

March 4, 2019

Ms. Patricia Beaumont

Director, Facilities Support Operations
University of Rochester
271 East River Road
Rochester, New York 14627

RE: *Revised Greenhouse Gas Inventory*

FILE: 10490/63347

Dear **Ms. Beaumont**:

OBG, part of Ramboll (OBG) is pleased to provide the University of Rochester with this revised greenhouse gas (GHG) inventory. This letter report and the enclosed information were prepared in accordance with the scope of services outlined in our March 16, 2016 proposal. This revised GHG inventory includes revised purchased electricity consumption that was provided by University of Rochester on April 17, 2017, as well as Version 9.0 of *Clean Air Cool Planet's Campus Carbon Calculator* (Calculator).

BACKGROUND

University of Rochester is not a signatory of the American College & University Presidents' Climate Commitment (ACUPCC). However, the school is actively evaluating and implementing energy efficiency and sustainability measures across the campus. In support of evaluating the effects of implemented measures and setting its own GHG reduction goals, the University of Rochester requested OBG's assistance with completing a GHG inventory for its campus.

The GHG inventory was completed using Version 9.0 of the Calculator. This following sections describe the methodologies used to compile the data required by the Calculator to complete this inventory and also provide a discussion of the results.

DATA COMPILATION

OBG attended a project kickoff meeting at the University of Rochester campus on June 28, 2016. The purpose of this meeting was to review the GHG emission sources with campus personnel and discuss the data that was required to complete the GHG inventory. The review of GHG emission sources was conducted within the context of the requirements for use of the Calculator to complete the GHG inventory. Prior to this meeting, OBG provided University of Rochester with a scorecard for distribution to appropriate staff to identify activities that result in the emissions of GHGs, metrics that quantify the emissions from these activities during the identified baseline year and the information required for each activity.



Data was provided by the University of Rochester for the following GHG emission sources:

- Scope 1 Emission Sources
 - » Stationary sources (*e.g.*, on-campus boilers and cogeneration)
 - » Mobile sources (*e.g.*, university vehicle fleet including light trucks, heavy trucks, other non-passenger mobile sources including the on-campus bus system)
 - » Refrigerants and chemicals (*e.g.*, laboratory operations)
 - » Agriculture sources
- Scope 2 Emission Sources
 - » Purchased electricity
- Scope 3 Emission Sources
 - » Faculty/staff commuting
 - » Student commuting
 - » Solid waste

The University of Rochester indicated that the following campus buildings should be included as part of the GHG inventory since they are considered to be part of the contiguous campus:

- **Central Utilities**
 - » Middle Campus Chiller Plant (MCCP)
 - » Central Utilities (CU)
- **Medical Center**
 - » Medical Center (MC) including School of Medicine & Dentistry (SMD) and Strong Memorial Hospital (SMH)
 - » Parking Garage
 - » Eastman Dental Center
 - » Helenwood Hall (HWH)
 - » Children's School at URMC (Child Care)
- **River Campus**
 - » River Campus Buildings (Div. 18 & 20)
 - » Alumni Advancement Center (AAC)
 - » University Facilities Building (UFC)
 - » Laboratory for Laser Energetics (LLE)
 - » Graduate Housing
 - » Fraternity and Sorority Housing
 - » Grounds
 - » Danforth Dining (DANF)
 - » University Health Service (UHS)
 - » Residential Life

The following campus buildings are not considered a part of the University of Rochester's contiguous campus but are under the University of Rochester's control and operations and are also included in the GHG inventory:

- Mount Hope Campus, located at 1305 Mt. Hope Avenue
- Memorial Art Gallery (MAG)
- Eastman School of Music (ESM)
- River Campus (RC) Properties
- Cardiovascular Research Institute (CVRI), located at 211 Bailey Road
- Telecom (including Townhouse ACS)
- Science Parkway

The following paragraphs provide discussion of the methodologies that were used to compile the required data for the aforementioned GHG emission sources.

SCOPE 1 EMISSION SOURCES

The data compiled for the Scope 1 GHG emission sources is summarized below:

1. **On-campus cogeneration:** University of Rochester provided OBG with the Central Utilities (CU) Cogen Hot Water Production and Power Production data for FY2010 through FY2016. The annual natural gas consumption for the CU facility for these years was used for the purpose of estimating total natural gas consumption for the cogeneration facility for FY2010 through FY2016. The electricity output for the cogeneration facility was provided by the University, which derived its exported electrical production from monthly meter readings. The steam output for the cogeneration facility was estimated from the heat Million British thermal unit (MMBtu) recovery data for the University's records for River Campus and the Medical Center.
2. **Boilers:** University of Rochester provided OBG with the annual natural gas consumption data for the boilers that serve the campus buildings that are under the University's control, as previously discussed.
3. **Mobile sources:** University of Rochester provided OBG with the gasoline, diesel and propane consumption for mobile sources, including the on-campus bus system, for FY2010 through FY2016.
4. **Fugitive Sources:** University of Rochester provided OBG with refrigerant & chemical usage for chillers and facility operations. Leak rates and losses were provided for a portion of the refrigeration units. For those units that the University of Rochester does not track losses for, it was conservatively assumed that 1% of the total charge is released on an annual basis.
5. **Agriculture Sources:** University of Rochester provided OBG with the total pounds of synthetic fertilizer used annually for FY2010 through FY2016. The percent nitrogen content for the fertilizer was also provided.

SCOPE 2 EMISSION SOURCES

The Scope 2 GHG emission sources operated at the campus include purchased electricity. University of Rochester provided the annual purchased electricity consumption for each of the aforementioned buildings for FY2010 through FY2016. It is noted that the aforementioned revised electricity consumption provided by University of Rochester does not include electricity generated by the on-campus cogeneration facility.

SCOPE 3 EMISSION SOURCES

University of Rochester provided OBG with the following data for FY2010 through FY2016:

- The number of faculty/staff and student parking permits

- The zip codes associated with the faculty/staff and student parking permits
- The number of students living on on-campus dorms/housing
- Mass of solid waste shipped offsite for landfill disposal that was generated by the campus buildings. It was indicated that the solid waste that is generated by the University of Rochester is shipped to a landfill that provides methane recovery with electricity generation.
- Mass of solid waste incinerated. The waste sent for incineration is not used for electricity generation
- Mass of recycled material consisting of plastic, metal, glass and scrap metal
- Mass of recycled paper

The faculty/staff and student commuting miles were estimated based on the following assumptions:

- Each member of the faculty and staff makes an average of 10 one-way trips per week to the campus
- 80% of the faculty and staff travel to campus 48 weeks per year
- 20% of the faculty and staff travel to campus 42 weeks per year
- The average distance for each one-way trip for each member of the faculty or staff is 9 miles. This distance was estimated based on an evaluation of the zip code data provided for the issued parking permits for faculty/staff.
- 65% of the faculty/staff commute via personal automobile and 35% of the faculty/staff commute via public bus.

University of Rochester has indicated that students who commute to the campus use personal automobile, public bus, ride bikes and walk. University of Rochester provided the number of parking permits that were issued for each zip code from which students commute using personal automobiles. The total commuting miles for student commuting via personal automobile and public bus were estimated based on the following assumptions:

- The number of students that commute was assumed to be the difference between the total number of students and the number of students living in on-campus dorms.
- 75% of the students that commute do so via person automobile
- 25% of the students who commute do so via public bus, bicycle and walking
- Equal numbers of students commute via public bus, bicycle and walking
- Students who commute via personal automobile or public bus make 8 one-way trips to the campus per week for 30 weeks per year.
- The average distance per one-way trip for students who commute via personal automobile or public bus is 6 miles. This distance was estimated by dividing the total, combined one-way distance for 80% of the students who have parking permits.

GHG INVENTORY RESULTS

Table 1 provides the GHG emissions, in units of metric tons of carbon dioxide equivalent (MTCO_{2e}), which were estimated by the Calculator for FY2010 through FY2016 for the contiguous campus plus the additional buildings that are under the University of Rochester's control. Figure 1 provides a graphical representation of the estimated GHG emission intensity in units of metric tons of CO_{2e} per thousand gross square foot (MTCO_{2e}/1000GSF). Figure 2 provides the relative contributions of the various GHG emission sources to the

total campus-wide GHG emissions. Figure 3 provides a summary of the absolute GHG emissions for FY2010 through FY2016, along with a depiction of the GSF for this same time period.

As shown in Table 1, the total GHG emissions for the University of Rochester have increased by approximately 9% from FY2010 emissions. It is noted that the GHG emissions estimated to be released from the landfilling of solid waste are now estimated to be negative. Version 9.0 of the Calculator utilizes an updated emission factor for the landfilling of solid waste at a facility which provides methane recovery and electricity generation. This updated emission factor reflects the avoidance of GHG emissions from the generation of electricity such that the net GHG emission factor is negative. As shown in Figure 2, the GHG emissions resulting from the operation of stationary combustion sources represent 67% of the total campus-wide emissions. The GHG emissions resulting from consumption of purchased electricity represent 14% of the total campus-wide emissions. The GHG emissions resulting from faculty/staff commuting represent 17% of the total campus-wide emissions.

The GHG emissions from Scope 2 purchased electricity have decreased by approximately 31%. This decrease is likely attributed to the decrease in purchased electricity due to the installation of the on-campus cogeneration facility.

The GHG emissions from Scope 1 stationary combustion have increased by approximately 21%. This increase may be attributed to the following:

- An increase in natural gas consumption for on-campus cogeneration facility of approximately 24% from the FY2010 natural gas consumption.
- An increase in total GSF for the University of Rochester of approximately 7% from the FY2010.

It is also noted that the GHG emissions from faculty/staff commuting increased 21% since FY2010. These increases may be attributed to a 21% increase in the total number of faculty and staff since FY2010. The total number of students increased by 14% since FY2010.

In general, the GHG emissions from the Scope 1, Scope 2 and Scope 3 emission sources at the University of Rochester have increased since FY2010. As shown in Figure 1, the GHG emission intensity has increased from 16.9 MTCO₂e/1000GSF to 17.2 MTCO₂e/1000GSF since FY2010. However, it is noted that, while the emission intensity was initially increasing from FY2010 to FY2015, it has since decreased from 18.5 MTCO₂e/1000GSF to 17.2 MTCO₂e/1000GSF.

Should you have questions regarding this letter or the enclosed information, please do not hesitate to Tricia D'Agostino at (315) 956-6774.

Very truly yours,
O'BRIEN & GERE ENGINEERS, INC.



Jamie D. Newtown
Director

Attachments: Table 1 – Summary of GHG Emissions
Figure 1 – Greenhouse Gas Emission Intensity
Figure 2 – GHG Emission Source Contributions
Figure 3 – Absolute GHG Emissions and Gross Square Footage

cc: Tricia M. D'Agostino, P.E. - OBG



Tables

Table 1 - Summary of GHG Emissions
University of Rochester
Rochester, New York

	FY2010	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016	
GHG Emission Source	(MTCO ₂ e)	(MTCO ₂ e)	(MTCO ₂ e)	(MTCO ₂ e)	(MTCO ₂ e)	(MTCO ₂ e)	(MTCO ₂ e)	% Change ^(a)
Scope 1								
Total Stationary Source Combustion	112,152	120,452	126,438	140,269	142,340	141,992	136,067	21.3
<i>Contiguous Campus</i>	106,817	114,726	121,475	135,207	136,701	136,277	131,234	22.9
<i>Stationary combustion - Central Utilities</i>	101,804	109,082	116,446	129,955	130,887	130,520	125,906	23.7
<i>Stationary combustion - River Campus</i>	4,726	5,374	4,766	5,042	5,610	5,578	5,160	9.2
<i>Stationary combustion - Medical Center</i>	288	269	263	209	204	180	169	-41.3
<i>Non-contiguous Campus</i>	5,335	5,726	4,963	5,062	5,639	5,714	4,833	-9.4
Mobile Source Combustion	1,884	2,044	2,002	1,986	2,111	2,355	2,331	23.7
Refrigerants and Chemicals	750	630	701	586	735	680	725	-3.4
Agriculture Sources	3.63	2.83	2.82	2.98	3.35	2.77	1.44	-60.5
Total Scope 1	114,789	123,129	129,144	142,843	145,189	145,030	139,124	21.2
Scope 2								
Purchased Electricity	43,238	44,713	31,976	30,712	30,346	32,340	29,586	-31.6
<i>Contiguous Campus</i>								
<i>Purchased electricity - Central Utilities</i>	4,415	4,441	3,711	3,361	3,024	4,423	4,109	-6.9
<i>Purchased electricity - River Campus</i>	14,026	14,468	10,287	10,263	10,382	10,531	9,761	-30.4
<i>Purchased electricity - Medical Center</i>	20,259	20,974	14,448	14,122	14,065	14,451	12,931	-36.2
<i>Non-contiguous Campus</i>	4,538	4,830	3,529	2,965	2,875	2,934	2,784	-38.6
Total Scope 2	43,238	44,713	31,976	30,712	30,346	32,340	29,586	-31.6
Scope 3								
Total Commuting	30,120	30,865	31,207	33,738	34,572	36,514	36,528	21.3
<i>Faculty/staff commuting</i>	29,325	30,028	30,363	32,864	33,640	35,573	35,573	21.3
<i>Student commuting</i>	795	836	843	873	931	941	955	20.1
Solid Waste	-212	-234	-241	-244	-246	-244	-253	15.2
Total Scope 3	29,908	30,631	30,966	33,494	34,326	36,270	36,275	21.3
Total (Scope 1, 2 and 3)	187,935	198,472	192,086	207,048	209,862	213,639	204,985	9.1

Notes:

(a) Represents change in GHG emissions from FY2010 to FY2016.



Figures

Figure 1 - Greenhouse Gas Emission Intensity

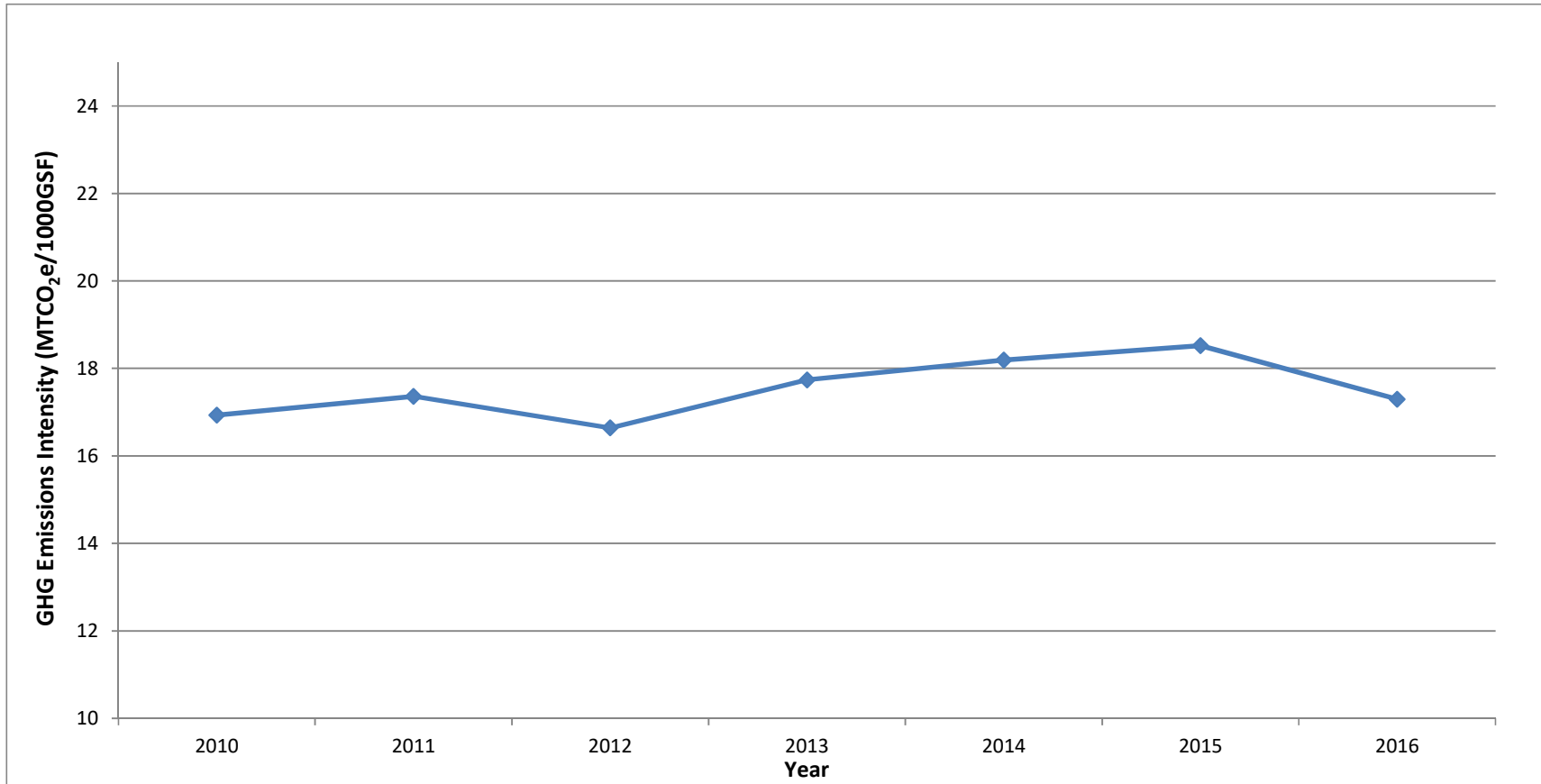


Figure 2 - GHG Emission Source Contributions

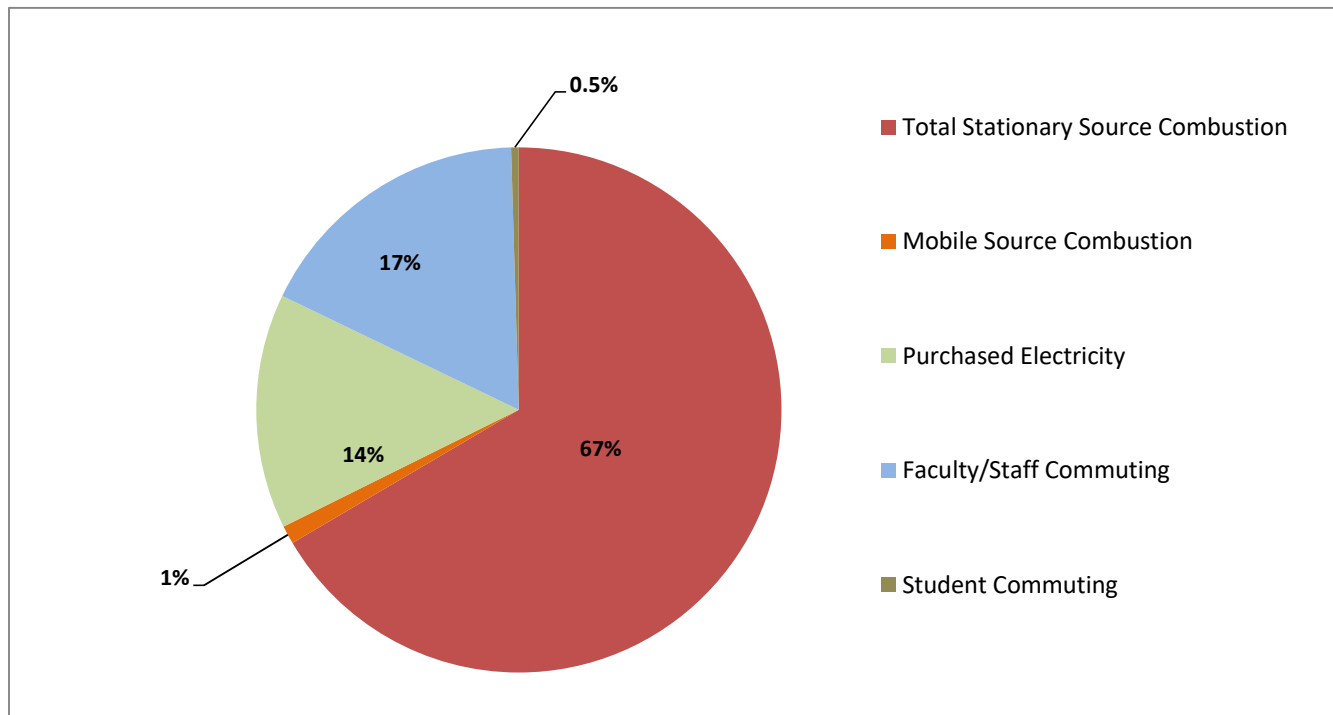


Figure 3 - Absolute GHG Emissions and Gross Square Footage

