



Facilities Management & Ancillary Services – Utilities & Energy Management

# Greenhouse Gas Inventory 2014 Reporting Year

2015-11-26



# McGill University – 2014 Greenhouse Gas Emissions Inventory

## Greenhouse Emissions per Activity

Scope	Activity	Activity Level	GHG Emissions (t CO <sub>2</sub> e)	
<b>Scope 1</b> <i>Direct Emissions</i>	Stationary combustion			
	Natural gas	18,593,062 m <sup>3</sup>	35,141	59%
	Propane	14,494 L	25	< 0.1%
	Heating oil	104,106 L	285	0.5%
	Diesel	45,252 L	126	0.2%
	Gasoline	546 L	1	< 0.1%
	Refrigerants <sup>[1]</sup>	124 kg	162	0.3%
	McGill-owned fleet of vehicles			
	Diesel	12,426 L	37	0.1%
	Gasoline	86,201 L	203	0.3%
	Ethanol	120 L	0	< 0.1%
	Agriculture			
	Livestock	8,175 heads	5,848	10%
Fertilizers	33 tonnes	67	0.1%	
<b>Sub Total – Scope 1 Emissions</b>			<b>41,896</b>	<b>71%</b>
<b>Scope 2</b> <i>Indirect Emissions</i>	Purchased energy			
	Electricity <sup>[2]</sup>	182,317,239 kWh	441	0.7%
	Steam	10,053,500 lb	912	1.5%
<b>Sub Total – Scope 2 Emissions</b>			<b>1,353</b>	<b>2%</b>
<b>Scope 3</b> <i>Other Emissions</i>	Commuting			
	Faculty & staff	10,755 ppl.	4,130	7%
	Students	30,082 ppl.	2,181	4%
	Directly-financed air travel <sup>[3]</sup>	74,798,212 km-pssngr.	9,028	15%
	Solid waste			
	Domestic	2,798 tonnes	- 59	-0.1%
	CRD	5,155 tonnes	171	0.3%
	Hazardous	142 tonnes	-250	-0.4%
Water supply & treatment				
Third-party fleet <sup>[6]</sup>	2,243,612 m <sup>3</sup>	489	0.8%	
	66,114 L	199	0.3%	
<b>Sub Total – Scope 3 Emissions</b>			<b>15,888</b>	<b>27%</b>
<b>Total Downtown, Macdonald, Bellairs, and Gault (Scope 1, 2, and 3<sup>[7]</sup>)</b>			<b>59,137</b>	<b>100%</b>

Table 1 - Greenhouse Inventory per Activity, Reporting Year 2014

### Equivalent in Emissions from Cars and Carbon Sequestered by Tree Seedlings

Scope	Emissions (t CO <sub>2</sub> e)	Equivalent in cars [6] (annual emissions)	Acres of forest [7]
<b>1</b>	41,896	8,800	34,300
<b>2</b>	1,353	300	1,100
<b>3</b>	15,888	3,300	13,000
<b>Total</b>	<b>59,137</b>	<b>12,400</b>	<b>48,400</b>

Table 2 - Greenhouse Gas Emissions per Scope and Comparables

Notes:

[1] Refrigerants for building HVAC systems only.

[2] Data for purchased electricity comes from the 2013-2014 report to the MESRS.

[3] Data includes travels for students on university business; data does not include study abroad travels.

[4] Data for the Macdonald Shuttle.

[5] Scope 3 emissions limited to those emissions listed in this table and only the Downtown and Macdonald campuses.

[6] Equivalent in annual emissions from passenger vehicles from US EPA's [Greenhouse Gas Equivalencies Calculator](#).

[7] Equivalent amount of CO<sub>2</sub> captured by acres of forest, from US EPA's [Greenhouse Gas Equivalencies Calculator](#).

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## Executive Summary

McGill University manages a stock of buildings of over 600,000 m<sup>2</sup> which are on average fifty years of age and older. A leader in education and research, McGill is characterized by very research-intensive activities, a travelling population, and high energy intensity.

In 2014 McGill emitted 59,137 tonnes of CO<sub>2</sub>e. This is the equivalent emissions from 12,400 cars in one year. This is also 16 times the annual carbon sequestration potential of McGill's forests (Gault Nature Reserve and Morgan Arboretum). Table 3 shows the relative change in greenhouse gas emissions between 2013 and 2014. The main differences are due to: a decrease in agricultural activities, an increase in steam consumption in the Ludmer Building, changes in emission factors used to calculate emissions for water supply & treatment and for electricity consumption at the Bellairs Research Institute in Barbados, as well as the inclusion of activities previously left out of the inventory. Also since January 2015, McGill has been paying emission rights for stationary combustion to the [Québec cap and trade system](#) which represent more than \$500,000 per year.

Scope	2014 Emissions (t CO <sub>2</sub> e)	2013 Emissions (t CO <sub>2</sub> e)	Change (%)
<b>1</b>	41,896	42,966	-2%
<b>2</b>	1,353	798	+70%
<b>3</b>	15,888	18,317	-13%
<b>Total</b>	<b>59,137</b>	<b>62,080</b>	<b>-5%</b>

Table 3 - Change in Emissions between 2013 and 2014

## Reductions Since 1990

2013 was McGill's first attempt at capturing as many emission sources as possible such as livestock and manure management, domestic waste disposal or travel emissions. However, emissions related to space heating and electricity usage on campus have been accounted for decades and are now 25% below 1990 levels, as illustrated in Table 4. Energy conservation projects (-26% in energy use per square foot) and a migration toward cleaner energy sources (-29% in emissions per unit of energy) are the main factors accounting for the change, in spite of campus growth (+44% square feet). Just for FY13-14, McGill's efforts have had the equivalent impact of taking 2,500 cars off the road or protecting 9,800 acres of forest land, i.e. 3 times the area of McGill's forests. The University is now setting itself ever more ambitious targets with the upcoming 2016-2020 Energy Management Plan and other Vision 2020 actions under development.

Emissions	1990	FY13-14	Change
<b>Absolute</b> (t CO <sub>2</sub> e)	49,400	37,415	-25%
<b>Per area</b> (t CO <sub>2</sub> e/m <sup>2</sup> )	90	47	-48%
<b>Per unit of energy</b> (t CO <sub>2</sub> e/GJ)	38	28	-29%

Table 4 - Changes in Emissions between 1990 and FY13-14

## System Boundary

This inventory covers, as much as possible, all assets owned by McGill University including:

- McGill's main downtown and Macdonald Campuses, both located on the Island of Montreal, QC;
- The Gault Nature Reserve located in Mont-Saint-Hilaire, QC;
- And the Bellairs Research Institute located in Holetown, Barbados.

The University comprises different entities broken down into two categories: academic units and self-funded units.

### Academic Units

Academic units include:

- All the faculties, schools and research centres;
- Libraries;
- All other administrative units including University Services.

### Self-Funded Units

Self-funded units are thus called because they are not funded by *le Ministère de l'Enseignement supérieur et de la Recherche du Québec* and should, therefore, be self-sufficient. These units include:

- Student unions (the SSMU, the PGSS, MCSS, MACES);
- Student Services;
- Student Housing and Hospitality Services;
- Faculty Clubs;
- Athletics (McGill Athletics and Macdonald Campus Athletics);
- Macdonald Campus Housing;
- Ancillary Services (the Bookstore);
- The Montreal Neurological Institute (which co-manages the Neuro with the McGill University Health Centre).

### External Entities

McGill supplies energy in part or in whole to several buildings owned or used by external entities (see list below). The emissions from these external entities are excluded from McGill's inventory.

- McGill University Health Centre (which co-owns the Neuro);
- The Canadian Aviation Heritage Centre.

## Methodology

The intent of McGill is to give as thorough as possible an account of its impact on climate change, and therefore, the report includes all scope 1 and scope 2 emissions, as well as some scope 3 emissions<sup>1</sup>. Emission accounting is based on the “emission factor” method except for emissions related to staff and student commuting.

## Existing Reporting Schemes

The University must report on most scope 1 emissions and some scope 2 emissions to the following reporting schemes:

- Mandatory reporting to **Natural Resources Canada’s National Greenhouse Gas Inventory**: scope 1 emissions from stationary combustion, organization-owned vehicles, and refrigerants regulated by the Kyoto Protocol.
- Mandatory reporting to **Québec’s cap and trade system** ([SPEDE](#) managed by the MDDELCC<sup>2</sup> within the frame of the [Western Climate Initiative](#)): scope 1 emissions from stationary combustion, organization-owned vehicles, and refrigerants regulated by the Kyoto Protocol.
- Mandatory reporting to the **City of Montreal’s airborne contaminant inventory**: scope 1 emissions from stationary combustion.
- Voluntary reporting to **AASHE<sup>3</sup> STARS**: all scopes, all activities.
- Mandatory reporting to Québec’s **MESR<sup>4</sup>**: energy use, scope 1 emissions from stationary combustion and scope 2 emissions from purchased energy.

## Data Collection

The table below lists the sources for all the data used in this report as well as the overall uncertainty associated with each set of data. Note that uncertainty of 0% means that the data set is 100% reliable and backed-up with invoices; a 100% uncertainty means there is no estimate whatsoever for the activity. Data is broken down into activities, fuels, and emission scopes. Notes on overall uncertainty of data:

- An overall uncertainty of 50% was attributed to any data set coming from a survey or an estimate made by a professional.
- An overall uncertainty of 25% was attributed to data sets backed up with invoices made available by Accounting on the premise that Accounting staff might miss some invoices.
- An overall uncertainty of 5% was attributed to electricity as the data available is for fiscal year 2012-2013 whereas this report is for calendar year 2013. Given the low impact of electricity on

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<sup>1</sup> Please refer to the Greenhouse Gas Protocol for a definition of emission scopes.

<sup>2</sup> Le Ministère du Développement durable, de l’Environnement et de la Lutte contre les changements climatiques

<sup>3</sup> The Association for the Advancement of Sustainability in Higher Education

<sup>4</sup> Le Ministère de l’Enseignement supérieur et de la Recherche du Québec



McGill's overall greenhouse gas emissions and how stable electricity consumption is, it was decided to use 2012-2013 data for electricity.

- An overall uncertainty of 10% was attributed to steam consumption data read off McGill's meters whose typical uncertainty is below 10%.

Campus	Activity	Fuel	Scope	Source	Overall Uncertainty
<b>Downtown</b>	Commute	N/A	3	All data from 2011 McGill Transportation Survey Report	50%
	Composting	N/A	3	Monthly report from Compost Montreal Only one data set estimated	5%
	Domestic waste	N/A	3	Monthly report from waste contractor	0%
	Generators	Diesel	1	Invoices from fuel supplier, collected by Accounting	25%
	Grounds	Diesel	1	Invoices from fuel supplier, collected by Accounting	25%
	Heating/processes	Natural gas	1	Invoices (online report) from utility company	0%
	Purchased Energy	Electricity		Annual report (fiscal year) to the MESRS prepared by Accounting, based on utility invoices and audited by an external auditor	5%
					Steam
	Refrigerants	N/A	1	Invoices from contractor, collected by Accounting	25%
	Vehicles	Diesel/Gasoline	1	Annual report from fleet management software, supplied by Parking Services + from SHHS (6 months missing for SHHS)	50%
<b>Macdonald</b>	Cattle	N/A	1	Headcount and information on manure management from Farm Manager	0%
	Composting	N/A	3	Estimate from the Supervisor of Property Maintenance	50%
	Domestic waste	N/A	3	Monthly report from waste contractor	0%
	Fertilizers	N/A	1	Volumes spread according to Chief Agronomy Technician	0%
	Generators	Diesel	1	Invoices from fuel supplier	0%
	Grounds	Diesel/Gasoline	1	Annual report from the Supervisor of Property Maintenance, based on each vehicle's fuel log	0%
	Heating/processes	Natural gas Heating oil Propane	1	Invoices (online report) from utility company	0%
				Invoices from fuel supplier	0%
				Invoices from supplier	0%
	Purchased energy	Electricity	2	Annual report (fiscal year) to the MESRS prepared by Accounting, based on utility invoices and audited by an external auditor	5%
	Refrigerants	R134a	1	Invoices from contractor	0%
Vehicles	Diesel/Gasoline	1	Annual report from the Supervisor of Property Maintenance, based on each vehicle's fuel log	0%	
Third-Party Fleet	Diesel	3	Reports from shuttle service provider.	0%	
<b>Gault Nature Reserve</b>	Heating/processes	Heating oil	1	Annual report to the MESRS prepared by Accounting, based on utility invoices and audited by an external auditor.	0%
	Purchased Energy	Electricity	2	Annual report to the MESRS prepared by Accounting, based on utility invoices and audited by an external auditor.	0%

Campus	Activity	Fuel	Scope	Source	Overall Uncertainty
<b>Bellairs Research Institute</b>	Purchased Energy	Electricity	2	Annual report to the MESRS prepared by Accounting, based on utility invoices and audited by an external auditor.	0%
<b>University</b>	Air Travel	Kerosene	3	Report from McGill's Travel Helpdesk based on re-imbursement requests	25%
	CRD waste	N/A	3	Estimate from Architect, Design Services	50%
	Hazardous Waste	N/A	3	Annual report (fiscal year) from Hazardous Waste Management. Only the largest items are included..	50%
	Water	N/A	3	Surveys water-consuming equipment on the Downtown and Macdonald campuses	50%

Table 5 - Data Sources and Uncertainty

### Emission Factors

Emission factors used in this report come from the following main organizations: *Le Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques du Québec (MDDELCC)*, the Intergovernmental Panel on Climate Change (IPCC), the US Environmental Protection Agency (US EPA), Natural Resources Canada (NRCan), the Ministry of Environment of British Columbia, the Government of Barbados, and McGill. For a detailed list of emission factors with their units, refer to Appendix A – Emission Factors. The tables below list the sources of the main emission factors used for the 2014 inventory.

Fuel	Organization	Source Specifics
<b>Diesel (Stationary Combustion)</b>	MDDELCC	LRQ Q-2, r. 15, Tableau 1-3, Diesel
<b>Propane</b>		LRQ Q-2, r. 15, Tableau 1-3, Propane - Autres secteurs
<b>Heating Oil #2</b>		LRQ Q-2, r. 15, Tableau 1-3, Mazout léger - Foresterie, construction et secteurs commerciaux et institutionnels
<b>Natural Gas</b>		LRQ Q-2, r. 15, Tableau 1-4 & Tableau 1-7, Secteurs résidentiels etc.
<b>Gasoline (Transportation)</b>		LRQ Q-2, r. 15, Tableau 27-1, Véhicule à essence
<b>Diesel (Transportation)</b>		LRQ Q-2, r. 15, Tableau 27-1, Véhicule au diesel

Table 6 - Emission Factor Source, Fossil Fuels

Fuel	Organization	Source Specifics
<b>Refrigerant R134a</b>	MDDELCC	LRQ Q-2, r. 15, Annexe A.1, HFC-134a
<b>Refrigerant R22</b>	IPCC	IPCC 4th Assessment Report, Table 2.14

Table 7 - Emission Factors Source, Refrigerants

Fuel	Organization	Source Specifics
<b>Fertilizer 46-0-0</b>	US EPA	Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors, Ch. 14.1
<b>Fertilizer 27-0-0</b>		
<b>Fertilizer 3-16-20</b>		
<b>Fertilizer 28-26-0</b>		
<b>Livestock (Dairy Cows)</b>	NRCan	National Inventory Report 1990-2010, Annex 3
<b>Livestock (Dairy Heifers)</b>		
<b>Livestock (Calves)</b>		
<b>Livestock (Market Hogs)</b>		
<b>Livestock (Meat Chickens)</b>		
<b>Livestock (Laying Hens)</b>		

Table 8 - Emission Factor Source, Agriculture

Fuel	Organization	Source Specifics
<b>Electricity, Québec</b>	NRCan	National Inventory Report 1990-2010, Annex 13, Table A13-6
<b>Electricity, Barbados</b>	Barbados Govt	Sustainable Energy Framework for Barbados, Final Report Vol 1, Jun 2010. From Table 2-24 in 2008
<b>Steam</b>	McGill	Calculated, assuming Royal Victoria Hospital steam distribution comparable to McGill's.

Table 9 - Emission Factor Source, Purchased Energy

Fuel	Organization	Source Specifics
<b>Air Travel (Long Haul)</b>	Environment BC	2013 BC Best Practices Methodology for Quantifying GHG Emissions, Table 11
<b>Air Travel (Medium Haul)</b>		
<b>Air Travel (Short Haul)</b>		
<b>Commuting (Faculty &amp; Staff)</b>	McGill	2011 McGill Transportation Survey Report, Data Extrapolated to Whole Year for Downtown Campus
<b>Commuting (Students)</b>		

Table 10 - Emission Factor Source, Travels

Fuel	Organization	Source Specifics
<b>Water (Supply)</b>	McGill	Fall 2014 ENVR 401 student project. Emission factors calculated from information gather from the City of Montreal, the City of Sainte-Anne-de-Bellevue, and Montreal Wastewater Treatment Plant.
<b>Water (Treatment)</b>		

Table 11 - Emission Factor Source, Water Supply & Treatment

Fuel	Organization	Source Specifics
<b>Domestic Waste</b> Landfill	US EPA	Warm Reduction Model Emission Factor for Municipal Solid Waste, Landfill, US National Average
<b>Domestic Waste</b> Recycling, Glass - Metal – Plastic		Warm Reduction Model Emission Factor for Mixed Recyclables, Landfilling – US National Average & Recycling
<b>Domestic Waste</b> Recycling, Paper – Cardboard		Warm Reduction Model Emission Factor for Mixed Papers (Mainly from Offices), Landfilling – US National Average & Recycling
<b>Domestic Waste</b> Composting		Warm Reduction Model Emission Factor for Mixed Organics, Landfilling – US National Average & Recycling
<b>CRD Waste</b> Landfill		Warm Reduction Model Emission Factor for Concrete, Landfilling – US National Average
<b>CRD Waste</b> Recycling		Warm Reduction Model Emission Factor for Concrete, Landfilling – US National Average & Recycling
<b>Hazardous Waste</b> E-waste		Warm Reduction Model Emission Factor for Personal Computers, Recycling
<b>Hazardous Waste</b> Scrap Metal		Warm Reduction Model Emission Factor for Mixed Metals, Recycling
<b>Hazardous Waste</b> Decayed Radioactivity		Warm Reduction Model Emission Factor for Municipal Solid Waste, Landfill, US National Average
<b>Hazardous Waste</b> Biomedical, Non Anatomical	NRCan	Travel Emission Factor from US EPA Emission Factors for Greenhouse Gas Inventories, Table 8, Medium- to Heavy-Duty Vehicles (in tCO <sub>2</sub> e/short ton-mi) Combustion Emission Factors from NRCan Waste GHG Calculator assuming a mix of 90% mixed plastics, 9% mixed paper and 1% mixed glass, distance to landfill set to 0 km, no recovery from fumes.
<b>Hazardous Waste</b> Biomedical, Anatomical	US EPA	Travel Emission Factor from US EPA Emission Factors for Greenhouse Gas Inventories, Table 8, Medium- to Heavy-Duty Vehicles (in tCO <sub>2</sub> e/short ton-mi) Combustion Emission Factors from NRCan Waste GHG Calculator assuming organic waste to be equivalent to “food scrap”, distance to landfill set to 0km, no recovery from fumes.

Table 12 - Emission Factor and Source, Solid Waste

### Limitations

US average emission factors were used for waste management because factors are not available yet for the Greater Montreal Area. An Applied Student Research has been proposed to students enrolled in ENVR-401 this fall with the goal to determine emission factors that would better represent the context of the Greater Montreal and McGill.

Last year’s report used UK’s DEFRA emission factors for water supply and treatment as no other factor were available for North America. In Fall 2014, a group of students enrolled in ENVR401 calculated specific factors for the Montreal downtown and Macdonald campuses. These factors are used in this year’s report and are much lower than DEFRA’s.

No emission factor is applicable to the disposal of most type of hazardous waste (e.g. fluorescent tubes, alkaline batteries, etc.) A project will be proposed for students to investigate emissions factors based on annual activity reports from Hazardous Waste Management.

Additionally, the following activities are known to be missing from the 2013 inventory:

Activity	Category	Scope	Unit	Plan
<b>Travel, university sport teams</b>	Directly-financed air travel, rail travel	3	McGill Athletics and Macdonald Athletics	Seek cooperation of Athletics
<b>Rail travel</b>	Directly-financed, rail travel	3	All units	Procurements working on better reporting from travel management company
<b>Car rentals</b>	Directly-financed, car rentals	3	All units	Seek cooperation of the Travel Desk
<b>Business trips with staff vehicles</b>	Directly-financed travel, personal vehicles	3	All units	Seek cooperation of the Travel Desk
<b>Refrigerants, arenas</b>	Refrigerants	1	Building Operations, McGill Athletics, and Macdonald Athletics	Seek cooperation of Building Operations
<b>Various (refrigerants, commute, waste, vehicles, etc.)</b>	Various	1,3	Gault Nature Reserve and Bellairs Research Institute	N/A. Negligible amounts.

Table 13- Missing Data

## Data

Refer to Appendix B – Greenhouse Gas Emissions per for a full list of activities, activity levels, and emissions. The table below shows the emissions for all units and all campuses for calendar year 2013.

### Emissions per Activity

Scope	Activity	Activity Level	GHG Emissions (t CO <sub>2</sub> e)	
<b>Scope 1</b> <i>Direct Emissions</i>	Stationary combustion			
	Natural gas	18,593,062 m <sup>3</sup>	35,141	59%
	Propane	14,494 L	25	< 0.1%
	Heating oil	104,106 L	285	0.5%
	Diesel	45,252 L	126	0.2%
	Gasoline	546 L	1	< 0.1%
	Refrigerants <sup>[1]</sup>	124 kg	162	0.3%
	McGill-owned fleet of vehicles			
	Diesel	12,426 L	37	0.1%
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	Livestock	8,175 heads	5,848	10%
Fertilizers	33 tonnes	67	0.1%	
<b>Sub Total – Scope 1 Emissions</b>			<b>41,896</b>	<b>71%</b>
<b>Scope 2</b> <i>Indirect Emissions</i>	Purchased energy			
	Electricity <sup>[2]</sup>	182,317,239 kWh	441	0.7%
	Steam	10,053,500 lb	912	1.5%
<b>Sub Total – Scope 2 Emissions</b>			<b>1,353</b>	<b>2%</b>
<b>Scope 3</b> <i>Other Emissions</i>	Commuting			
	Faculty & staff	10,755 ppl.	4,130	7%
	Students	30,082 ppl.	2,181	4%
	Directly-financed air travel <sup>[3]</sup>	74,798,212 km-pssngr.	9,028	15%
	Solid waste			
	Domestic	2,798 tonnes	- 59	-0.1%
	CRD	5,155 tonnes	171	0.3%
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	Water supply & treatment	2,243,612 m <sup>3</sup>	489	0.8%
Third-party fleet <sup>[6]</sup>	66,114 L	199	0.3%	
<b>Sub Total – Scope 3 Emissions</b>			<b>15,888</b>	<b>27%</b>
<b>Total Downtown, Macdonald, Bellairs, and Gault (Scope 1, 2, and 3<sup>[7]</sup>)</b>			<b>59,137</b>	<b>100%</b>

Table 14 - Greenhouse Gas Emissions per Activity and Scope, 2013 Reporting Year

## Greenhouse Gas Equivalencies

Scope	Emissions (t CO <sub>2</sub> e)	Equivalent in cars [6] (annual emissions)	Acres of forest [7]
<b>1</b>	41,896	8,800	34,300
<b>2</b>	1,353	300	1,100
<b>3</b>	15,888	3,300	13,000
<b>Total</b>	<b>59,137</b>	<b>12,400</b>	<b>48,400</b>

Table 15 - Greenhouse Gas Equivalencies

### Notes:

[1] Refrigerants for building HVAC systems only.

[2] Data for purchased electricity comes from the 2013-2014 report to the MESRS.

[3] Data includes travels for students on university business; data does not include study abroad travels.

[4] Data for the Macdonald Shuttle.

[5] Scope 3 emissions limited to those emissions listed in this table and only the Downtown and Macdonald campuses.

[6] Equivalent in annual emissions from passenger vehicles from US EPA's [Greenhouse Gas Equivalencies Calculator](#).

[7] Equivalent amount of CO<sub>2</sub> captured by acres of forest, from US EPA's [Greenhouse Gas Equivalencies Calculator](#).





## Appendix A – Emission Factors

Fuel	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Other	EF Unit	Overall EF	Overall EF Unit	Source Org	Source Specifics
<b>Diesel</b> (Stationary Combustion)	2,663.00	0.13	0.40	0.00E+00	g/L	2.79E-03	t CO <sub>2</sub> e/L	MDDELCC	LRQ Q-2, r. 15, Tableau 1-3, Diesel
<b>Gasoline</b> (Stationary Combustion)	2,289.00	2.70	0.05	0.00E+00	g/L	2.36E-03	t CO <sub>2</sub> e/L	MDDELCC	LRQ Q-2, r.15, Tableau 27-1, Véhicule à essence
<b>Heating Oil #2</b>	2,725.00	0.03	0.03	0.00E+00	g/L	2.74E-03	t CO <sub>2</sub> e/L	MDDELCC	LRQ Q-2, r. 15, Tableau 1-3, Mazout léger - Foresterie, construction et secteurs commerciaux et institutionnels
<b>Natural Gas</b>	1,878.00	0.04	0.04	0.00E+00	g/m <sup>3</sup>	1.89E-03	t CO <sub>2</sub> e/m <sup>3</sup>	MDDELCC	LRQ Q-2, r. 15, Tableau 1-4 & Tableau 1-7, Secteurs résidentiels etc.
<b>Propane</b>	1,510.00	0.02	0.11	0.00E+00	g/L	1.54E-03	t CO <sub>2</sub> e/L	MDDELCC	LRQ Q-2, r. 15, Tableau 1-3, Propane - Autres secteurs
<b>Diesel</b> (Transportation)	2,663.00	0.15	1.10	0.00E+00	g/L	3.01E-03	t CO <sub>2</sub> e/L	MDDELCC	LRQ Q-2, r. 15, Tableau 27-1, Véhicule au diesel
<b>Ethanol</b> (Transportation)	1,494.00	2.70	0.05	0.00E+00	g/L	1.57E-03	t CO <sub>2</sub> e/L	MDDELCC	LRQ Q-2, R.15, Tableau 27-1, Tout véhicule alimenté à l'éthanol
<b>Gasoline</b> (Transportation)	2,289.00	2.70	0.05	0.00E+00	g/L	2.36E-03	t CO <sub>2</sub> e/L	MDDELCC	LRQ Q-2, r. 15, Tableau 27-1, Véhicule à essence
<b>Refrigerant</b> R134a	0.00	0.00	0.00	1.30E+06	g/kg	1.30E+00	t CO <sub>2</sub> e/kg	MDDELCC	LRQ Q-2, r. 15, Annexe A.1, HFC-134a
<b>Refrigerant</b> R22	0.00	0.00	0.00	1.81E+06		1.81E+00		IPCC	IPCC 4th Assessment Report, Table 2.14
<b>Fertilizer</b> 27-0-0	0.00	0.00	4,964.00	0.00E+00	g/ton	1.54E+00	t CO <sub>2</sub> e/ton	US EPA	Emissions Factors & AP 42, Computation of Air Pollutant Emission Factors, Ch. 14.1
<b>Fertilizer</b> 28-26-0	0.00	0.00	5,148.00	0.00E+00		1.60E+00			
<b>Fertilizer</b> 3-16-20	0.00	0.00	551.60	0.00E+00		1.71E-01			
<b>Fertilizer</b> 46-0-0	0.00	0.00	8,547.00	0.00E+00		2.65E+00			
<b>Livestock</b> (Calves)	0.00	41,100.00	40,820.60	0.00E+00	g/head	1.35E+01	t cO <sub>2</sub> e/head	NRCan	National Inventory Report 1990-2010, Annex 3
<b>Livestock</b> (Dairy Cows)	0.00	154,700.00	157,891.00	0.00E+00		5.22E+01			
<b>Livestock</b> (Dairy Heifers)	0.00	91,500.00	88,264.92	0.00E+00		2.93E+01			
<b>Livestock</b> (Laying Hens)	0.00	30.00	10.00	0.00E+00		3.73E-03			
<b>Livestock</b> (Market Hogs)	0.00	9,400.00	17,442.86	0.00E+00		5.60E+00			

<b>Livestock</b> (Meat Chickens)	0.00	30.00	10.00	0.00E+00		3.73E-03			
<b>Electricity</b> (Québec)	2.00	0.00	0.00	0.00E+00	g/kWh	2.04E-06	t CO2e/kWh	NRCan	National Inventory Report 1990-2010, Annex 13, Table A13-6
<b>Electricity</b> (Barbados)	0.00	0.00	0.00	8.79E+02	g/kWh	8.79E-04	t CO2e/kWh	Gov of Barbados	Sustainable Energy Framework for Barbados
<b>Steam</b>	0.00	0.00	0.00	9.07E+01	g/lb	9.07E-05	t CO2e/lb	McGill	Calculated, assuming Royal Victoria Hospital steam distribution comparable to McGill's.
<b>CRD Waste</b> (Landfill)	0.00	0.00	0.00	4.41E+04		4.41E-02			Warm Reduction Model Emission Factor for Concrete, Landfilling - National Average
<b>CRD Waste</b> (Recycling)	0.00	0.00	0.00	- 1.10E+04		-1.10E-02			Warm Reduction Model Emission Factor for Concrete, Landfilling - National Average & Recycling
<b>Domestic Waste</b> (Mixed Municipal Solid Waste, Landfill)	0.00	0.00	0.00	5.29E+05		5.29E-01			Warm Reduction Model Emission Factor for Municipal Solid Waste, Landfill, National Average
<b>Domestic Waste</b> (Recycling, Glass - Metal - Plastic)	0.00	0.00	0.00	- 3.12E+06		-3.12E+00			Warm Reduction Model Emission Factor for Mixed Recyclables, Landfilling - National Average & Recycling
<b>Domestic Waste</b> (Recycling, Paper - Cardboard)	0.00	0.00	0.00	- 3.96E+06		-3.96E+00		US EPA	Warm Reduction Model Emission Factor for Mixed Papers (Mainly from Offices), Landfilling - National Average & Recycling
<b>Domestic Waste</b> (Composting, Food )	0.00	0.00	0.00	- 1.54E+05	g/ton	-1.54E-01	t CO2e/ton		Warm Reduction Model Emission Factor for Mixed Organics, Landfilling - National Average & Recycling
<b>Domestic Waste</b> (Composting, Yard Trimmings)	0.00	0.00	0.00	- 1.32E+05		-1.32E-01			Warm Reduction Model Emission Factor for Yard Trimmings, Composting
<b>Hazardous Waste</b> (E-waste)	0.00	0.00	0.00	- 2.77E+06		-2.77E+00			Warm Reduction Model Emission Factor for Personal Computers, Recycling
<b>Hazardous Waste</b> (Scrap Metal)	0.00	0.00	0.00	- 4.83E+06		-4.83E+00			Warm Reduction Model Emission Factor for Mixed Metals, Recycling
<b>Hazardous Waste</b> (Biomedical, Non Anatomical)	0.00	0.00	0.00	4.69E+05		4.69E-01		NRCan + US EPA	NRCan Waste GHG Calculator (90% plastic, 9% paper, 1% glass, distance to landfill 0km, incineration w no heat recovery) + US EPA Emission Factors for GHG Inventories, Table 8, Medium- and Heavy-duty Trucks, distance 1,000 km
<b>Hazardous Waste</b>	0.00	0.00	0.00	2.53E+05		2.53E-01			NRCan Waste GHG Calculator (food scrap, distance to landfill 0km, incineration w no heat recovery) + US EPA Emission Factors for GHG

(Biomedical,  
Anatomical)

Inventories, Table 8, Medium- and Heavy-duty  
Trucks, distance 1,000 km

<b>Air Travel</b> (Long Haul)	0.00	0.00	0.00	1.21E+02		1.21E-04			
<b>Air Travel</b> (Medium Haul)	0.00	0.00	0.00	1.03E+02	<b>g</b> <b>/psngr-km</b>	1.03E-04	<b>t CO2e</b> <b>/pasngr-km</b>	<b>Environment</b> <b>BC</b>	<b>2013 BC Best Practices Methodology for</b> <b>Quantifying GHG Emissions, Table 11</b>
<b>Air Travel</b> (Short Haul)	0.00	0.00	0.00	1.74E+02		1.74E-04			
<b>Commuting</b> (Faculty & Staff)	0.00	0.00	0.00	3.84E+05		3.84E-01			
<b>Commuting</b> (Students)	0.00	0.00	0.00	7.25E+04	<b>g/pers.</b>	7.25E-02	<b>t CO2e/pers.</b>	McGill	2011 McGill Transportation Survey Report, Data Extrapolated to Whole Year for Downtown Campus
<b>Water</b> (Supply, Downtown)	0.00	0.00	0.00	8.00E+01		8.00E-05			
<b>Water</b> (Supply, Macdonald Campus)	0.00	0.00	0.00	1.10E+01	<b>g/m<sup>3</sup></b>	1.10E-05	<b>t CO2e/m<sup>3</sup></b>	McGill	ENVR 401 Student Report, Fall 2014
<b>Water</b> (Treatment)	0.00	0.00	0.00	2.31E+02		2.31E-04			



## Appendix B – Greenhouse Gas Emissions per Fuel

Campus	Client	Category	Activity		GHG Emissions (t CO2e)	Scope
Downtown Campus	Academic Buildings	On-Site Stationary Combustion	Stationary Combustion, Natural Gas	12,232,650 m <sup>3</sup>	23,120	1
		Purchased Electricity	Electricity (QC Grid)	129,770,028 kWh	265	2
		Purchased Steam	Steam	10,053,500 lb	912	2
	Athletics	On-Site Stationary Combustion	Stationary Combustion, Natural Gas	1,413,804 m <sup>3</sup>	2,672	1
		Purchased Electricity	Electricity (QC Grid)	8,242,079 kWh	17	2
	Bookstore	On-Site Stationary Combustion	Stationary Combustion, Natural Gas	61,608 m <sup>3</sup>	116	1
		Purchased Electricity	Electricity (QC Grid)	461,107 kWh	1	2
	Faculty Club	On-Site Stationary Combustion	Stationary Combustion, Natural Gas	15,547 m <sup>3</sup>	29	1
		Purchased Electricity	Electricity (QC Grid)	346,590 kWh	1	2
		Solid Waste	Domestic Waste, Composting, Food	1 tons	-0	3
	MACES	Purchased Electricity	Electricity (QC Grid)	132,960 kWh	0	2
	Student Housing & Hospitality Services	On-Site Stationary Combustion	Stationary Combustion, Diesel	7,368 L	21	1
		On-Site Stationary Combustion	Stationary Combustion, Natural Gas	2,440,751 m <sup>3</sup>	4,613	1
		On-Site Transportation	Transportation, Ethanol	120 L	0	1
		On-Site Transportation	Transportation, Gasoline	758 L	2	1
		Purchased Electricity	Electricity (QC Grid)	20,443,766 kWh	42	2
		Solid Waste	Domestic Waste, Composting, Food	67 tons	-10	3
		Solid Waste	Domestic Waste, Municipal Solid Waste	309 tons	163	3
		Solid Waste	Domestic Waste, Recycling, Glass - Metal - Plastic	21 tons	-66	3
	Student Services	On-Site Stationary Combustion	Stationary Combustion, Natural Gas	5,953 m <sup>3</sup>	11	1
		Purchased Electricity	Electricity (QC Grid)	1,199,286 kWh	2	2
	The Montreal Neurological Institute	On-Site Stationary Combustion	Stationary Combustion, Natural Gas	137,621 m <sup>3</sup>	260	1
		Purchased Electricity	Electricity (QC Grid)	3,384,100 kWh	7	2
	The PGSS	On-Site Stationary Combustion	Stationary Combustion, Natural Gas	43,177 m <sup>3</sup>	82	1
		Purchased Electricity	Electricity (QC Grid)	244,370 kWh	0	2
		Solid Waste	Domestic Waste, Composting, Food	7 tons	-1	3
	The SSMU	On-Site Stationary Combustion	Stationary Combustion, Natural Gas	238,576 m <sup>3</sup>	451	1
		Purchased Electricity	Electricity (QC Grid)	1,729,476 kWh	4	2
		Solid Waste	Domestic Waste, Composting, Food	7 tons	-1	3
	All Units	On-Site Stationary Combustion	Stationary Combustion, Diesel	13,606 L	38	1
On-Site Transportation		Transportation, Diesel	6,279 L	19	1	
On-Site Transportation		Transportation, Gasoline	82,101 L	194	1	
Faculty & Staff Commuting		Commuting, Faculty & Staff	10,755 staff	4,130	3	
Student Commuting		Commuting, Students	30,082 students	2,181	3	

		Solid Waste	Domestic Waste, Composting, Food	5 tons	-1	3		
		Solid Waste	Domestic Waste, Municipal Solid Waste	1,617 tons	855	3		
		Solid Waste	Domestic Waste, Recycling, Glass - Metal - Plastic	330 tons	-1,030	3		
		Water Supply & Treatment	Water, Supply, Downtown	2,063,648 m <sup>3</sup>	165	3		
		Water Supply & Treatment	Water, Treatment	1,274,323 m <sup>3</sup>	294	3		
<b>Macdonald Campus</b>	Academic	On-Site Stationary Combustion	Stationary Combustion, Heating Oil #2	79,956 L	219	1		
		On-Site Stationary Combustion	Stationary Combustion, Natural Gas	1,699,661 m <sup>3</sup>	3,212	1		
		On-Site Stationary Combustion	Stationary Combustion, Propane	16,494 L	25	1		
		Agriculture	Fertilizer 21-0-0	8 tons	9	1		
		Agriculture	Fertilizer 27-0-0	5 tons	8	1		
		Agriculture	Fertilizer 28-26-0	3 tons	5	1		
		Agriculture	Fertilizer 46-0-0	17 tons	44	1		
		Agriculture	Livestock, Calves	20 heads	270	1		
		Agriculture	Livestock, Dairy Cows	75 heads	3,915	1		
		Agriculture	Livestock, Dairy Heifers	50 heads	1,465	1		
		Agriculture	Livestock, Laying Hens	3,200 heads	12	1		
		Agriculture	Livestock, Market Hogs	30 heads	168	1		
		Agriculture	Livestock, Meat Chickens	4,800 heads	18	1		
				Purchased Electricity	Electricity (QC Grid)	144,555,520 kWh	29	2
		Faculty Club (Macdonald Campus)		On-Site Stationary Combustion	Stationary Combustion, Natural Gas	5,700 m <sup>3</sup>	11	1
			Purchased Electricity	Electricity (QC Grid)	1,200 kWh	-	2	
	Macdonald Campus Housing		On-Site Stationary Combustion	Stationary Combustion, Natural Gas	6,746 m <sup>3</sup>	13	1	
	Student Housing & Hospitality Services		On-Site Stationary Combustion	Stationary Combustion, Natural Gas	207,610 m <sup>3</sup>	392	1	
			Purchased Electricity	Electricity (QC Grid)	606,214 kWh	1	2	
			Refrigerants & Chemicals	Refrigerant R134a	122 kg	159	1	
			Refrigerants & Chemicals	Refrigerant R22	1 kg	2	1	
			On-Site Stationary Combustion	Stationary Combustion, Diesel	24,278 L	68	1	
			On-Site Stationary Combustion	Stationary Combustion, Gasoline	546 L	1	1	
			On-Site Stationary Combustion	Stationary Combustion, Natural Gas	83,658 m <sup>3</sup>	158	1	
			On-Site Transportation	Transportation, Diesel	6,147 L	19	1	
			On-Site Transportation	Transportation, Gasoline	3,342 L	8	1	
			Purchased Electricity	Electricity (QC Grid)	759,955 kWh	2	2	
			Solid Waste	Domestic Waste, Composting, Food	51 tons	-8	3	
			Solid Waste	Domestic Waste, Composting, Yard Trimmings)	11 tons	-1	3	
			Solid Waste	Domestic Waste, Municipal Solid Waste	329 tons	174	3	
			Solid Waste	Domestic Waste, Recycling, Glass - Metal - Plastic	43 tons	-134	3	
			Water Supply & Treatment	Water, Supply, Macdonald	179,964 m <sup>3</sup>	2	3	
		Water Supply & Treatment	Water, Treatment	121,463 m <sup>3</sup>	28	3		
<b>Bellairs</b>	Academic	Purchased Electricity	Electricity (Barbados Grid)	78,588 kWh	69	2		
	Academic	On-Site Stationary Combustion	Stationary Combustion, Heating Oil #2	24,150 L	66	1		

<b>Gault Nature Reserve</b>		Purchased Electricity	Electricity (QC Grid)	462,000	kWh	1	2
<b>University</b>	All Units	Directly-Financed Air Travel	Air Travel - Long Haul	72,322,246	passenger- km	8,751	3
		Directly-Financed Air Travel	Air Travel - Medium Haul	2,166,694	passenger- km	223	3
		Directly-Financed Air Travel	Air Travel - Short Haul	309,272	passenger- km	54	3
		Solid Waste	CRD Waste, Landfill	4,124	tons	182	3
		Solid Waste	CRD Waste, Recycling	1,031	tons	-11	3
		Solid Waste	Hazardous Waste, Decayed Radioactivity	3	tonnes	2	3
		Solid Waste	Hazardous Waste, Biomedical, Anatomical	15	tonnes	4	3
		Solid Waste	Hazardous Waste, Biomedical, Non Anatomical	50	tonnes	23	3
		Solid Waste	Hazardous Waste, E-waste	41	tonnes	-113	3
		Solid Waste	Hazardous Waste, Scrap Metal	34	tonnes	-166	3
		Mobile Combustion (Shuttle)	Transportation, Diesel	66,114	L	199	3



