

Energy Profiles Limited

2017 GHG Emissions Inventory Summary MacEwan University

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1.0 EXECUTIVE SUMMARY

This report presents energy and greenhouse gas (GHG) emissions for MacEwan University for Fiscal Year 2017 (July 2016 through June 2017) vs. previous years as per the GHG Protocol.

Absolute GHG emissions were 9% lower in FY 2017 than FY 2014, as shown below.

Fiscal Year 2014 – 2017 GHG Emissions - Absolute

Scope / Source	Emissions (tCO ₂ e)			2017 vs. 2014 Increase (+) / Decrease (-)	
	FY 2014	FY 2016	FY 2017	Absolute	%
Scope 1 - Natural Gas, Fleet Fuel, Diesel Fuel	9,105	7,237	7,869	-1,236	-14%
Scope 2 - Electricity	21,649	21,260	20,199	-1,449	-7%
Total	30,753	28,497	28,068	-2,685	-9%

Additionally, year-over-year results for natural gas and electricity are reported on a weather-normalized basis to better understand the performance of MacEwan's buildings.

After accounting for differences in weather, the decrease in emissions was reduced to 6%, largely because winter weather was milder in FY 2017.

Fiscal Year GHG Emissions – Weather Normalized (electricity and natural gas)

Year	Area (ft ²)	Energy (ekWh)	Emissions (tCO ₂ e)
FY 2014 actual	1,369,833	75,642,951	30,688
Changes in weather	-	-4,170,922	-849
FY 2014 normalized	1,369,833	71,472,029	29,839
FY 2017	1,369,833	67,267,699	28,013
Increase (+)/Decrease(-):	0	-4,204,330	-1,826
Intensity (+/-):	0%	-5.9%	-6%

A site-by-site breakdown of weather normalized emissions can be found in Appendix C.

2.0 INVENTORY BOUNDARIES

2.1 Organizational Boundaries

The organizational boundaries for this project were set using the control approach, using the operational control criteria as defined by the GHG Protocol:

Operational Control. A company has operational control over an operation if the former or one of its subsidiaries (see Table 1 for definitions of financial accounting categories) has the full authority to introduce and implement its operating policies at the operation. This criterion is consistent with the current accounting and reporting practice of many companies that report on emissions from facilities, which they operate (i.e., for which they hold the operating license). It is expected that except in very rare circumstances, if the company or one of its subsidiaries is the operator of a facility, it will have the full authority to introduce and implement its operating policies and thus has operational control.

The following buildings are included in the organizational boundaries of this report:

MacEwan Buildings

Building Name	Address	Area (ft ²)	Type
Alberta College Campus	Alberta College (10050 MacDonald Drive)	110,687	multi-use
Centre for the Arts & Communications	CFAC (10045 156 Street)	148,969	multi-use
Christenson Family Centre for Sport & Wellness	Christenson Bldg (10700 104 Avenue)	80,952	multi-use
City Centre Campus - 105 Street	105 Street Bldg (10700 104 Avenue)	119,295	multi-use
City Centre Campus - 106 Street	106 Street Bldg (10700 104 Avenue)	185,214	multi-use
City Centre Campus - 107 Street	107 Street Bldg (10700 104 Avenue)	207,044	multi-use
Robbins Health Learning Centre	Robbins Bldg (10910 104 Avenue)	182,401	multi-use
Student Residence Building	Student Residence (11050 104 Avenue)	268,589	multi-use
University Service Centre	USC (10930 104 Avenue)	66,682	office

2.2 Operational Boundaries

This report includes Direct (Scope 1) and Energy Indirect (Scope 2) emissions at MacEwan, as follows:

Emission Sources by Scope

Direct/Indirect	Scope	Emission Source	End Use
Direct	1	Natural Gas	Space heating, domestic water heating, cooking
Direct	1	Diesel Fuel	Stationary Sources - Back-up electricity generators
Direct	1	Vehicle Fuel	Mobile Sources - University operated vehicles
Energy Indirect	2	Electricity	Lighting, HVAC, space cooling, plug load, etc.

2.1 Exclusions

Scope 1 emissions are not reported for fugitive emissions from refrigerants used in facility refrigeration or air-conditioning units. Scope 3 emissions from waste disposal and fuel used by contracted maintenance operations or personal vehicles are not reported.

3.0 QUANTIFICATION OF GHG EMISSIONS

Measuring GHG emissions directly is cost prohibitive for a project of this size. Therefore, in keeping with industry best practices, GHG emissions have been quantified using the following formula for each GHG source identified in Section 2.2:

$$\text{GHG Emissions} = \text{Activity Data (consumption)} \times \text{Emission Factor}$$

3.1 Activity Data

The following subsections describe the sources of the activity data used.

3.1.1 Electricity

Electricity is purchased by MacEwan from Enmax via seven (7) metered electricity services. Building level electricity consumption was obtained directly from the utility bills. Billed electricity consumption is detailed in Appendix A, as allocated to the buildings served.

3.1.2 Natural Gas

Natural gas is purchased by MacEwan from Direct Energy via six (6) metered natural gas services. Natural gas consumption was obtained directly from the utility bills. Billed natural gas consumption is detailed in Appendix A, as allocated to the buildings served.

Note that Direct Energy meter reading dates do not always fall on the first day of the month. Consumption has therefore been allocated to the appropriate calendar month based on the meter reading dates and temperature trends.

3.1.3 Diesel Fuel

Diesel fuel is used for backup electricity generation. Total annual fuel costs were provided by MacEwan. Consumption was estimated based on the fuel costs and average fuel prices for each reported year. Calculated fuel consumption is detailed in Appendix A.

3.1.4 Fleet Fuel

Gasoline is consumed by university operated vehicles. Total annual fuel costs were provided by MacEwan. Consumption was estimated based on the fuel costs and average fuel prices for each reported year. Calculated fuel consumption is detailed in Appendix A.

3.2 GHG Emission Factors and Global Warming Potentials (GWPs)

The following table provides the Global Warming Potentials (GWPs) for the types of emissions reported.

Global Warming Potentials

Emission Type	GWP (gCO ₂ e/g)	Source
CO ₂	1	National Inventory Report (1990-2015) Greenhouse Gas Sources and Sinks in Canada
CH ₄	25	National Inventory Report (1990-2015) Greenhouse Gas Sources and Sinks in Canada
N ₂ O	298	National Inventory Report (1990-2015) Greenhouse Gas Sources and Sinks in Canada

The following table provides the GHG emissions factors used to calculate emissions due to building energy use:

Building Energy: GHG Emission Factors with Sources

GHG Source	CO ₂	CH ₄		N ₂ O		Factor	Units	Factor Source
	gCO ₂	gCH ₄	gCO ₂ e	gN ₂ O	gCO ₂ e			
Electricity	790	0.040	1.00	0.020	5.96	790	gCO ₂ e /kWh	National Inventory Report (1990-2015) Greenhouse Gas Sources and Sinks in Canada
Natural Gas	1,928	0.037	0.93	0.035	10.43	1,939	gCO ₂ e /m ³	National Inventory Report (1990-2015) Greenhouse Gas Sources and Sinks in Canada
Diesel Fuel	2,690	0.1330	3.33	0.400	119.2	2,813	gCO ₂ e /l	National Inventory Report (1990-2015) Greenhouse Gas Sources and Sinks in Canada
Gasoline	2,316	0.1400	3.50	0.022	6.6	2,326	gCO ₂ e /l	National Inventory Report (1990-2015) Greenhouse Gas Sources and Sinks in Canada

Note that, as per the GHG Protocol, the electricity emission factor used does not account for emissions due to transmission and distribution losses.

4.0 GHG INVENTORY SUMMARY

4.1 Building Activity Data and Emissions

This section details the activity data and emissions resulting from building operations.

4.1.1 Activity Data

The following table summarizes the activity data for FY 2014 – FY 2017:

Activity Data: FY 2014 – FY 2017

Source	Consumption			2017 vs. 2014 Increase (+) / Decrease (-)	
	FY 2014	FY 2016	FY 2017	Absolute	%
Natural Gas (m3)	4,660,837	3,695,261	4,028,864	-631,973	-14%
Electricity (kWh)	27,403,285	26,911,739	25,568,954	-1,834,330	-7%
Diesel Fuel (L)	10,357	11,776	9,167	-1,190	-11%
Gasoline (L)	15,722	16,200	12,804	-2,919	-19%

4.1.2 GHG Emissions and Removals: Performance Period vs. Base Year

The following table details GHG emissions for FY 2014 – FY 2017 by emission source:

Emissions by Source: FY 2014 – FY 2017

Scope / Source	Emissions (tCO ₂ e)			2017 vs. 2014 Increase (+) / Decrease (-)	
	FY 2014	FY 2016	FY 2017	Absolute	%
Scope 1 - Natural Gas	9,039	7,166	7,813	-1,226	-14%
Scope 1 - Diesel Fuel	29	33	26	-3	-11%
Scope 1 - Fleet Gasoline	37	38	30	-7	-19%
Scope 2 - Electricity	21,649	21,260	20,199	-1,449	-7%
Total	30,753	28,497	28,068	-2,685	-9%

4.2 Certainty

The following table shows the level of certainty in the activity data and emission factors used in preparing this emissions inventory. Note that the combined emissions from natural gas and electricity account for over 99% of total emissions. As such, the overall certainty of building emissions is considered to be high. Overall certainty for diesel and gasoline emissions is considered to be medium.

Certainty of Emissions Calculations by Emission Source

Emission Source	Certainty		
	Activity Data	Emission Factor	Explanation
Natural Gas	High	High	Consumption is measured via revenue grade meters by Direct Energy. The emission factor is published by Environment Canada.
Electricity	High	High	Consumption is measured via revenue grade meters by Enmax. The emission factor is published by Environment Canada.
Diesel and Gasoline	Medium	High	Consumption is estimated based on fuel costs and average annual fuel prices. The emission factor is published by Environment Canada.

APPENDIX A DETAILED ACTIVITY DATA**FY 2014 Energy Consumption by Building**

Property Information			Electricity	Natural Gas	Totals	
Building Name	Area (ft2)	Type	kWh	ekWh	ekWh	ekWh/ft2
Alberta College Campus	110,687	multi-use	2,349,635	4,459,295	6,808,930	61.5
Centre for the Arts & Communications	148,969	multi-use	2,612,542	5,641,906	8,254,448	55.4
Christenson Family Centre for Sport & Wellness	80,952	multi-use	2,809,543	3,329,629	6,139,171	75.8
City Centre Campus - 105 Street	119,295	multi-use	2,233,919	4,993,013	7,226,931	60.6
City Centre Campus - 106 Street	185,214	multi-use	5,297,207	8,078,734	13,375,941	72.2
City Centre Campus - 107 Street	207,044	multi-use	6,135,766	9,486,501	15,622,267	75.5
Robbins Health Learning Centre	182,401	multi-use	2,956,663	5,774,433	8,731,096	47.9
Student Residence Building	268,589	multi-use	1,600,443	4,854,724	6,455,166	24.0
University Service Centre	66,682	office	1,407,567	1,621,433	3,029,000	45.4

Overall Totals	1,369,833	All	27,403,285	48,239,667	75,642,951	55.2
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FY 2016 Energy Consumption by Building

Property Information			Electricity	Natural Gas	Totals	
Building Name	Area (ft2)	Type	kWh	ekWh	ekWh	ekWh/ft2
Alberta College Campus	110,687	multi-use	2,159,107	3,575,986	5,735,093	51.8
Centre for the Arts & Communications	148,969	multi-use	2,609,996	4,622,990	7,232,986	48.6
Christenson Family Centre for Sport & Wellness	80,952	multi-use	2,416,356	2,612,836	5,029,192	62.1
City Centre Campus - 105 Street	119,295	multi-use	2,364,169	3,918,131	6,282,300	52.7
City Centre Campus - 106 Street	185,214	multi-use	5,343,557	6,339,567	11,683,124	63.1
City Centre Campus - 107 Street	207,044	multi-use	6,016,484	7,444,273	13,460,757	65.0
Robbins Health Learning Centre	182,401	multi-use	3,033,419	4,452,175	7,485,594	41.0
Student Residence Building	268,589	multi-use	1,579,459	3,748,061	5,327,520	19.8
University Service Centre	66,682	office	1,389,191	1,531,935	2,921,126	43.8

Overall Totals	1,369,833	All	26,911,739	38,245,953	65,157,692	47.6
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FY 2017 Energy Consumption by Building

Property Information			Electricity	Natural Gas	Totals	
Building Name	Area (ft2)	Type	kWh	ekWh	ekWh	ekWh/ft2
Alberta College Campus	110,687	multi-use	2,153,711	3,997,924	6,151,635	55.6
Centre for the Arts & Communications	148,969	multi-use	2,534,773	4,917,566	7,452,340	50.0
Christenson Family Centre for Sport & Wellness	80,952	multi-use	2,236,338	2,866,898	5,103,236	63.0
City Centre Campus - 105 Street	119,295	multi-use	2,169,930	4,299,115	6,469,046	54.2
City Centre Campus - 106 Street	185,214	multi-use	5,051,407	6,956,002	12,007,409	64.8
City Centre Campus - 107 Street	207,044	multi-use	5,611,767	8,168,126	13,779,893	66.6
Robbins Health Learning Centre	182,401	multi-use	2,946,885	4,818,535	7,765,420	42.6
Student Residence Building	268,589	multi-use	1,468,908	4,141,891	5,610,799	20.9
University Service Centre	66,682	office	1,395,235	1,532,688	2,927,923	43.9

Overall Totals	1,369,833	All	25,568,954	41,698,745	67,267,699	49.1
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Estimated Fuel Consumption by Year

Year	Cost		Average Price (\$/L)		Consumption (L)	
	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline
FY 2014	\$12,748	\$17,522	\$1.23	\$1.11	10,357	15,722
FY 2016	\$10,406	\$14,389	\$0.88	\$0.89	11,776	16,200
FY 2017	\$8,926	\$11,810	\$0.97	\$0.92	9,167	12,804

APPENDIX B DETAILED EMISSIONS DATA**FY 2014 Scope 1 and 2 Emissions by Building**

Property Information			Scope 1	Scope 2	Totals	
Building Name	Area (ft2)	Type	tCO2e	tCO2e	tCO2e	kgCO2e/ft2
Alberta College Campus	110,687	multi-use	836	1,856	2,692	24.3
Centre for the Arts & Communications	148,969	multi-use	1,057	2,064	3,121	21.0
Christenson Family Centre for Sport & Wellness	80,952	multi-use	624	2,220	2,843	35.1
City Centre Campus - 105 Street	119,295	multi-use	936	1,765	2,700	22.6
City Centre Campus - 106 Street	185,214	multi-use	1,514	4,185	5,699	30.8
City Centre Campus - 107 Street	207,044	multi-use	1,778	4,847	6,625	32.0
Robbins Health Learning Centre	182,401	multi-use	1,082	2,336	3,418	18.7
Student Residence Building	268,589	multi-use	910	1,264	2,174	8.1
University Service Centre	66,682	office	304	1,112	1,416	21.2
Overall Totals	1,369,833	All	9,039	21,649	30,688	22.4

FY 2016 Scope 1 and 2 Emissions by Building

Property Information			Scope 1	Scope 2	Totals	
Building Name	Area (ft2)	Type	tCO2e	tCO2e	tCO2e	kgCO2e/ft2
Alberta College Campus	110,687	multi-use	670	1,706	2,376	21.5
Centre for the Arts & Communications	148,969	multi-use	866	2,062	2,928	19.7
Christenson Family Centre for Sport & Wellness	80,952	multi-use	490	1,909	2,399	29.6
City Centre Campus - 105 Street	119,295	multi-use	734	1,868	2,602	21.8
City Centre Campus - 106 Street	185,214	multi-use	1,188	4,221	5,409	29.2
City Centre Campus - 107 Street	207,044	multi-use	1,395	4,753	6,148	29.7
Robbins Health Learning Centre	182,401	multi-use	834	2,396	3,231	17.7
Student Residence Building	268,589	multi-use	702	1,248	1,950	7.3
University Service Centre	66,682	office	287	1,097	1,385	20.8
Overall Totals	1,369,833	All	7,166	21,260	28,427	20.8

FY 2017 Scope 1 and 2 Emissions by Building

Property Information			Scope 1	Scope 2	Totals	
Building Name	Area (ft2)	Type	tCO2e	tCO2e	tCO2e	kgCO2e/ft2
Alberta College Campus	110,687	multi-use	749	1,701	2,451	22.1
Centre for the Arts & Communications	148,969	multi-use	921	2,002	2,924	19.6
Christenson Family Centre for Sport & Wellness	80,952	multi-use	537	1,767	2,304	28.5
City Centre Campus - 105 Street	119,295	multi-use	806	1,714	2,520	21.1
City Centre Campus - 106 Street	185,214	multi-use	1,303	3,991	5,294	28.6
City Centre Campus - 107 Street	207,044	multi-use	1,531	4,433	5,964	28.8
Robbins Health Learning Centre	182,401	multi-use	903	2,328	3,231	17.7
Student Residence Building	268,589	multi-use	776	1,160	1,937	7.2
University Service Centre	66,682	office	287	1,102	1,389	20.8
Overall Totals	1,369,833	All	7,813	20,199	28,013	20.4

Scope 1 Emissions from Fuel

Year	Emissions (tCO2e)		
	Stationary Diesel	Fleet Gasoline	Total
FY 2014	29.129	36.6	65.7
FY 2016	33.121	37.7	70.8
FY 2017	25.782	29.8	55.6

APPENDIX C WEATHER NORMALIZED ENERGY AND EMISSIONS BY BUILDING

To better understand how each building has performed with respect to utility consumption, FY 2014 and FY 2016 energy and emissions are normalized to reflect FY 2017 weather conditions.

As part of this normalization process, linear regression models are developed for both historical years for each individual utility account consumption as a function of heating degree hours (for accounts providing heating energy) and cooling degree hours (for accounts providing cooling energy) using hourly weather data from Environment Canada.

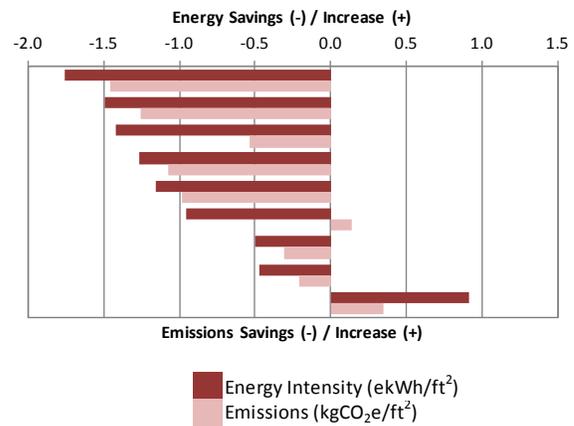
The FY 2014 and FY 2016 models are applied to FY 2017 weather data to calculate, in effect, what consumption in historical years *would have been* had they experienced FY 2017 weather.

The following tables show FY 2017 energy and emissions intensity vs. FY 2016 and FY 2014, normalized for differences in weather.

Note that in some cases emissions increase despite energy savings, or vice versa. This occurs where a property achieves heating fuel savings but uses more electricity. Since electricity is more carbon intensive per ekWh than heating fuel, there is sometimes a net emissions increase for the property.

Change in Weather Normalized Energy and Emissions Intensity in FY 2017 vs. FY 2016

Address	Building type	Area	Increase (+) / Decrease (-)	
			ekWh/ft ²	kgCO ₂ e /ft ²
Christenson Family Centre	multi-use	80,952	-1.8	-1.5
City Centre Campus - 107 Street	multi-use	207,044	-1.5	-1.3
Centre for the Arts & Comm.	multi-use	148,969	-1.4	-0.5
City Centre Campus - 105 Street	multi-use	119,295	-1.3	-1.1
City Centre Campus - 106 Street	multi-use	185,214	-1.2	-1.0
University Service Centre	office	66,682	-1.0	0.1
Student Residence Building	multi-use	268,589	-0.5	-0.3
Robbins Health Learning Centre	multi-use	182,401	-0.5	-0.2
Alberta College Campus	multi-use	110,687	0.9	0.3



Change in Weather Normalized Energy and Emissions Intensity in FY 2017 vs. FY 2014

Address	Building type	Area	Increase (+) / Decrease (-)	
			ekWh/ft ²	kgCO ₂ e /ft ²
Christenson Family Centre	multi-use	80,952	-9.1	-6.0
City Centre Campus - 107 Street	multi-use	207,044	-4.8	-2.4
City Centre Campus - 106 Street	multi-use	185,214	-3.5	-1.5
Alberta College Campus	multi-use	110,687	-3.3	-1.5
Robbins Health Learning Centre	multi-use	182,401	-2.6	-0.5
City Centre Campus - 105 Street	multi-use	119,295	-2.6	-0.8
Centre for the Arts & Comm.	multi-use	148,969	-1.9	-0.5
Student Residence Building	multi-use	268,589	-1.6	-0.6
University Service Centre	office	66,682	1.0	0.3

