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Green House Gas Emissions Report: Airport Executive Park Building 7

Bentall Kennedy (Canada) LP
Airport Executive Park Building 7
10991 Shellbridge Way, Richmond BC

Submitted to: CaGBC, LEED EB:O&M
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1 SUMMARY

Prism Engineering Ltd. on behalf of Bentall Kennedy (Canada) LP, has prepared this emission inventory report for the Airport Executive Park Building 7 (AEP7) office. This report has been prepared in accordance with ISO 14064-1 in partial fulfillment of the requirements for LEED Canada EB:O&M credit EAc6.

This report compares the emissions generated at AEP7 between the performance period (April 1, 2012 to March 31, 2013) and the base year (April 1, 2011 to March 31, 2012). For the purpose of this report, only scope 1 emissions (direct emissions) and scope 2 emissions (energy indirect emissions) were considered. Scope 3 (non-energy indirect) emissions are not included in this analysis.

In accordance with LEED Canada EB:O&M reporting requirements, this report will be submitted to the CSA CleanStart Registry and an independent third party, Evan Jones of 3P Analysis and Consulting, will verify the results.

The table below shows the emissions for the base year, the emissions for the performance period and the comparison of emissions between the performance period and the base year.

Scope	**Base Year [Tonnes CO2e]**	**Performance period [Tonnes CO2e]**	**Comparison to base year [Tonnes CO2e]**
Direct	143.3	96.3	-47.0
Energy indirect	30.6	25.1	-5.5
Total	**173.9**	**121.5**	**-52.4**

2 ORGANIZATIONAL PROFILE

2.1 General Building Description

Airport Executive Park Building 7 (AEP7) at 10991 Shellbridge Way, Richmond was constructed in 2002. The building has three stories and an outdoor parkade. The total floor area of the building is 79,477 sq ft.

The main entrances have glass doors without vestibules. Windows make up approximately 50-60 percent of the overall wall area. The glazing is green tinted dual glazed sealed units with a low e coating and fixed windows. The building has shading provided by trees and blinds to reduce solar gains.

Typical building operating hours are from 6 am to 6 pm Monday to Friday. Currently one of the tenants occupies the building beyond the typical operating hours which requires the HVAC system and the lighting on the concerning floor to operate on following extending schedule. Monday to Friday 6am to 8pm, Saturday and Sunday 10am to 6pm.

Cleaning is performed daily from 5pm to 11pm. Cleaners typically take 2 hours per floor. The building is also patrolled by security guards throughout the night after the building is vacated.

2.2 Major Energy Consuming Systems

Lighting Systems Description

The base building lighting system (the majority of the indoor lighting systems) consists of 20”x48” fluorescent luminaires with 30 watt T8 lamps operating on 347 volt electronic instant-start ballasts. The luminaires are arranged approximately in a 7’x10’ square pattern providing light levels of approximately 30 to 46 footcandles.

The entrance lobbies, stairwells and elevator lobbies are illuminated by downlights with 2-13, 18, 16 watt compact fluorescent lamps.

Washrooms are illuminated by striplights in valences using T8 lamps operating on rapid-start electromagnetic ballasts and by compact fluorescent downlights. Although a switch is available, lights are typically left on during the day.

There are 1,980 four foot T8 lamps in the building. The luminaires were relamped with 30 watt T8 lamps in 2010 which replaced the original 32 watt T8 lamps.

Note that lighting information provided is based on a high level audit.

Interior Lighting Controls

The interior base building lighting is controlled by a DDC system. This system automatically turns the lighting off at 6pm, and performs sweeps every hour. Occupants have the option of overriding the control system using the master low voltage switches on each floor. This turns on the lights controlled by the switch until the next sweep.

Exit Signs

Exit signage is provided by LED single and double-faced internally lit rectangular exit signs.

Exterior Lighting

Exterior lighting is provided primarily by a mixture of HID and compact fluorescent luminaires. The front entrance and walkway is illuminated by lensed downlights and bollards. The building perimeter is illuminated by wall mounted luminaires. Two metal halide flood luminaires are aimed upwards to light up the main column.

Compact fluorescent wall luminaires are mounted above exterior stairwells or patios to provide illumination.

The exterior lighting was observed to be off during the day.

Mechanical Systems Description

Heating and cooling for the building is provided by a hydronic system. Central hot water heating and cooling plants supply hot and chilled water through a four-pipe piping system to fan coil units and makeup air units (MAUs).

The following sections provide an overview of these systems and a description of their operation.

Heating Systems

The heating plant consists of two (B1 and B2) 1,000 mBH AERCO condensing boilers. A summary of the heating distribution pumps is included in Table 1.

Table 1: Summary of Heating Water Distribution Pumps

Tag	Description	Hp
P1	Primary Hot Water Supply	2
P2	Primary Hot Water Supply	2

Cooling Systems

The building is cooled by a chilled water plant located in the penthouse mechanical room. The plant consists of a 110 - tons York packaged air cooled water chiller, with two screw compressors, and two primary chilled water pumps.

A summary of the chilled water distribution pumps is included in Table 2.

Table 2: Summary of Chilled Water Distribution Pumps

Tag	Description	Hp
P1	Primary Chilled Water Supply	5
P2	Primary Chilled Water Supply	5

Ventilation Systems

A summary of ventilation systems is provided in the following table:

Tag	Service	Hp	CFM	Flow Control	Heating
AHU-1	West Make-up Air	7.5	9,486	VSD	HW Coil
AHU-2	East Make-up Air	7.5	9,221	VSD	HW Coil
EF2	General Exhaust Fan	3	11,000	VSD	-

Exhaust Systems

Exhaust from washrooms is provided by EF-1 (5 hp) controlled by the BAS. Additional fans are provided for the electrical and elevator rooms. These fans are controlled by local thermostats.

Central Building Controls

Building Management/Automation System (BAS)

The mechanical systems serving the building are controlled by a Reliable Controls direct digital control (DDC) system.

Domestic Hot Water

Domestic hot water is provided by two gas fired 120 MBH hot water heaters located in the penthouse mechanical room. The heaters are equipped with flue dampers to reduce standby losses.

3 GHG INVENTORY DESIGN AND DEVELOPMENT

3.1 Organizational Boundaries

The control approach was used to quantify the GHG emissions for the Airport Executive Park Building 7, as the organization has both operational and financial control of 100% of the building.

3.2 Operational Boundaries

At AEP7, there are direct and energy indirect GHG emissions, but there are no 'other indirect' GHG emissions. Furthermore, there are no biomass fuels, GHG removals, or GHG sinks at this organization.

The following table summarizes the emissions by type:

Emission Type	Emission Source	End Use
Direct GHG emissions	Refrigerant leakage	Cooling
	Diesel	Emergency generator
	Natural Gas	Space heating
Energy Indirect GHG Emissions	Electrical	Lighting, HVAC, plug load, DHW etc.
Other Indirect GHG Emissions	n/a	

4 QUANTIFICATION OF GREENHOUSE GAS (GHG) EMISSIONS

4.1 Methodology

The methodology used to quantify GHG emissions was derived from the ISO 14064-1 standard:

GHG Activity Data x GHG Emission Factor = GHG Emissions

There are no removals at this organization. A modelling or continuous approach was considered cost prohibitive, and was not feasible.

4.2 Activity data

The following sections outline the activity data for AEP7:

4.2.1 Electrical Activity Data

AEP7 purchases electricity from BC Hydro. Consumption is metered on one account and one meter for the building.

The consumption from the first and last periods were prorated to a daily average to calculate the consumption as per the exact number of days.

Baseline year: April 1, 2011 to March 31, 2012

Start Date	End Date	Consumption (kWh)
2011-04-01	2011-04-27	104,652
2011-04-28	2011-05-26	110,880
2011-05-27	2011-06-24	110,880
2011-06-25	2011-07-27	119,880
2011-07-28	2011-08-25	105,840
2011-08-26	2011-09-27	119,880
2011-09-28	2011-10-27	105,480
2011-10-28	2011-11-28	109,800
2011-11-29	2011-12-23	86,400
2011-12-24	2012-01-26	114,840
2012-01-27	2012-02-23	96,840
2012-02-24	2012-03-31	118,668
TOTAL		**1,304,037**

Performance Period: April 1, 2012 to March 31, 2013

Start Date	End Date	Consumption (kWh)
2012-04-01	2012-04-25	76,800
2012-04-26	2012-05-25	102,240
2012-05-26	2012-06-25	99,720
2012-06-26	2012-07-25	94,680
2012-07-26	2012-08-23	91,800
2012-08-24	2012-09-25	94,320
2012-09-26	2012-10-24	77,760
2012-10-25	2012-11-26	86,400
2012-11-27	2012-12-27	81,000
2012-12-28	2013-01-25	76,680
2013-01-26	2013-02-25	77,040
2013-02-26	2013-03-31	112,863
TOTAL		**1,071,300**

4.2.2 Natural Gas Data

AEP7 purchases natural gas from Fortis BC. Consumption is metered on one account and one meter for the building. The conversion factor from GJ to m3 is 0.0372.

Baseline year: April 1, 2011 to March 31, 2012

Start Date	End Date	Consumption (m^3)
2011-04-01	2011-04-27	7,795
2011-04-28	2011-05-26	6,051
2011-05-27	2011-06-24	2,831
2011-06-25	2011-07-27	1,535
2011-07-28	2011-08-25	849
2011-08-26	2011-09-27	1,790
2011-09-28	2011-10-27	5,341
2011-10-28	2011-11-28	15,352
2011-11-29	2011-12-23	1,769
2011-12-24	2012-01-26	5,296
2012-01-27	2012-02-23	14,188
2012-02-24	2012-03-31	9,212
TOTAL		**72,010**

Performance Period: April 1, 2012 to March 31, 2013

Start Date	End Date	Consumption (m^3)
2012-04-01	2012-04-25	3,761
2012-04-26	2012-05-25	4,562
2012-05-26	2012-06-25	2,296
2012-06-26	2012-07-25	1,145
2012-07-26	2012-08-23	849
2012-08-24	2012-09-25	1,589
2012-09-26	2012-10-24	2,876
2012-10-25	2012-11-26	4,766
2012-11-27	2012-12-27	6,457
2012-12-28	2013-01-28	7,212
2013-01-29	2013-02-26	5,844
2013-02-27	2013-03-31	6,274
TOTAL		**47,631**

4.2.3 Refrigerant Activity Data

Building operations staff monitor the units and contractors perform regular maintenance on all units. Since actual leakage rates are not available, leakage rates for all units have been estimated based on 2% of the charge capacity, as per LEED Canada EB:O&M credit EAc5. Refrigerant activity data is assumed to be the same during the performance period and the base year.

Make	Model	Tag #	Refri ger-ant	Locatio n	Refriger-ant Charge (kg)	Estimated Annual Leakage (2% of charge) (kg)
York	YCAS0110 EC58YFA	CH-1	R22	Baseme nt	106	2.12
Keep Rite (National Refrigeration and Air Conditioning Canada)	KVC1B110 13A-T5C-1703	BBM Data Centre	R22	roof	5.2	0.104
Keep Rite (National Refrigeration and Air Conditioning Canada)	KVC1B110 13A-T5C-1703	BBM Data Centre	R22	roof	5.2	0.104
York	ZF060C00 P2AAA1A	Talent Technologi es 3rd floor server room	R410 -A	roof	2.44	0.0488
5005 York	AC042X10 21A	Talent Technologi es (Backup)	R22	roof	2.38	0.0476
York	H4DB018S 06A	Graymont 2nd floor	R22	roof	1.76	0.0352

4.2.4 Diesel Activity Data

The diesel generator at AEP7 is used to back up the tenant data centre.

Baseline year: April 1, 2011 to March 31, 2012

Fuel Consumption (L)
22.2 Litres

Performance Period: April 1, 2012 to March 31, 2013

Fuel Consumption (L)
22.2 Litres

4.3 GHG emissions factors and Global Warming Potentials (GWPs)

The emissions factors in this report are from Canada's 2013 National Inventory Report. The year used for the factors is 2010, given that this factor represents the most recent year of complete data.

The following tables outline the GHG emissions factors and Global Warming Potentials (GWP) used in this report:

Emission Factors:

GHG Source	Emissions factor		Source
Natural Gas	1916	g CO_2/m^3	Canada's National Inventory Report 1990-2011, Annex 8, written in 2013 (Marketable)
	0.037	g CH_4/m^3	Canada's National Inventory Report 1990-2011, Annex 8, written in 2013 (Commercial)
	0.035	g N_20/m^3	Canada's National Inventory Report 1990-2011, Annex 8, written in 2013 (Commercial)
Diesel	2663	g CO_2/L	Canada's National Inventory Report 1990-2011, Annex 8, written in 2013
	0.133	g CH_4/L	Canada's National Inventory Report 1990-2011, Annex 8, written in 2013
	0.4	g N_20/L	Canada's National Inventory Report 1990-2011, Annex 8, written in 2013
BC Electricity	23.1	g CO_2/kWh	Canada's National Inventory Report 1990-2011, Annex 13, written in 2013 (2010 intensity)
	0.006	g CH_4/kWh	Canada's National Inventory Report 1990-2011, Annex 13, written in 2013 (2010 intensity)
	0.0007	g N_20/kWh	Canada's National Inventory Report 1990-2011, Annex 13, written in 2013 (2010 intensity)

Global Warming Potential

GHG	Formula	100-Year GWP (gCO2e/g)	Atmospheric Lifetime (years)	Source
Carbon Dioxide	CO2	1	Variable	Canada's National Inventory Report 1990-2011, Chapter 1
Methane	CH4	21	12 ± 3	Canada's National Inventory Report 1990-2011, Chapter 1
Nitrous Oxide	N2O	310	120	Canada's National Inventory Report 1990-2011, Chapter 1
HFC-23	CHF3	11 700	264	Canada's National Inventory Report 1990-2011, Chapter 1
HFC-134a	C2H2F4 (CH2FCF3)	1 300	14.6	Canada's National Inventory Report 1990-2011, Chapter 1
HFC-32	CH_2F_2	675	4.9	IPCC Fourth Assessment Report: Climate Change 2007 (Climate Change 2007: Working Group I: The Physical Science Basis)
HFC-125	CHF_2CF_3	3500	29	IPCC Fourth Assessment Report: Climate Change 2007 (Climate Change 2007: Working Group I: The Physical Science Basis)
HCFC-22 (R-22)	CHCIF2	1810	12	IPCC Fourth Assessment Report: Climate Change 2007 (Climate Change 2007: Working Group I: The Physical Science Basis)
R-410a	Mixture of: HFC-32 and HFC-125 (50/50 %)	2088	17	Calculated based on the average between HFC-125 and HFC-32

5 GHG INVENTORY COMPONENTS

5.1 Base year and reporting period

The base year used for this report is the year from April 1, 2011, to March 31, 2012. As this is the first emissions inventory report for AEP 7, this base year shall be used as the base year for subsequent emission inventories. The performance period ran from April 1, 2012, to March 31, 2013. This performance period coincides with AEP 7's LEED Canada EB:O&M EAc1 performance period.

5.2 GHG emissions and removals: performance period vs. base year

Changes in GHG emissions during project performance period and base year by source:

Emission Source	**Base Year (Tonnes CO_2e)**	**Performance Period (Tonnes CO_2e)**	**Change from Base Year (Tonnes CO_2e)**
Electricity	30.6	25.1	5.5
Natural Gas	138.8	91.8	47.0
Diesel	0.06	0.06	0.0
Refrigerant	4.5	4.5	0.0
TOTAL	**173.9**	**121.5**	**52.4**

Changes in GHG emissions during project performance period and base year by type:

Emission Source	**Base Year (Tonnes CO_2e)**	**Performance Period (Tonnes CO_2e)**	**Change from Base Year (Tonnes CO_2e)**
Direct	143.3	96.3	47.0
Energy Indirect	30.6	25.1	5.5
TOTAL	**173.9**	**121.5**	**52.4**

Changes in **Direct** GHG emissions during project performance period and base year GHGs:

Emission Source	**Base Year (Tonnes CO_2e)**	**Performance Period (Tonnes CO_2e)**	**Change from Base Year (Tonnes CO_2e)**
CO_2	142.5	95.8	46.7
CH_4	0.0560	0.0371	0.0189
N_2O	0.7841	0.5196	0.2645
TOTAL	**143.3**	**96.3**	**47.0**

Changes in **Indirect** GHG emissions during project performance period and base year GHGs:

Emission Source	**Base Year (Tonnes CO_2e)**	**Performance Period (Tonnes CO_2e)**	**Change from Base Year (Tonnes CO_2e)**
CO_2	30.1	24.7	5.4
CH_4	0.2	0.1	0.0
N_2O	0.3	0.2	0.1
TOTAL	**30.6**	**25.1**	**5.5**

5.3 GHG emission reduction initiatives

The following is a list of energy savings initiatives completed at AEP7:

Measure Implemented	**Estimated Energy reduction (kWh)**	**Estimated GHG Emission Reduction (tonnes CO_2e)***
ECM 5.1 Lighting Retrofit	11,455	0.26
ECM 5.3 Align Make-up Units Operation Hours with Occupancy	5,650	0.13
ECM 5.4 Align the Exhaust Fans Operation with MUA	4,000	0.09
ECM 5.5 Add Holiday Scheduling and Weekly Schedule by Tenant Area	16,000	0.37

* The estimated GHG emissions were calculated by multiplying the estimated energy reduction by the electrical emissions factor listed above (23.1 g CO_{2e}/kWh).

Other implemented energy savings initiatives without estimated energy reduction figures included modifying the unoccupied setback, and investigating the boiler operation.

5.4 Certainty

Overall, we feel that the level of certainty with this emission inventory is high. The reason for this level of certainty is the major emission sources at AEP7 are Natural gas and electricity consumption, which are monitored with revenue grade meters. The following table shows our judgement of the level of certainty in the activity data for each emission source present in this in inventory.

Emission Source	Certainty	Explanation
Natural Gas	High	The activity is metered by a revenue grade meter, and the emissions factors and GWP are provided from a reputable source.
Electricity	High	The activity is metered by a revenue grade meter, and the emissions factors and GWP are provided from a reputable source.
Diesel	Low	Fuel data is estimated, but the emissions factors and GWP are provided from a reputable source.
Refrigerants	Medium	Leakage data is estimated using a well-known best practice, and the emissions factors and GWP are provided from a reputable source.

6 GHG INVENTORY QUALITY MANAGEMENT

6.1 GHG Data Management

The following roles and responsibilities have been assigned to ensure completeness accuracy and continuity in GHG reporting at AEP7 in accordance to ISO 14064-1.

Responsible Party		Responsibilities
Name **Role** **Organization**	Kas Chandok Operations Supervisor, Real Estate Services Bentall Kennedy (Canada) LP	Provide Prism Engineering with Electrical, Natural Gas bills, and facilitate collection of diesel fuel bills.
Name **Role** **Organization**	Nadine O'Donnell Data Analyst Prism Engineering	Receive the activity data and enter into PUMA utility monitoring software.
Name **Role** **Organization**	Stefanie Jones LEED project coordinator Prism Engineering	Collect and update emissions factors and global warming potentials. Prepare emissions inventory report.
Name **Role** **Organization**	Evan Jones Independent Verifier 3P Analysis and Consulting	Verify that the report prepared by Prism Engineering meets ISO 14064 requirements for the Registry.

6.2 Base Year Recalculation Policy

As per the ISO 14064-1 standard, section 5.3.2, a base-year recalculation policy has been applied and documented for AEP7 as follows.
Our base year recalculation policy is to recalculate base year emissions when changes result in a variation that is greater than 5% in base year emissions.
Changes considered are:

- changes to operational boundaries,
- changes to the ownership and control of GHG sources or sinks transferred into or out of organizational boundaries, and
- changes to GHG quantification methodologies that result in significant changes to quantified GHG emissions or removals.

AEP7 base-year GHG inventory shall not be recalculated to account for changes in facility production levels, including the closing or opening of facilities.

6.3 Document Retention and Record Keeping

Utility data is stored on site at AEP7, and also sent to Prism Engineering for entry into the PUMA utility monitoring online tool, where it is stored on a server with offsite storage for redundancy.

7 VERIFICATION ACTIVITIES

Evan Jones of 3P Analysis and Consulting completed independent third party verification of this emissions inventory report as per ISO 14064-3:06.

8 REFERENCES

Environment Canada. (2013). *National Inventory Report 1990–2011: Greenhouse Gas Sources and Sinks in Canada.* Available online: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/7383.php

[Pages: Global Warming Potential Chapter 1, pg 32; Annex 8; Annex 13]

IPCC. (2007). *Fourth Assessment Report: Climate Change 2007: Working Group I: The Physical Science Basis.* Available online: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

[Section: Section 2.10.2 Direct Global Warming Potentials]