio Manager reporting of historic data was performed against previous reports by the City of Vancouver. The floor area has recently been confirmed and updated in the City's database through site visits. Data accuracy can be confirmed for private buildings during future energy benchmarking submissions by performing auditing and through third party verification of energy consumption with the local utility and floor area through building surveys.

3.3   Property Use Types

When adding a property in Portfolio Manager the Primary Property Use Type is selected to identify what the user believes is the buildings main function. Additional Property Use Types can also be added to better reflect the actual use of the building (eg. a multiunit residence with main floor retail space). Each Property Use Type has specific details associated with its function, such as Hours of Operation, that should be included for a complete property description. These details are used by Portfolio Manager when calculating the Energy Star Score. If they are not input correctly this could have an impact on the comparison of property performance. This is investigated in more detail in Section 5.

If multiple properties are being added using the sequential spreadsheet upload templates described in Section 0 the Property Use Details will need to be added manually to each property type as they are not accounted for in the templates. If property use details are not included Portfolio Manager will use default values based on Property Type and Gross Floor Area when required to perform internal calculations.

3.4   Alternative Fuel Sources

One City of Vancouver building utilizes biomethane to meet heating needs in place of Natural Gas. This fuel source is added in Portfolio Manager as a utility meter with Energy Type: Other. Portfolio Manager does not yet have the capabilities of including any biofuels other than wood as a building energy source. Although the use of biomethane can be considered a sustainable method of heating a building, this improvement over natural gas use is not captured or rewarded in the metrics provided by Portfolio Manager. The reason for this is that the building energy performance (the amount of energy use required to operate the building on site) remains the same even though biomethane is being used (eg. the same amount of heating energy is required). Fuel switching from natural gas to biomethane does not lower the building energy demand in the same manner as other building improvements such as increased insulation.

Though it can result in a reduction of net greenhouse gas emissions in the province it is not captured within portfolio manager.

3.5 Comparison of Building Types without Energy Star Score

The Energy Star Score is a heavily normalized building comparison feature unique to Portfolio Manager that allows for a comparison of building energy performance within a category of buildings against the national building stock peer group [5]. In Canada the Energy Star Score is currently available for only three building types: Offices, K-12 schools, and Hospitals. For other use types a different method of comparison is required within Canada. An Energy Star Score will be released in the fall for Food Retail.

The next most normalized comparison metric is the Weather Normalized Energy Use Intensity (EUI). EUI is the typical method of normalizing energy use to allow for comparison between buildings. EUI is defined as the Energy Use divided by the Floor Area and is used to compare buildings of different sizes. Weather normalization compares the property energy use while accounting (and normalizing) for differences in weather between years over which energy data has been provided in Portfolio Manager. Since the weather normalization uses weather data that the actual building has experienced it provides a good comparison for the individual building's performance year-over-year. The Weather Normalized EUI can be used to compare energy performance when the Energy Star Score is not available. When using Weather Normalized data for comparing building performance it is important to realize that this data is **not** normalized across different climates and therefore should not be used to compare energy use for buildings in different cities. The only climate normalization in Portfolio Manager occurs using the Energy Star Score.

3.6 Challenging Building Types

Energy Star Portfolio Manager has over 80 property types to select from when creating a new property. This allows for the majority of buildings to be placed in an appropriate peer group category. However, a number of challenges have been found when attempting to benchmark buildings in the City of Vancouver portfolio.

3.6.1 Parking Structures

The City owns a number of parking structures, two of which have been entered in to Portfolio Manager. These are properties that have a primary purpose of providing parking but have additional areas that are used for office space that account for less than 20% of the total area. Parking structures pose a challenge for Portfolio Manager as Parking is not typically considered to be part of the main property for energy analysis. The EUI of the property in Portfolio Manager is calculated using the area of the Property Use Types that are not for parking. As such the EUI for properties that are predominantly Parking would be calculated as higher than the actual EUI because of the use of the smaller (building only) area. Additionally, the Energy Star Score is calculated by subtracting a theoretical energy use associated with the parking structure from the total property energy use. More details regarding the impact of parking on the Energy Star Score of the City of Vancouver Offices are provided Section 5.4.

The City of Boston details an EPA recommended process for including Parking Garages or properties with the primary purpose of providing parking [6]. The City of Vancouver Parking Garages have been added in Portfolio Manager using this process. The Parking portion of these properties is added with the Building Use Type of Other and assigned a Gross Floor Area equal to the area used for parking. No additional Parking Property Use Types are added. This method

ensures that the floor area and energy use of the parking are both included to calculate the property EUI.

3.6.2 Multi-building Properties

When creating a property in Portfolio Manager the user is required to specify how many physical buildings are contained on the property. The available options are None (the property is part of a structure), One, or More than one. If energy use data is available for the single standalone building or the component of a building then the property can be added using one of the first two options. If the property consists of multiple buildings and/or multiple meter configurations the set-up is more complex.

The City of Vancouver has a number of Multi-building Properties in different configurations. Many properties consist of multiple buildings that share one or more meters. These buildings must be included as a Multi-building Property to accurately account for energy use. An example of this type of property is the VanDusen Gardens which consists of both garden and visitor facilities. The Multi-property buildings account for the number of buildings on the property and the floor area associated with each use type under the Property Use Details. This accounts for the overall energy use and energy use intensity of the property as a whole but does not allow for any analysis of the individual sub properties.

Portfolio Manager can also account for Multi-building properties by combining single building properties (that are metered individually) as "Child Properties" into a "Campus". Though this is a common configuration for building owners (such as universities) the City of Vancouver does not have any Campuses in its portfolio. If future property additions include campuses the Portfolio Manager "How to benchmark a Campus in portfolio Manager" document [7] should be consulted for detailed instructions to link meters and building attributes between the Campus and Child properties appropriately.

Energy benchmarking of multi-building properties has been addressed by other cities to account for unique property, lot, and meter configurations. This can include requiring estimation of energy apportionment. An example of methods that campuses and multi-building properties have been addressed by a city can be found in The Boston Energy Reporting How-To Guide [6].

3.6.3 Buildings with Multiple Uses

A large number of buildings contain a mix of use types within the same structure that may or may not have separate utility meters. A common example of this is an office building that has commercial or retail space on the ground floor. If no single use accounts for over 50% of the floor area the building is classified as a Mixed-Use property by Portfolio Manager. If one of the Use Types accounts for more than 50% of the area then the property is classified by that Use Type by the EPA.

A number of the City of Vancouver properties have multiple uses where one type accounts for more than 50% of the floor area. Portfolio Manager will calculate an Energy Star Score (where possible) based on an averaging of the use types but cautions that common configurations (ie an office building with a small ground floor bank) will be provided with a more accurate score if the building is classified only with the single dominant use type [5]. This is because the Energy Star Score is determined by comparison with real buildings of single use types which does not differentiate between single use buildings and mixed buildings that are dominated by the majority use. The multiple uses have been included in the City of Vancouver portfolio as this is the preferred approach from the standpoint of building energy management.

4 Integration with Existing Energy Management Practices

4.1 Existing energy management software

The City of Vancouver currently uses Ameresco Asset Planner to compile building and energy use data. AssetPlanner is an energy monitoring software with similar features to numerous other software packages available from other providers. The energy use database is populated from monthly utility bills and allows for monitoring of the actual energy consumption of buildings owned and occupied by the City of Vancouver throughout the building life. An example of the data output from AssetPlanner is shown in Figure 4.
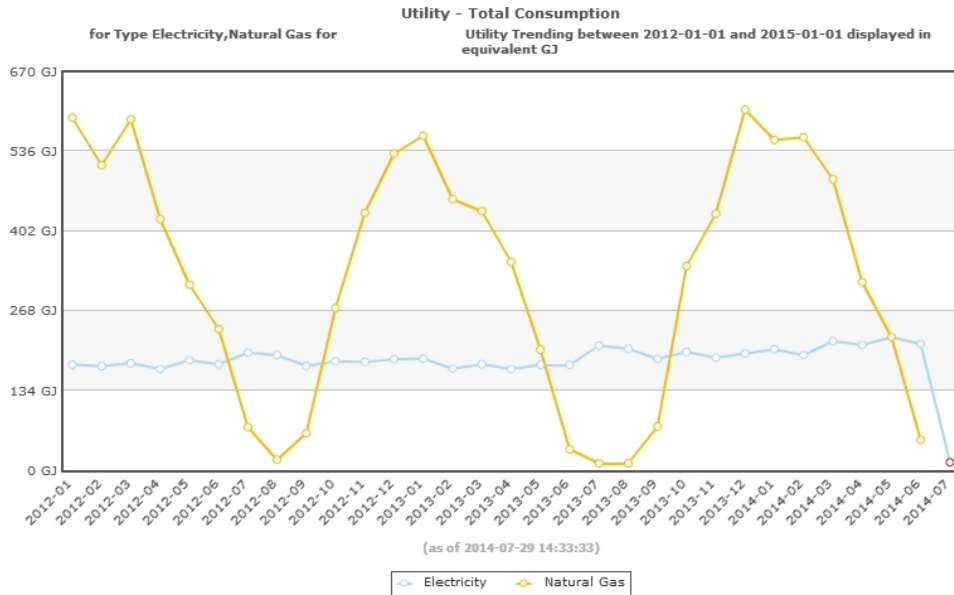
Figure 4: Typical Ameresco AssetPlanner utility data output

The monthly utility data can then be used to compare historical energy consumption trends to identify anomalies in building operation. This data is also aggregated by the City of Vancouver to provide an annual reporting of energy use intensity and greenhouse gas emissions from the buildings to target retrofits and improvements to the buildings with the highest EUI.

For near real-time monitoring the City of Vancouver also utilizes the Pulse Energy dashboard for a number of its buildings. This data visualization tool uses energy meter data to provide reporting on energy consumption. The data provided from the Pulse Energy platform allows for analysis of intraday energy trends and identification of trouble energy consumption. An example of the output data from the Pulse Energy system for a City of Vancouver building is shown in Figure 5.

Figure 5: Sample energy use output from Pulse Energy platform

4.2 Integration of Portfolio Manager

4.2.1 Benefits to Building Managers

Portfolio Manager can be used to supplement the existing energy management practices at the City of Vancouver and for other building owners with similar systems. One of the key features of Portfolio Manager that can be used to enha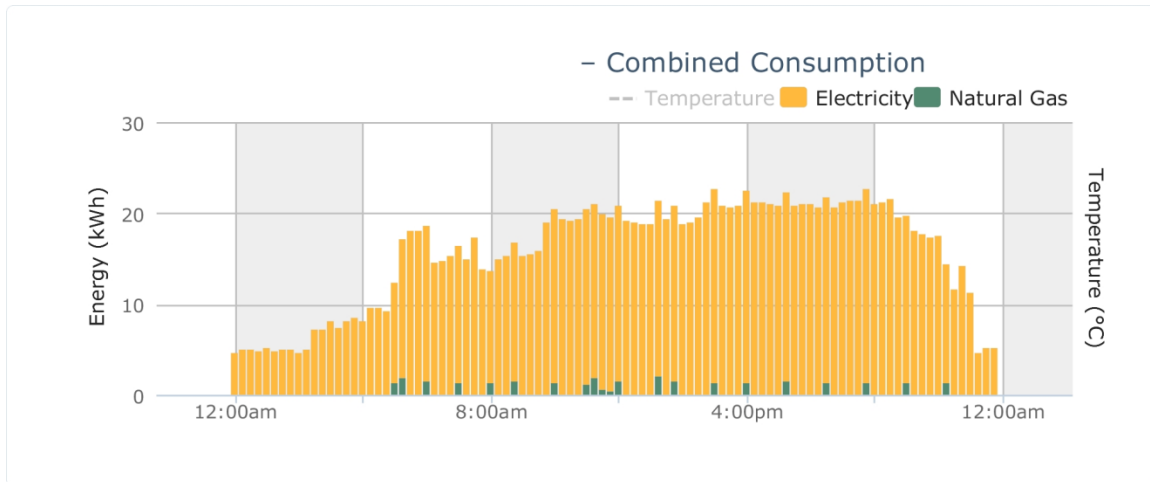nce existing practices is the additional energy normalization not available within other software packages. Normalization of building energy use against various metrics such as occupancy, hours of operation, and weather conditions can be used to inform the building energy management and to potentially explain energy use anomalies.

The Energy Star Score is the most heavily normalized metric within Portfolio Manager. This allows for a normalized comparison of the building performance with other buildings of similar type within Canada. The score normalizes with respect to varying climate and accounts for the Property Use Details that the EPA has identified as being important to building operation. The other primary default normalization metric provided in Portfolio Manager is the Weather Normalized Energy Use Intensity. Details of the limitations of using Weather Normalized data have been discussed in Section 3.5.

The data collected to populate the Property Use Details in Portfolio Manager can also be used to provide custom normalization metrics that are not available in other software. These details are used to calculate the Energy Star Score but can also be used individually or in combination with other factors by the building manager. Potentially useful normalization metrics for the building user include Number of Office Workers, Hours of Operation, or Number of Living Units.

There are a number of reporting and planning features within Portfolio Manager that can aid in managing building energy use beyond the provision of energy use comparisons. Examples of these features include:

- Setting energy efficiency targets and tracking process and goal achievements
- Reporting energy use trends through standard and custom reporting templates
- Tracking energy efficiency projects, expenditures, and achievements

4.2.2 Software Integration

The largest time commitment associated with the use of Portfolio Manager is the need to continuously update the energy consumption data. This can be done by manually uploading data to Portfolio Manager or through the spreadsheet upload templates provided in the software. Portfolio Manager has an associated API developed to allow for data transfer and upload automatically [8]. This API has been used by utilities in cities requiring benchmarking to reduce the time burden on building owners through automatically updating energy consumption data directly from the utility provider [9, 10]. Additionally, energy monitoring providers such as Ameresco or Pulse Energy can develop the required programming and interface to allow for data exchange to ease integration of Portfolio Manager.

5 Comparison of Portfolio Manager Energy Data

5.1 Analysis of City of Vancouver Portfolio

The Portfolio Manager Energy Benchmarking data has been used to perform a preliminary analysis of City of Vancouver owned building stock. The analysis has been limited to the 2013 calendar year and used to provide an indication of overall portfolio performance, compare between building types, and highlight potential for individual building analysis. The data provided is a sample of the potential of the benchmarking method. Analyses of significantly greater depth and detail are possible with the existing data.

The total site energy consumption (primary and secondary) and GHG source emissions are shown in Figure 6 for the three main sources of building energy in the city. The total energy consumption and GHG emissions of the buildings benchmarked in Portfolio Manager are 637 TJ and 17,912 tons eCO_2 per year, respectively. The greenhouse gas emissions have been determined using the Ministry of Environment's Best Practice Methodology [15] rather than the Portfolio Manager calculations to allow for comparison with other provincial organizations.
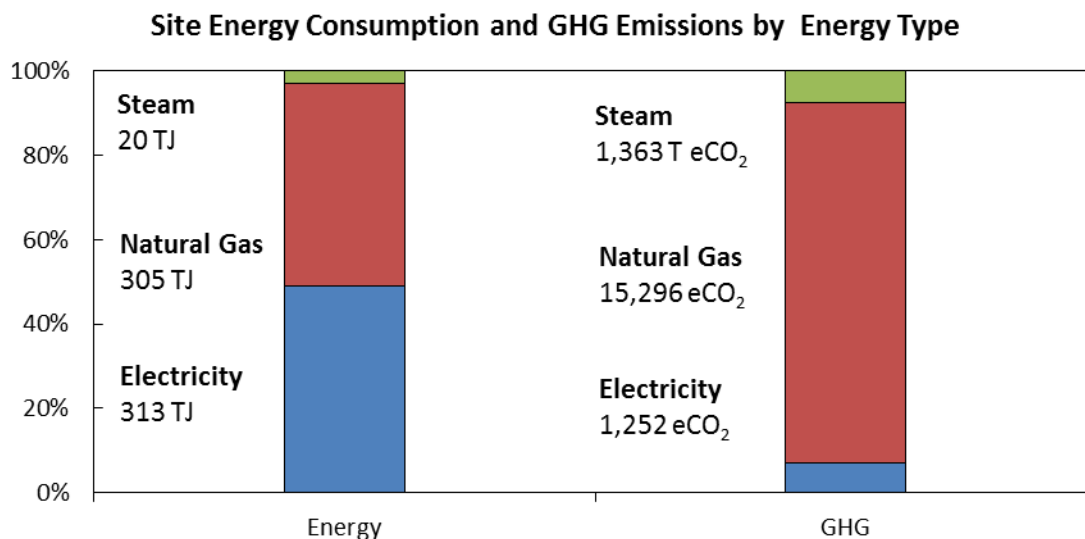

Figure 6: City of Vancouver building portfolio energy consumption and GHG emissions by energy type

The site energy use is comprised of approximately equal amounts of electricity (49%) and natural gas (48%) with a small contribution from district steam (3%). The natural gas consumption on

site is used primarily as a heating source for the HVAC and domestic water systems. The electricity is utilized for lighting, operations, and the HVAC system.

Though electricity and natural gas account for approximately equal fractions of the onsite energy use the GHG emissions from the buildings in this study are dominated by burning of natural gas; 85%. The remaining 13% is approximately evenly split between emissions from electricity and district steam sources. The disparity in contributions to the GHG emissions is due to the low emissions factor associated with electricity because of the heavy reliance on hydroelectric generation stations in British Columbia.

The average EUI of each property type is shown in Figure 7. EUI is the typical method used to compare buildings but it has limitations due to a number of factors that it does account for including weather, climate, occupancy, and operating hours.

Average Site EUI by Operation Type (ekWh/m^2)
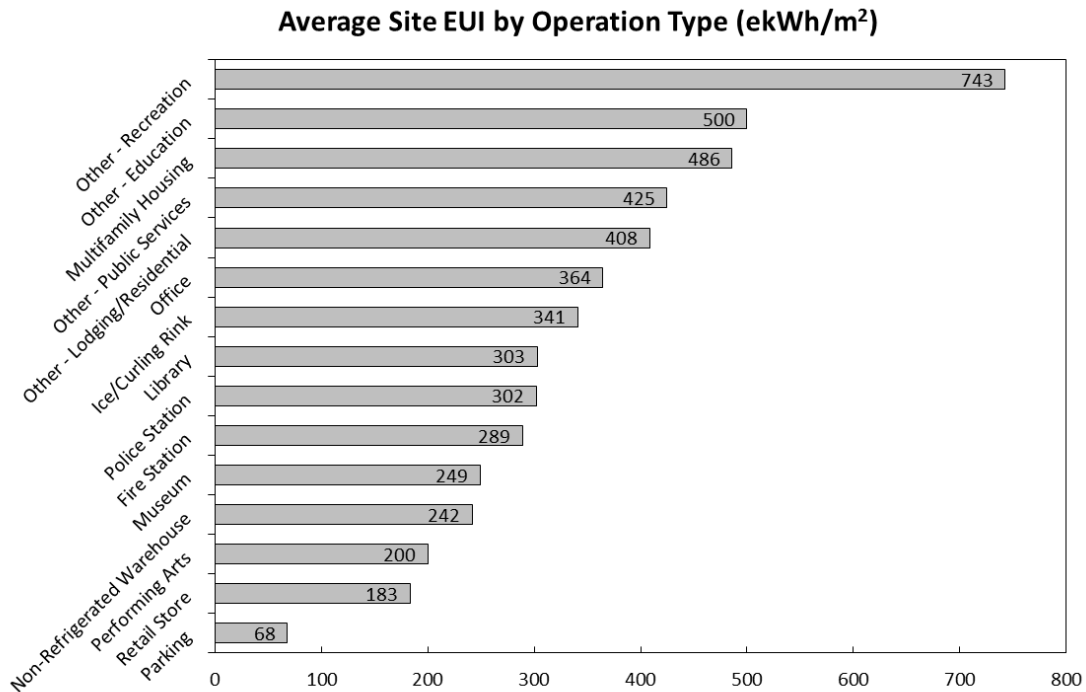
Figure 7: Average annual site energy use intensity by Operation Type (ekWh/m2)

A comparison of the EUI by property Type shows that Recreation buildings utilize a disproportionate amount of energy for the size of the building. The EUI is high for this property type because it includes swimming pools and other facilities that use significant amounts of heating and space conditioning to meet operational requirements. At the lower end of the EUI scale are buildings that are often used for low intensity applications, those with large footprints or intermittent operating hours such as Parking, Retail, and Performing Arts properties. High energy intensity building types should be the focus of retrofit programs in order to achieve maximum energy reduction benefits.

Use of the average EUI of a property type can provide an indication of the relative energy efficiency of a group of buildings but does not indicate which specific buildings consume the most energy. Figure 8 shows the annual EUI of each of the 20 Fire Halls in Vancouver. The average EUI of all of the Fire Halls is 288 ekWh/m^2. Comparing the EUI of each individual Fire

Hall shows that there is a wide range of energy use. The Fire Hall with the lowest EUI (Fire Hall #15) uses only 38% as much energy per square foot as the most energy intense Fire Hall (#18). This can be explained in part by the age and technology in the respective buildings and serves as an example of how the benchmarking data can be used to further focus improvements in energy use for specific buildings.
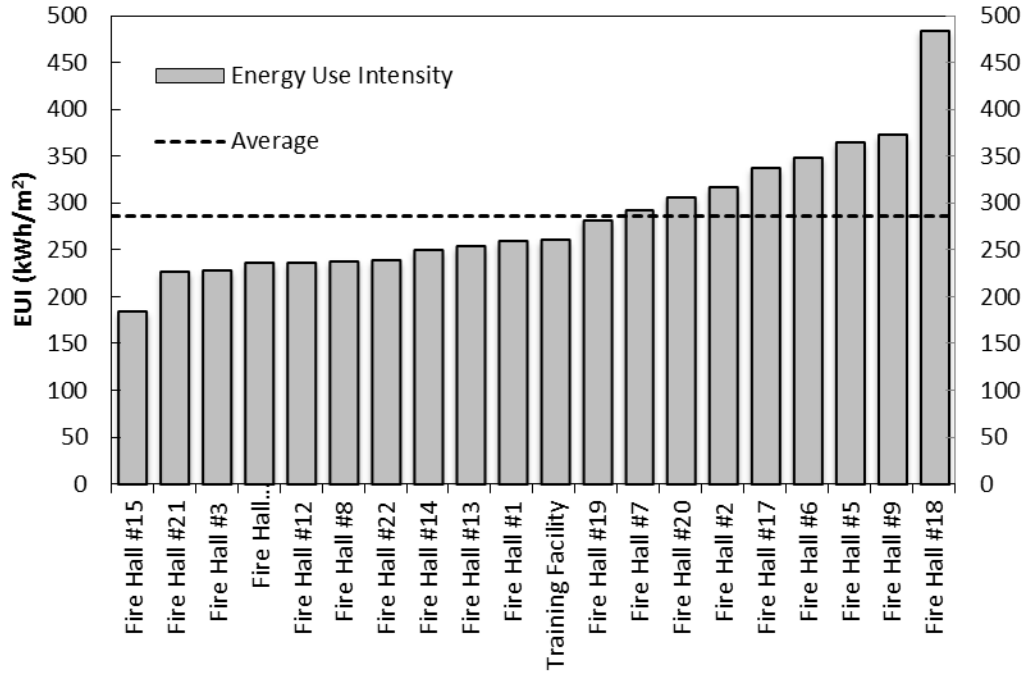
Figure 8: Annual average EUI of each of the 20 Fire Halls in the City of Vancouver

5.2   Comparison of Portfolio Manager Performance Metrics

Property performance can be determined in Portfolio Manager based on a number of metrics. In developing a benchmarking program it is important to choose the appropriate metric for comparison to achieve the desired result. A comparison of the ranking outcome of Office buildings has been performed to understand how the choice of metric can impact which buildings are deemed the best or worst performers. Ideally the choice of metric would not impact the comparison of building performance and the benchmarking program could use any of the available performance metrics. The metrics investigated for this purpose include Energy Star Score, Site EUI, Electricity EUI, Natural Gas EUI, and Total GHG Emissions Intensity. Numerous other related metrics have been investigated and found to be heavily correlated to those in Table 2 and are therefore accurately represented. An example of this is Site EUI being an accurate representation of Source EUI, and Weather Normalized Site or Source EUI. The buildings used for this comparison are shown in Table 2 along with the respective performance measurements and ranking. A rank of 1 indicates the best performer.

Table 2: Office energy performance metrics

		City Hall	City Hall - West	450-458 West Broadway	312 Main St	311 Building
ENERGY STAR Score	Value	74	100	31	35	94
	Rank	3	1	5	4	2
Site EUI (GJ/m²)	Value	0.9	0.5	1.2	1.1	1.2
	Rank	2	1	4	3	5
Electricity EUI (kWh/m²)	Value	143.7	110.8	129.3	150.0	168.8
	Rank	3	1	2	4	5
NG EUI (ekWh/m²)	Value	1.4	15.9	204.8	156.2	166.6
	Rank	1	2	5	3	4
Total GHG Emissions Intensity (kgCO2e/m²)	Value	19	7	41	33	36
	Rank	2	1	5	3	4
Building Area (m²)		20,692	11,428	4,843	9,617	1,115
Parking Area (m²)		3,138	4,723	0	5,667	0
Computer Density (#/m²)		2.5	4.5	2.1	2.2	15.6
Weekly Operating Hours		45	45	45	45	45
Occupant Density (#/m²)		2.5	4.5	2.1	2.5	15.6

Figure 9 shows a visual representation of the ranking of office buildings (represented by the lines) when compared using each performance metric (x-axis). If all performance metrics ranked the buildings in the same manner the figure would show only straight horizontal lines. Any instance of a line crossing in the figure shows when the ranking order changes from one metric to the next.
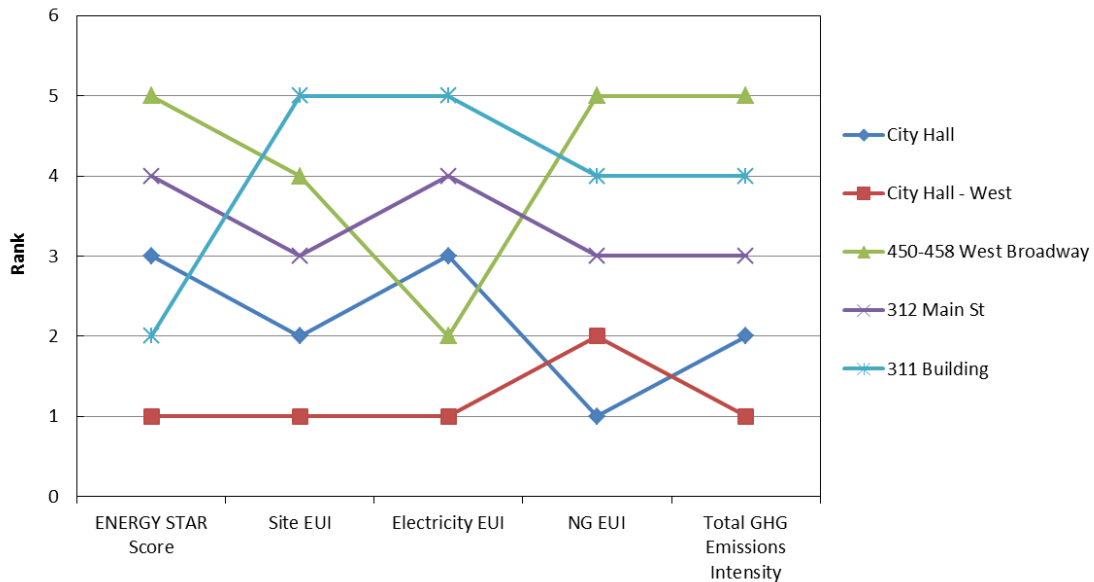

Figure 9: Office ranking by performance metric

The comparison of performance metrics has identified that the relative building ranking and performance can be impacted by the chosen metric. The ranking based on Energy Star Score,

Site EUI, and Electricity EUI show no change for the top ranked (City Hall – West) but does have some variability for the intermediate buildings. The performance changes significantly when using Natural Gas EUI as the comparison method as City Hall uses the least Natural Gas (due to biomethane substitute). The Total GHG Emissions performance also varies significantly from the Energy Star Score, Site EUI, and Electricity EUI performance when comparing between buildings because of the heavy weighting on natural gas emissions.

The use of Office buildings as a case study to investigate the impact of choosing different performance metrics has shown that there can be significant variability. The Energy Star Score allows for a comparison of the building performance as a whole and is in line with Site EUI and Electricity EUI for Offices because electricity accounts for a large fraction of the total energy consumption in these building types. The relative evaluation and ranking of the buildings changes if Natural Gas EUI or Total GHG Emissions Intensity is the chosen metric.

This variation in performance comparison can have a significant impact on the outcome of a benchmarking program and is important to consider for future work. If the goal of the program is to achieve overall reductions in building energy performance then Energy Star Score and Site EUI are ideal metrics for comparison. Electricity or Natural Gas EUI are better suited if the comparison and performance evaluation is to be energy source specific. If the goal of the benchmarking program is to reduce GHG emissions then the appropriate performance metric would be the GHG emissions intensity or natural gas EUI in the Vancouver context as natural gas accounts for significantly greater emissions per gigajoule of site energy (49.99 kgCO_2e/GJ versus 4 kgCO_2e/GJ [15]).

5.3   Impact of Property Use Detail Data on Office Energy Star Score

As the Energy Star Score is dependent on the Property Use information, including correct data is important for an accurate comparison. Portfolio Manager allows for default data to be used where no real data is available for some Property Use information. The degree to which this information affects the Energy Star Score is an important factor that will be investigated using the City of Vancouver office buildings as a case study. This will aid in determining the value of the additional requirements necessary to determine the optional Property Use data. The investigation has been limited to a comparison of default to real values and not a range of potential values for parameters as this is outside the scope of this study. A wide array of potential values for Property Use details exists between real buildings.

The optional Property Use data investigated for Office buildings is Weekly Operating Hours, Number of Computers, and Number of Workers on Main Shift. The default values as determined by Portfolio Manager and the real values for City of Vancouver Offices are shown in Table 3. The most significant variability occurs for Computers and Occupants mainly due to the substantially higher than default values (625% and 520%) reported for the 311 Building. Hours of Operation for each of the City offices is 31% less than the Portfolio Manager default values.

Table 3: Portfolio Manager Default Property Data (based on building type and area) and real data for City of Vancouver Office Buildings

		City Hall	City Hall - West	450-458 W Broadway	311 Building
	Floor Area (m^2)	20692	11428	4843	1115
Default Values	Computers	615	206	104	24
	Occupants	708	237	120	28
	Hours	65	65	65	65
	Energy Star Score	78	97	43	6
Real Values	Computers	658	512	101	174
	Occupants	658	512	101	174
	Hours	45	45	45	45
	Energy Star Score	74	100	31	94

The difference in Energy Star Score as computed using scenarios of real values versus default values is shown in Figure 10. The Energy Star Score using default values is shown in parentheses beside the building name. In the majority of instances there is only a small change in Energy Star Score for the buildings studied. The major outlier is the 311 Call Centre Building which shows a significant increase (improvement) in Energy Star Score when the real values are used instead of the Portfolio Manager default values. This is due to the significantly higher than default Occupant and Computer density in the building.
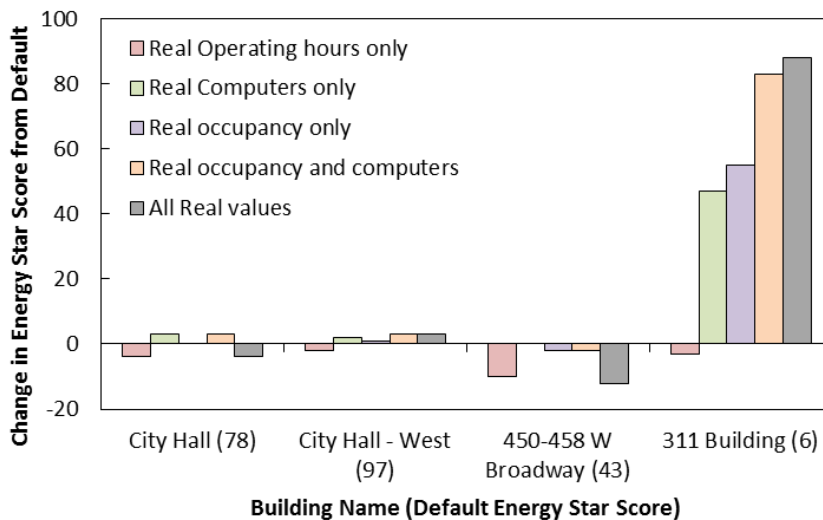
Figure 10: Change in Energy Star Score for use of real versus default Portfolio Manager parameters

If a building has lower than default computer density, occupancy, or operating hours the Energy Star Score will decrease when real values are input. Excluding the significant difference from the 311 Building (large positive outliers) the changes in Energy Star Score are greater when the building operates with lower than normal occupancy or computer density. The difference in Energy Star Score are not linear and are also dependent on building size as evident from the

different reductions in Energy Star Score between each office for the same change in building operating hours.

The Energy Star Score can be significantly influenced by the Building Use parameters. If the intension of a benchmarking effort is to compare Energy Star Scores every effort should be made to determine the real values instead of using the Portfolio Manager default values. Since the Property Use details do not impact the energy intensity calculations for the property, the actual energy performance comparison (weather normalized or otherwise) will not be impacted. If the benchmarking initiative will be using actual energy consumption or energy use intensity for comparisons then the Property Use Details are not significant in for inclusion in the process. As the Property Use Details can be difficult to obtain by building owners that lease the space it may be a challenging parameter to obtain and even more difficult to confirm by the City.

5.4   Impact of Parking Lots on Office Energy Star Score

A common feature of many properties is a parking structure or parking lot. Parking can have an impact on the energy use of the associated building through the provision of lighting, ventilation, and heating. To provide a fair comparison of building energy efficiency for the main property type, Portfolio Manager subtracts the energy consumption of the parking from the building energy consumption before calculating the Energy Star Score. Portfolio Manager determines an assumed energy consumption for the parking structure based on the design and size. A detailed description of this methodology is provided in the Portfolio Manager Technical Reference "Parking and the ENERGY STAR Score in the United States and Canada" [18].

An analysis of the impact of including parking structures to Office buildings in the City of Vancouver portfolio is shown in Figure 11. The original data provided did not include building parking and was used to calculate the Energy Star Score without parking. After further investigation the actual parking details were found and added which allowed for the Energy Star Score with parking to be calculated. The results are presented in Figure 11 as the change in Energy Star Score from that calculated with parking versus that without. The Energy Star Score with parking (real building score) is shown in parentheses beside the Building ID. The buildings chosen for analysis are limited to Office buildings as this is the only building type in the City of Vancouver Portfolio for which Energy Star Scores are available. Details of the base building parameters are provided in Table 4.
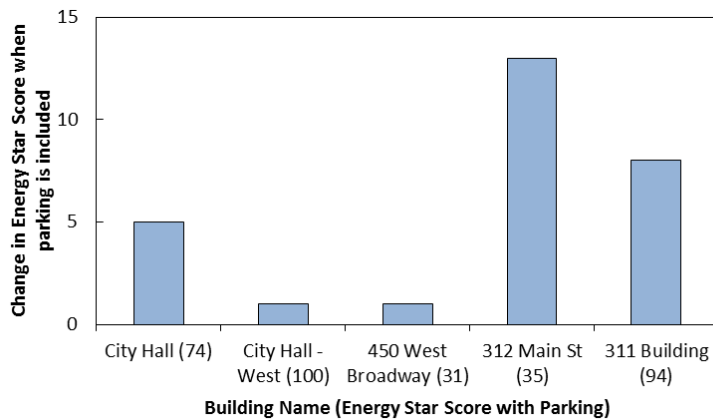

Figure 11: Impact of parking lots on Energy Star Score in Office Buildings

Table 4: Building details

	City Hall	City Hall - West	450 West Broadway	312 Main St	311 Building
Office - Number of Computers	658	512	101	207.02	174
Office - Number of Workers on Main Shift	658	512	101	238.08	174
Office - Weekly Operating Hours	45	45	45	45	45
Property Floor Area (Building(s)) (m²)	20692	11428	4843	9617	1115
Open Parking Area (m2)	4838	0	570	0	4373
Enclosed Parking Area (m2)	3138	4723	0	5667	0
Parking - Supplemental Heating	Yes	Yes	N/A	Yes	N/A
Site EUI (GJ/m²)	0.85	0.46	1.2	1.1	1.21
ENERGY STAR Score (w parking)	74	100	31	35	94
ENERGY STAR Score (w/o parking)	69	99	30	22	86

The results in Figure 11 show that the provision of parking can have a large impact on the building Energy Star Score. Parking increases the Energy Star Score for all buildings. The largest increase in Energy Star Score in this study is 13 for the 312 Main St when a heated enclosed parking structure is included. Parking has minimal impact on City Hall - West because of the high Energy Star Score and limited room for improvement. 450 West Broadway also shows minimal change when parking is included because it is comprised of a small area of open surface parking.

Adding Open Parking has a minimal impact on the Energy Star Score of the property because the lighting energy intensity is low and is assumed to operate for only 16 hrs per day. Partially Enclosed Parking adds more to the Energy Star Score due to the assumed provision of lighting with twice the density for 24hr per day. Changing from Partially Enclosed to Fully Enclosed parking is not as significant an increase as from Open to Partially Enclosed because the additional ventilation energy is only ~27% of the lighting energy intensity. Finally, adding heating to Enclosed Parking adds minimally to the score because Portfolio Manager assumes that the structure is only heated to 40deg F which limits the heating days significantly for Vancouver's climate.

The addition of Parking to Office buildings can play a significant role in the property Energy Star Score and should be carefully accounted for in the property setup. If parking exists on the property and contributes to the metered energy use but is not accounted for in the building use details the property's Energy Star Score will be artificially low. If the Parking has separate utility meters and does not add to the metered building energy consumption it should not be included in the Portfolio Manager Property file.

5.5   Portfolio Manager 50th Percentile Performance

Portfolio Manager determines the Energy Star rating based on a comparison with the National Median Energy Consumption. A score of 50 means the building performs as the median of the peer group. A score of 75 means it performs better than 75% of the buildings.

The actual value of energy intensity associated with the Energy Star Score for each building type is **not** determined by a comparison with other buildings in Portfolio Manager but is rather determined based on national building surveys. In the United States the data is from Commercial Building Energy Consumption Survey (CBECS) [13]. In Canada the data is determined from the Survey on Commercial and Institutional Energy Use (SCIEU) [11] and is not influenced by building performance data from the United States (with the exception of Data Centres, and Water and Wastewater Treatment Facilities).

The City of Vancouver utilizes building type designation for internal energy performance analyses that are different from the building types used in Portfolio Manager. A summary of the normalized energy use intensity for City of Vancouver Building types with reference to the associated Portfolio Manager Building Type can be seen in Appendix D. A complete list of median Energy Use Intensity for each property type in Portfolio Manager is provided by the EPA [14].

6   Recommendations

6.1   Potential Improvement to Portfolio Manager

Through the exercise of benchmarking and maintaining the City of Vancouver building energy portfolio during this project a number of areas for potential improvement to Portfolio Manager have been identified. The following changes can improve usability, functionality, and benefits to building owners, operators, and energy managers:

- Provision of individual building performance reporting and visualization along with the existing features that aggregate into groups by building type to improve usefulness to building managers.
- Adding Monthly energy use trends on individual properties pages along with the existing annual energy use trends would allow for Portfolio Manager to have an increased usefulness for energy managers.
- The inclusion of Property Use Details as additional normalizing metrics to compare within and between groups (ie EUI per operating hours, water use per residence, etc.) can add value to the internal Portfolio Manager reporting that is not available through any other software.
- Improved navigation tools within Portfolio Manager such as a Master navigation bar or a "Next" property button can improve the ease of moving through the building portfolio.

6.2   Recommendations for Benchmarking with Portfolio Manager

Energy Use Data: The energy use data for benchmarking purposes should be uploaded a minimum of three months after the date of interest (ie. Upload and report in April for the previous year of energy data) due to the delay in updating energy use information from utility bills. This will ensure accurate data is transferred and stored in Portfolio Manager.

Collection of Property Use Details: The Property Use Details (ie operating hours) can significantly affect building comparisons (Section 5.3) the information should be included in the benchmarking effort. The City would benefit from collecting this data from the project outset

and performing a comparison of the building EUI and Energy Star Score to compare accuracy of information with a larger sample set than was available from the City buildings.

Parking Data: Parking data can have a significant impact on the Energy Star Score of a property and should be included in the benchmarking process. Separately metered parking energy use would allow for improved accuracy of the building specific energy consumption by preventing the need for predictions of the energy associated with the parking structure.

Benchmarking Parkades: Advocating for modification to the Portfolio Manager building type "Parking" to allow for calculation of energy metrics applicable to parking structures will allow for more accurate benchmarking of parking facilities in the City of Vancouver.

Buildings with Multiple Uses: In light of the limited number of building types eligible for an Energy Star Score in Canada the City of Vancouver should collect details on all major building use types within a given property as it will not impact the energy comparison based on the primary use type but can provide reasons for potential differences in energy efficiency between buildings that seem to have equivalent purposes (ie. Include data on ground floor retail in a building dominated by office use).

Performance metrics: The choice of performance metric can have a significant impact on ranking and performance evaluation in a benchmarking program. The Energy Star Score provides the best indication of building performance compared to the national median but is available only for limited property types. The City benchmarking would be best served by tracking Energy Star Score but using both Site (or Source) EUI and GHG Emissions Intensity to ensure that the outcomes of the benchmarking program can address the targets of both energy use and GHG emissions.

7 Future Work

The City of Vancouver energy benchmarking portfolio has been updated with all available information for the buildings identified for inclusion in the initial study. There exists information that was not available to complete the portfolio which will be described below. Additionally, the Energy Benchmarking study to date has identified a number of areas for potential future investigation to further inform the development of the City of Vancouver's Energy Benchmarking initiative.

7.1 Addition of Water Data

The City of Vancouver is currently in the process of integrating water meter data into the Ameresco AssetPlanner database. Mapping of the water meters to the City of Vancouver buildings has not been completed which limits the number of buildings for which water data is available. Where the data is available for buildings it has been added to Portfolio Manager. This encompasses 51 properties and water meter data between Jan 2010 to Dec 2013. The water use data can be added for the remaining properties as the information becomes available.

7.2 Addition of parking area

Parking areas have been shown to be an important factor in determining a property's Energy Star Score. The existing AssetPlanner database used by the City of Vancouver is missing parking garage/lot information for most of the properties. When parking information was available in AssetPlanner it was included in the Portfolio Manager. Additionally, parking information has been determined for the office buildings in Portfolio Manager to ensure that an Energy Star

Score can be calculated. As parking information becomes available it should be added to Portfolio Manager

7.3 Tenant Occupied Buildings

The majority of buildings currently benchmarked in the City of Vancouver Portfolio are owned and occupied by the City. The City therefore has access to the required benchmarking information such as Property Use Details and utility data. The majority of City of Vancouver buildings that have not been benchmarked are those which the City owns but that are occupied by tenants. Tenant occupied buildings are common and will occur in Portfolios of other building owners. The City of Vancouver is interested in identifying means of accessing data for tenant occupied buildings to determine the steps required and any potential roadblocks.

One potential method for accessing this data is to request information from the tenant directly. This may be a feasible method for single tenant occupied buildings but can be cumbersome for multitenant buildings such as large office buildings or multiunit residences. The Property Use details can either be estimated using default values in Portfolio Manager or from the building owner's records if available. For larger multitenant buildings the potential exists for accessing aggregated energy use data from the utilities directly in order to reduce the demands on the individual tenants. Details of methodology and difficulties associated with accessing utility data directly from the provider will be investigated in the future with cooperation from BC Hydro.

7.4 Comparison of Smart tool and Portfolio Manager Reporting Details

SMARTTool is a GHG emissions reporting tool used to help organizations meet GHG reductions targets. The City of Vancouver Energy Benchmarking team is interested in how the emissions reporting metrics of Portfolio Manager and SMARTTool compare and how these can be used to complement each other for potential data exchange. A future investigation of the potential for integration of the two tools is planned that will help to inform Vancouver's Energy benchmarking plan.

7.5 Analysis of Building Energy Performance within City of Vancouver Building Types

Now that the energy benchmarking is completed for the City of Vancouver owned and operated buildings the potential exists to compare energy efficiency between buildings. This can be performed to highlight the largest relative consumers within an individual group, such as the office buildings, to inform potential methodologies for energy reduction or to identify reasons for the performance outliers.

8 References

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[3] The City of New York. "New York City Local Law 84 Benchmarking Report September 2013". <http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/ll84_year_two_report.pdf>

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[14] EPA. "Technical Reference – Canadian Energy Use Intensity by Property Type". Available online:

<https://portfoliomanager.energystar.gov/pdf/reference/Canadian%20National%20Median%20Table.pdf>

[15] Ministry of Environment. 2013 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions". Available Online: <http://www.env.gov.bc.ca/cas/mitigation/pdfs/BC-Best-Practices-Methodology-for-Quantifying-Greenhouse-Gas-Emissions.pdf>

9 Appendix A

Property Name	Primary Property Type	Property Floor Area (m²)	Year Built
(1064) Orpheum Theatre	Performing Arts	11,071	2009
(1086) Queen Elizabeth Theatre	Performing Arts	27,833	2010
(1295) Hillcrest Community Centre	Other - Recreation	16,087	2009
(1469) Trout Lake Community Centre	Other - Recreation	6,578	2011
(1562B) Kerrisdale Cyclone Taylor Arena	Ice/Curling Rink	5,306	1930
(1562A) Kerrisdale Community Centre	Other - Recreation	6,986	1950
(1821) Killarney Community Centre	Other - Recreation	10,089	1999
(1872A) Manitoba Yards (exclude Transfer station)	Other - Public Services	20,895	1966
(1872B) South Transfer Station include Recycling Depot	Other - Public Services	6,661	2008
(2041) New Continental and The Gathering Place	Multifamily Housing	7,472	1992
(2130) 281 Industrial Ave	Other - Public Services	5,095	1942
(3421) City Hall - Main Building	Office	20,692	1936
(4698) Central Library and Library Square	Library	40,224	1995
(5939) Museum of Vancouver and Planetarium	Museum	16,586	2004
(6108) City Hall - West Annex (Vancity Building)	Office	11,428	1976
(6461) Evans Yard	Other - Public Services	5,738	1994
(6503) VPD - Cambie Building	Police Station	7,990	1993
(6882) West End Community Centre	Other - Recreation	7,070	1976
(7100) Roundhouse Community Arts and Recreational Centre	Other - Recreation	10,994	1990
(7475) 2780 E Broadway - East Van Bottle Depot	Non-Refrigerated Warehouse	9,624	1950
(7557) VPD - Police Tact Training C and Storage	Police Station	12,839	2011
(7588) VPD - Police Intelligence Services	Office	6,039	2011

|			
(7693) Mt Pleasant Community Center	Other - Recreation	5,054	2009
(7858) National Yards	Other - Public Services	16,098	2004
(8635) Vancouver Aquatic Centre	Other - Recreation	6,020	1970
(9435) Kingsway Continental	Multifamily Housing	6,875	1962
(8222) VPD - 3585 Graveley && 1570 Kootenay	Police Station	39,324	1999
(1052) 450-458 West Broadway	Office	4,843	1947
(4837) Evelyne Saller Centre	Other - Recreation	836	1986
(1553) Dunbar Community Centre	Other - Recreation	4,540	1957
(1899) Renfrew Community Centre	Other - Recreation	4,337	1960
(3254) Roddan Lodge	Multifamily Housing	4,011	1977
(8456) Creekside Community Centre	Other - Recreation	4,181	2010
(1246A) Kitsilano Rink	Ice/Curling Rink	3,716	1975
(3210) Champlain Heights Community Centre	Other - Recreation	2,675	1980
(3252) Central Residence	Multifamily Housing	3,619	1978
(1393) Carnegie Community Centre	Other - Recreation	3,530	1903
(4384) Hastings Community Centre	Other - Recreation	3,525	1980
(1880) Old Continental	Multifamily Housing	3,380	1911
(3612) Oppenheimer Lodge	Multifamily Housing	3,353	1974
(1377) 2151 Burrard St	Retail Store	2,323	1964
(1310) Marpole Oakridge Community Centre	Other - Recreation	3,182	1985
(1246B) Kitsilano Community Centre excl Rink	Other - Recreation	3,140	1950
(1337) Kensington Community Centre	Other - Recreation	2,928	1980
(7904) Granville Residence	Multifamily Housing	3,039	1919
(3230) Fire Hall #1	Fire Station	2,926	1973
(1150) West Point Grey Community Centre	Other - Recreation	2,974	1909
(2126) 240 Northern St	Other - Lodging/Residential	648	1961
(3610) Antoinette Lodge	Multifamily Housing	2,574	1977
(1305) VanDusen Gardens	Other - Education	4,596	2010

(7872) Ray-Cam Community Centre	Other - Recreation	2,926	1988
(4496) False Creek Community Centre	Other - Recreation	2,568	1991
(1346) Sunset Rink	Ice/Curling Rink	3,693	1970
(1547) Kitsilano Pool	Other - Recreation	840	1970
(1759) 312 Main St - Public Safety Building	Office	9,617	1954
(4328) 151 W Cordova St (VFS && EasyPark)	Parking	29,819	2003
(7817) 311 Building - 1800 Spyglass Pl	Office	1,115	1989
(3229) Fire Hall #2	Fire Station	717	1975
(3232) Fire Hall #3	Fire Station	851	2000
(4483) Fire Hall #4	Fire Station	2,123	1992
(3325) Fire Hall #5	Fire Station	626	1949
(3224) Fire Hall #6	Fire Station	754	1907
(3226) Fire Hall #7	Fire Station	830	1973
(3228) Fire Hall #8	Fire Station	715	1974
(3236) Fire Hall #9	Fire Station	697	1959
(1779) Fire Hall #12	Fire Station	707	1986
(7694) Fire Hall #13	Fire Station	720	2002
(3227) Fire Hall #14	Fire Station	635	1982
(8281) Fire hall #15	Fire Station	1,136	2011
(3240) Fire Hall #17	Fire Station	754	1954
(1307) Fire Hall #18	Fire Station	1,207	1999
(3231) Fire Hall #19	Fire Station	616	1978
(3239) Fire Hall #20	Fire Station	474	1961
(1811) Fire Hall #21	Fire Station	648	1984
(3241) Fire Hall #22	Fire Station	760	1981
(4493) Marpole Branch - Library	Library	334	1955
(4498) Champlain Branch - Library	Library	409	2001
(3244) South Hill Branch - Library	Library	465	1949
(4468) West Point Grey Branch - Library	Library	474	1978
(3245) Collingwood Branch - Library	Library	492	1951
(3246) Dunbar Branch - Library	Library	595	1991
(8089) Kensington Branch - Library	Library	687	2008
(3233) Kitsilano Branch - Library	Library	799	1963

|			
(1738) Hastings Branch - Library	Library	827	1989
(1364) Fraserview Branch - Library	Library	1,115	1971
(3245) Renfrew Branch - Library	Library	1,505	1994
(1263) Barclay Manor	Other - Recreation	470	1980
(1534) Douglas Park Community Centre	Other - Recreation	1,936	1960
(7595) Coal Harbour Community Centre	Other - Recreation	2,146	2000
(1346) Sunset Community Centre	Other - Recreation	2,889	2007
(7265) Fire Training Centre (USAR) and Fire Rescue and Training Facility	Fire Station	1,762	2011
(1365) New Brighton Pool	Other - Recreation	2,192	1970
(3012) Lord Byng Pool	Other - Recreation	1,410	1970
(1485) Templeton Park && Pool	Other - Recreation	1,909	1970
(6447) Bloedel Conservatory	Other - Public Services	1,821	1968
(5904) Vancouver Maritime Museum	Museum	2,435	1958
(4325) Second Beach Pool	Other - Recreation	568	1950
(1761) Police Museum	Museum	1,430	1932
(3251) Alexander Residence	Multifamily Housing	973	1912
(4908) Gresham Hotel	Multifamily Housing	1,532	1908
(1232) Hodson Manor	Office	552	1903
(1262) Barclay Heritage Square	Multifamily Housing	1,421	1900
(1273) VPD Former Police Garages	Repair Services (Vehicle, Shoe, Locksmith, etc.)	1,389	1971
(5187) VPD Dog Squad	Police Station	650	2009
(1347) Sunset Nursery	Other	3,605	1950
(2136) Animal Control Shelter	Other	1,018	1977
(8395) Salt Building	Other	2,929	1931
(2010) Fraserview Golf Course	Other - Recreation	1,790	1990
(4454) Langara Golf Course	Other - Recreation	787	1990
(2147) McCleery Golf Course Service Yard	Other - Recreation	763	1990
(6820) 142-150 Water St (Water Street Parkade Building)	Parking	33,306	1971

10 Appendix B

The energy use data for ongoing uploads can be accessed using the following steps:

1. Open the Asset Planner Energy & Sustainability Database.
2. Generate a new Utility Trending Report from the Reports Tab -> Energy Data Reports -> Utility Trending Report
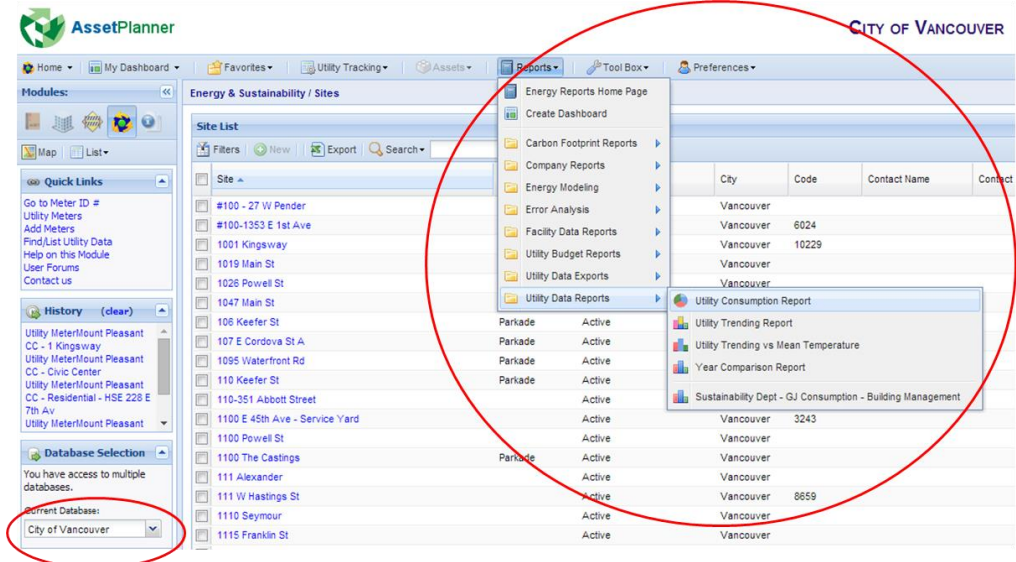
3. Filter the Utility Trending Report using the Filters button. Select the Utility Type desired, select the desired Site (for easy selection of all sites in PM copy and paste the list of Ameresco Site Identifiers below), and the desired Date Range.
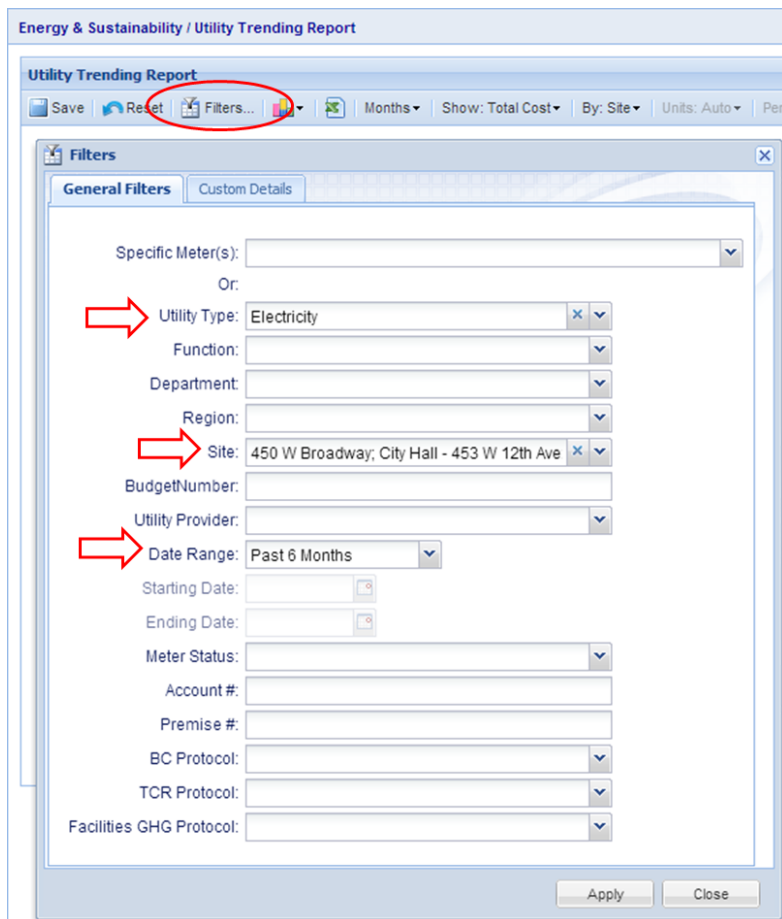
4. Download the Total Consumption and Total Consumption Cost data to a spreadsheet by selection the Show: button and clicking the Excel symbol. Note: for Natural Gas the Units should be selected as m³ for easy importing to Portfolio Manager.

The energy data can then be imported in to Portfolio Manager by:

1. Using the Add Bills to Existing Meters Template generated for all buildings in the Portfolio (https://portfoliomanager.energystar.gov/pm/dataimport/createTemplate). The energy data from Ameresco will need to be matched with building and meter data in Portfolio Manager which is most easily done by sorting by the common Building ID code.
2. Upload the spreadsheet through the Portfolio Manager data import interface (https://portfoliomanager.energystar.gov/pm/dataimport/upload).

Ameresco site identifiers for future energy downloads:

450 W Broadway; City Hall - 453 W 12th Ave; Dunbar Branch - 4515 Dunbar St; Queen Elizabeth Theatre - 649 Cambie St; West Point Grey Branch - 4480 W 10th Ave; West Point Grey Community Centre - 4397 West 2nd Ave; Kitsilano Arena - 2690 Larch St; Kitsilano Branch - 2425 MacDonald St; Kitsilano Community Centre - 2690 Larch St; Kitsilano Pool - 2305 Cornwall St; Barclay Heritage Square - 1433 Barclay St; Barclay Manor - 1447 Barclay St; Hillcrest Community Centre (Incl Pool, Rink & Library); South Hill Branch - 6076 Fraser St; Hodson Manor -1254 W 7th Ave; HootSuite - Formerly VPD - 5 E 8th Ave; VPD - 3585 Graveley & 1570 Kootenay; VPD Cambie Building - 2120 Cambie St; VPD Dog Squad - 755 Evans St; VPD Police Garage - 342 Alexander St; VanDusen Botanical Garden - 5251 Oak St; Fire Hall #1 - 900 Heatley Ave; Fire Hall #12 - 2460 Balaclava St; Fire Hall #13 - 4013 Prince Albert St; Fire Hall #14 - 2804 Venables St; Fire Hall #15 - 3003 E 22nd St; Fire Hall #17 - 7070 Knight St; Fire Hall #18 - 1375 W 38th Ave; Fire Hall #19 - 4396 W 12th Ave; Fire Hall #2 - 199 Main St; Fire Hall #20 - 5402 Victoria Dr; Fire Hall #21 - 5425 Carnarvon St; Fire Hall #22 - 1005 W 59th Ave; Fire Hall #3 - 2801 Quebec St; Fire Hall #4/Library Firehall; Fire Hall #5 - 3090 E 54th Ave; Fire Hall #6 - 1001 Nicola St; Fire Hall

#7 - 1090 Haro St; Fire Hall #8 - 895 Hamilton St; Fire Hall #9 - 1805 Victoria Dr; Fire Rescue Training Facility - 1330 Chess St; Marpole Branch - 9386 Granville St; Marpole Oakridge Community Centre - 990 W 59th Ave; Kensington Branch - 1428 Cedar Cottage Mews; Kensington Community Centre - 5175 Dumfries St; 1800 Spyglass Pl - 311 Call Centre; 2151 Burrard St; 240 Northern St; 2780 E Broadway; 281 Industrial Ave; 450 W Broadway; Alexander Residence - 58 Alexander St; Animal Control Shelter - 1280 Raymur Ave; Antoinette Lodge - 535 E Cordova St; Barclay Heritage Square - 1433 Barclay St; Barclay Manor - 1447 Barclay St; Bloedel Conservatory - 400 W 33rd AVe; Carnegie Community Centre - 401 Main St; Central Library - 350 W Georgia St; Central Residence - 42 & 44 E Cordova St; Champlain Heights Branch - 7110 Kerr St; Champlain Heights Community Centre - 3350 Maquinna Dr; City Hall - 453 W 12th Ave; City Hall West Annex - 515 W 10th Ave; Coal Harbour Community Centre - 480 Broughton St; Collingwood Branch - 2985 Kingsway; Creekside Community Centre (incl Daycare) - 1 Athletes Way; Douglas Park Community Centre - 801 W 22nd Ave; Dunbar Branch - 4515 Dunbar St; Dunbar Community Centre - 4747 Dunbar St; Evans Yard - 955 Evans Ave; Evelyne Saller Centre - 320 Alexander St; False Creek Community Centre - 1318 Cartwright St; Fire Hall #1 - 900 Heatley Ave; Fire Hall #12 - 2460 Balaclava St; Fire Hall #13 - 4013 Prince Albert St; Fire Hall #14 - 2804 Venables St; Fire Hall #15 - 3003 E 22nd St; Fire Hall #17 - 7070 Knight St; Fire Hall #18 - 1375 W 38th Ave; Fire Hall #19 - 4396 W 12th Ave; Fire Hall #2 - 199 Main St; Fire Hall #20 - 5402 Victoria Dr; Fire Hall #21 - 5425 Carnarvon St; Fire Hall #22 - 1005 W 59th Ave; Fire Hall #3 - 2801 Quebec St; Fire Hall #4/Library Firehall; Fire Hall #5 - 3090 E 54th Ave; Fire Hall #6 - 1001 Nicola St; Fire Hall #7 - 1090 Haro St; Fire Hall #8 - 895 Hamilton St; Fire Hall #9 - 1805 Victoria Dr; Fire Rescue Training Facility - 1330 Chess St; Fraserview Branch - 1950 Argyle Dr; Fraserview Golf Course - 7800 Vivian Dr; Granville Residence - 1261 Granville St; Gresham Hotel - 716 Smithe St; Hastings Branch - 2674 E Hastings St; Hastings Community Centre - 3096 E Hastings St; Hillcrest Community Centre (Incl Pool, Rink & Library); Hodson Manor -1254 W 7th Ave; HootSuite - Formerly VPD - 5 E 8th Ave; Kensington Branch - 1428 Cedar Cottage Mews; Kensington Community Centre - 5175 Dumfries St; Kerrisdale Arena - 5670 E Blvd; Kerrisdale Community Centre - 5851 West Blvd; Killarney Community Centre - 6260 Killarney St; Kingsway Continental - 3484 Kingsway; Kitsilano Arena - 2690 Larch St; Kitsilano Branch - 2425 MacDonald St; Kitsilano Community Centre - 2690 Larch St; Kitsilano Pool - 2305 Cornwall St; Langara Golf Course - 6706 Alberta St; Lord Byng Pool - 3990 W 14th Ave; Manitoba Yards (excludes Transfer station) - 250 W 70th Ave; Maritime Museum - 1905 Ogden Ave; Marpole Branch - 9386 Granville St; Marpole Oakridge Community Centre - 990 W 59th Ave; McCleery Golf Course Service Yard - 7188 MacDonald St; Mount Pleasant CC - 1 Kingsway; Museum of Vancouver & Planetarium - 1100 Chestnut St; National Yards - 701 National Ave; New Brighton Pool - North Windermere St; New Continental - 1065 & 1067 Seymour St; Old Continental - 1390 Granville St; Oppenheimer Lodge - 450 E Cordova St; Park Board Office - 2099 Beach Ave; Police Museum - 240 E Cordova St; Police Tactical Training Centre - 2010 Glen Dr; Public Safety Building - 312 Main St; Queen Elizabeth Theatre - 649 Cambie St; Ray-Cam Community Centre - 920 E Hastings St; Renfrew Branch - 2969 E 22nd Ave; Renfrew Community Centre - 2929 East 22nd Ave; Roddan Lodge - 124 Dunlevy Ave; Roundhouse Community Centre - 181 Roundhouse; Salt Bldg - 85 W 1st Ave; Second Beach Booth - 1 Stanley Park Dr; Second Beach Pool - Stanley Park Dr; South Hill Branch - 6076 Fraser St; South Transfer Station & Recycling Depot - 377 W Kent Ave; Sunset Arena - 390 E 51st Ave; Sunset Community Centre - 6810 Main St; Sunset Nursery Office - 290 E 51st Ave; Sunset Nursery Services - 290 E 51st Ave; Templeton Park & Pool - 700 Templeton Dr; The Gathering Place - 609 Helmcken St; Trout Lake Community Centre - 3360 Victoria Dr; Vancouver Aquatic Centre - 1050 Beach Ave; VanDusen Botanical Garden - 5251 Oak St; VFS & EasyPark - 151 W Cordova St; VPD - 3585 Graveley & 1570 Kootenay; VPD Cambie Building - 2120 Cambie St; VPD Dog Squad - 755 Evans St; VPD Police Garage - 342 Alexander St; West End Community Centre & Joe Fortes Library - 870 Denman; West Point Grey Branch - 4480 W 10th Ave; West Point Grey Community Centre - 4397 West 2nd Ave

11 Appendix C

Adding buildings individually

Time required: ~30-60 minutes per building

Adding a building (or property) manually to Portfolio Manager is more time intensive than creating multiple buildings at once using upload spreadsheets. Adding a building is initiated using the Add a Property button in Portfolio Manager and following the in-program instructions. The steps taken to populate the building data as required using data from the City of Vancouver sources are as follows:

- Follow the Portfolio Manager prompts to add building information such as address and construction date.
- Add Property Use details including additional Use Types information for the building as required by finding information as outlined in Section 2.1.
- Continue through the property setup steps as guided by Portfolio Manager until the final Create Property button is selected.
- After creating the property add the required energy and water meters.
- In the Meters tab of the newly created property, add new meters. Download electricity and gas data from the Ameresco Energy database dating as far back as desired or as

information is available. Energy data can be added to manually or through the spreadsheet upload when prompted.

- Select Finish Meter Setup and check the appropriate boxes for meters that should be included in energy metrics.

Adding buildings in bulk

Time required: ~30-60 minutes building set

Buildings can be added in bulk using the default Portfolio Manager upload templates. Uploading multiple properties at once can save significant amounts of time but is subject to greater human error when copying large datasets. The upload templates should be used in the following order after assembling the required building details and energy use data.

- Use the Add Properties template to add the properties in bulk.
- Use the Add Meters to Existing Properties template to add the required meters to all the properties.
- Use the Add Bills to Existing Meters template to add energy information.
- Note: Property Use Details such as Hours of Operation cannot be added using the spreadsheet upload method and must be done manually for each building after the bulk uploads are complete.

12 Appendix D

Table 5: City of Vancouver Building Types and National Median Energy Use Intensity (EUI)

CoV Building Type	Portfolio Manager Building Type	Source EUI (kWh/m²)	Site EUI (kWh/m²)	Reference
Office	Office	363.9	255.6	SCIEU - Offices
Public	Performing Arts or Museum	2991.7	1866.7	CIBEUS - Public Assembly
Outdoor Pool	Other - Recreation	530.6	308.3	CIBEUS - Entertainment and Recreation
Indoor Pool	Other - Recreation	530.6	308.3	CIBEUS - Entertainment and Recreation
CC & Pool	Other - Recreation	530.6	308.3	CIBEUS - Entertainment and Recreation
Com Center	Other - Recreation	530.6	308.3	CIBEUS - Entertainment and Recreation
Rink	Ice/Curling Rink	536.1	419.4	CIBEUS – Pool, Skating Rink, Fitness Centre and Bowling
Library	Library	2991.7	1866.7	CIBEUS - Public Assembly
Firehall	Fire Station	452.8	341.7	CIBEUS - Municipal Administration
Golf Course	N/A	N/A	N/A	N/A
Housing	Multifamily Housing	N/A	N/A	NA
Wrks Yrd/Storg	Other - Public Services	341.7	250.0	SCIEU - Other
Misc	Other - Other or Other - Public Services	341.7	250.0	SCIEU - Other