Department of Geography, Environment and Geomatics Carbon Accounting Report 2020-2021

Mary Stuart, Work-study student, May 11th, 2021

Introduction and Departmental Climate Policy

The Department of Geography, Environment, and Geomatics is in the process of establishing the most effective means by which to reduce its carbon footprint and provide leadership to the University of Ottawa in responding to the climate crisis. This is the second in a series of reports seeking to create an inventory of the department's GHG emissions following the Climate Policy that was enacted on January 16th, 2020.

This report will briefly frame the University of Ottawa's climate commitments in the larger picture and then will detail the department's current emissions. It will then provide some considerations for future steps that align with the departmental Climate Policy that follows:

1. Preamble: The Department of Geography, Environment and Geomatics at the University of Ottawa conducts research into the physical processes of climate change as well as the natural and societal impacts and responses to it. We acknowledge that human behaviour is the root cause of present-day climate change, and we have developed this policy to be transparent about our own behaviour, and to work toward eliminating its contribution to climate change.
2. Aspiration: The Department aims to become carbon neutral. While the research and teaching we do *requires* traveling to work, field sites and conferences, lighting, heating and cooling our buildings, and powering our equipment, we aim to reduce and ethically offset the greenhouse gas emissions generated by these activities with the ultimate goal to achieve carbon neutrality.
3. Transparency: To assess our progress, we will conduct regular climate audits to track our progress toward reducing and offsetting our greenhouse gas emissions. While many activities contribute to greenhouse gas emissions, we will focus on the following important sources: Air travel, commuting, heating and cooling, electricity use, as well as our offset activities. We will make the results of our climate audits publicly available on our website, broken down into collective (e.g. heating and cooling), teaching (e.g., field courses) and individual (e.g. air travel) contributions. Individual contributions may be accompanied by statements explaining the necessity of the emissions (e.g. travel to remote field sites) and actions taken to reduce them.

4. Reductions: The department is committed to providing the tools for reducing greenhouse gas emissions, for example by developing teleconferencing infrastructure and by looking for energy savings in our offices, laboratories and classrooms. We will propose to the central university administration to make the Simard Building a pilot project on campus for smarter energy management (e.g., heating in the garage, cooling in offices) and work towards LEED-EBOM certification.
5. Influencing: We will work with the university community to make these policies widespread on campus and we will continue to include climate change awareness in our teaching and collaboration with students. We will also involve students in research activities required to accomplish the goals of this policy.

Disclaimer

The information provided in this report is based on currently available data which is subject to change as new information becomes available. Further, some of the data presented must be necessarily understood within the context of the COVID-19 pandemic as it is not representative of average annual data. This document is to be taken as a contribution to the department's understanding of its environmental impact and used for discussion and future improvement of accounting methods.

Acknowledgments

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Context

Canada's Climate Commitments

In 2015, Canada signed the Paris Agreement, thereby committing to reducing its greenhouse gas (GHG) emissions by 30% below 2005 levels by 2030 (Environment and Climate Change Canada, 2021). However, as of 2020, Canada's GHG emissions are projected to reach 674 Mt of CO_2e in 2030, which is 163 Mt higher than its Paris Agreement target. Canada has plans to reduce its emissions to exceed its target by 8Mt and it has since committed to reaching net-zero emissions by 2050 (Environment and Climate Change Canada, 2021; Government of Canada, 2021). Although the Paris Agreement committed its 195 signatories to limiting planetary warming to well below 2°C, the most recent nationally determined contributions (NDC) sent to the UN do not meet the 45% reduction in total carbon emissions that is required to limit warming to 1.5°C (Gabbatiss, 2021).

uOttawa's Climate Commitments

The University of Ottawa has reduced its emissions through several actions including the creation of the EcoProsperity deep energy retrofit Program[1], replacing a third of Facilities' fleet vehicles with electric vehicles, and improving cycling infrastructure on campus (University of Ottawa, 2021). As outlined in its Campus Sustainability Plan, the University aims to achieve carbon neutrality by 2040 (ten years ahead of the national target) and eliminate its remaining scope 1 emissions (those emitted through direct energy combustion by the University) by 2050.[2] The University plans to reduce emissions through a combination of measures including creating solar photovoltaic and deep energy retrofit projects as well as creating guidelines that require new building construction to target carbon neutral operations (Office of Campus Sustainability, n.d.). The University's sustainability plan also targets a reduction in its overall volume of waste by 30% by 2030 and to become zero waste by 2050, although it has not associated emissions reductions with these targets. Further, Policy 72 on Environmental Management and Sustainability that was adopted in 2017 requires that all faculties and services create a Sustainability plan that aligns with the institution's goals. Materials have now been created by the Office of Campus Sustainability to support the creation of these plans.[3]

[1] Deep energy retrofit programs are those that lead to a reduction in a building's energy consumption by 25% or more (Facilities, n.a.).
[2] Based on figures shared in its report *Action on Climate Change by the University of Ottawa 2019-2020*, this reduction will account for roughly 34.5% of the University's total emissions.
[3] No such plan has been created yet.

Definitions

Organizational and operational boundaries

- Setting organizational boundaries entails defining the facilities to be taken into consideration for an organization's carbon inventory, while operational boundaries define the activities and associated emissions that are included as well as the chosen scopes for direct and indirect emissions (Bhatia & Ranganathan, 2004).
- For this report, the organizational boundaries will be the two floors of the Simard building where the department is located.
- The operational boundaries for this report include emissions associated with the heating, cooling and electricity for the Simard building, business travel (flying) and commuting (pre-COVID responses).

Emissions scopes

The Greenhouse Gas Protocol[4] divides emissions into three 'scopes' to help delineate emissions sources, to improve transparency and to help organizations effectively account for their emissions (Bhatia & Ranganathan, 2004).

Scope 1: Direct emissions from sources owned or controlled by the organization.
Scope 2: Indirect emissions from purchased electricity.
Scope 3: Following the Greenhouse Gas Protocol, organizations must report on scopes 1 and 2 at a minimum. Scope 3 includes all other indirect emissions that are caused by the operations of the reporting company but that are not emitted by sources that are owned by it nor are under its control. These can be from goods consumed, waste production, commuting, and business travel (Bhatia & Ranganathan, 2004).

Global Warming Potential:

Global Warming Potentials (GWPs) allow for comparisons to be made between the effect of different greenhouse gases (GHGs) and constitute the amount of energy that the emission of 1 ton of a certain gas will absorb over a set period of time relative to the emissions from 1 ton of carbon dioxide (CO_2) (US Environmental Protection Agency, n.d.).

Carbon Dioxide Equivalent:

This is a measure used to compare GHG emissions based on their GWP expressed as CO_2e (Organization for Economic Cooperation and Development, 2013). Most emissions in this report will be expressed in CO_2e.

[4] The Greenhouse Gas Protocol (GHG Protocol) was created by the World Resources Institute and the World Business Council for Sustainable Development in recognition of a need for an international standard for GHG accounting and reporting (GHG Protocol,n.d.). The GHG Protocol now offers the most widely used accounting standards for GHGs (GHG Protocol, n.d.).

Emissions Accounting

Scope 1

This scope will encompass direct emissions from the heating of the Simard building. Much of the University of Ottawa's main campus is heated and cooled by a district energy system which circulates hot water, steam, and cold water through a network of underground pipes connecting campus buildings. Heating is powered through the combustion of natural gas at the University's power plant. District energy systems are more sustainable than other heating and cooling systems thanks to their high efficiency: these systems reduce the number of individual boilers and cooling units needed to regulate temperature in a series of buildings and allow hot and cold air to flow between buildings. Further, heat can be recycled from the district cooling system to improve heating efficiency.

Simard is heated and cooled through the district system and for this reason there is no account that details the energy used for heating and cooling this specific building. It is thus difficult to determine the emissions from the building's heating and cooling, so the data provided are estimates. Data for the entire Simard building were divided by four to provide estimates on the two floors occupied by the department.[5]

Energy consumption (kWh) and emissions (tonnes CO_2e) for heating [6], department of Geography, Environment and Geomatics

2019		1,173,132 kWh	208 t/CO_2e
2020		1,057,681 kWh	188 t/CO_2e

[5] The estimate of 25-30% is a personal communication, Facilities Manager Justin Hanley, May 2021. The amount will depend on the function of Café Alt.

[6] Heating energy consumption was measured in Gj but converted to kWh for this report.

Scope 2

This scope includes purchased electricity, and the University of Ottawa purchases its electricity from the Ontario power grid (hence Scope 2, unlike heating, which is a direct emission from the burning of natural gas on-site and, is therefore Scope 1). The chilled water system used to cool the University of Ottawa's campus is also powered by electricity. Data for the entire Simard building were divided by four to provide estimates on the two floors occupied by the department.

Electricity consumption (kWh) and emissions (tonnes CO_2e) for cooling, department of Geography, Environment and Geomatics

2019	88,715 kWh	2.7 t/CO_2e
2020	84,000 kWh	2.5 t/CO_2e

Electricity consumption[7] (kWh) and emissions (tonnes CO_2e), department of Geography, Environment and Geomatics

2019 [8]	114,293 kWh	4.0-5.0 t/CO_2e[8]
2020	147,506 kWh	4.4 t/CO_2e

[7] Electricity consumption other than for cooling.
[8] Data for the 2019 energy consumption is not complete and therefore not fully representative of an average year.

Scope 3

This report will look specifically at business travel and commuting. Business travel was accounted for the 2020 year based on flights accounted for through Concur, and data on commuting was collected by a survey on daily commuting habits of full-time and part-time professors. It should be noted that the number of flights reported in 2020 year was reduced due to COVID-19, and that survey data pertains to pre-pandemic commuting habits.[9]

Flights: Total flight distance (km) and associated flight emissions (tonnes CO_2)

2019 184,054 km 12.0 t/CO_2

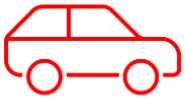
2020 61,427 km 4.3 t/CO_2

Commuting: **Total emissions from transportation amount to roughly 4.5 tonnes CO_2e**

Active transportation:
58% of respondents
Main mode of transit

Public transportation:
26% of respondents

2.1 t/CO_2e



Driving:
16% of respondents

2.4 t/CO_2e

[9] Further, business travel data only includes flights accounted for through Concur and omits other modes of transit such as helicopter flights.

A note on teleworking and the unusual COVID-19 year

It is important to mention the surprising fact that scope 1 & 2 emissions did not decline significantly between in 2020 as one might think they would have. This is because the University does not turn off the heating and electricity for buildings when they are at reduced capacity. Further, due to the COVID-19 pandemic, global use of online video calling platforms skyrocketed; by the end of April 2020, the video call platform Zoom exceeded 300 million video call participants each day (Zoom, 2020). It is possible to track and calculate emissions associated with zoom calls and conferences by considering factors such as participant computers, internet energy intensity, network data transfer, and server power ratings among other factors (Faber, 2021). Videoconferencing only uses up to 7% of the energy compared to in-person meetings (Ong et al., 2014).

Considerations for the Future

The above analysis of emissions suggests that several measures could be taken to reduce the department's carbon emissions.

Reducing emissions

Scopes 1 & 2:

- Reduce the total number of rooms occupied by faculty, staff and students.
    - This could be done by establishing more flexible use of space in the building such that rooms can become multi-purpose, for example through creating meeting rooms, and shared offices, to minimize room use.
- Make department spaces available for campus events and meetings to maximize their use.[10]
- Establish a policy and public awareness campaign on turning off lights, computers, and monitors when rooms are not occupied.[11]
- Advocate for the development of renewable energy projects on campus to enable the University to generate its own electricity (mentioned in uOttawa's Sustainability plan).
- Explore managing landscapes around the Simard building, planting trees and plants to help reduce energy consumption of the building.

Scope 3 emissions:

- Consider increasing teleworking opportunities for professors who travel lengthy distances in commuting to campus.

[10] It should be noted that a reduction in energy consumption within building space is ultimately dependent on the University's decisions to keep heating and electricity on in buildings.
[11] Coordinate with Arts IT on the feasibility of these actions.

- Establish a policy such that air travel for business purposes will only be reimbursed if the distance is over 500km.
    - In 2019, flights between Ottawa and Toronto resulted in 780 kg of CO_2. According to Via Rail Canada, taking the train between Ottawa and Toronto emits roughly 14kg of CO_2/ passenger (n.d.). If in 2019 the train had been taken between these two destinations, the associated emissions would have been reduced by about 78%.
    - Taking the train can also increase productive time by avoiding the extra time required at airports, and unlike driving, taking the train allows time to relax or work while in transit (Via Rail Canada, n.d.).
- Sign onto the Zero Emissions University Climate Pledge.
- Establish a system to record all forms of business travel in Scope 3.
- Advocate to the University Administration for a University-wide flight policy through an open letter similar to the Zero Emissions University Open Letter.
- Mandate that local and vegetarian/vegan food options be prioritized at departmental events.
    - Local and vegetarian/vegan catering options at the University of Ottawa also tend to be more cost effective, e.g., a large cheese plate of local cheeses costs $118-132 compared to an international cheese plate that ranges from $139-150 (Conventions and Reservations, n.d.).
- In order to reduce emissions associated with waste, the department can encourage faculty and students to learn about uOttawa's recycling programs and where to find appropriate recycling stations.

Thoughts for Next year's report

- Work to meet key LEED EBOM criteria e.g., perform an annual commuting survey of Simard building occupants, create a purchasing program, or work with the University to establish a system to capture rainwater on the Simard building (U.S. Green Building Council, 2019).
- Continue to communicate with the University of Ottawa's Energy Analyst as well as other specialists from Facilities to obtain more precise data on building emissions from Simard as they become available.
- Consider flight emissions calculation methods that include methane and nitrous oxide emissions as well as carbon dioxide, and possibly radiative forcing.
- Establish a mechanism for accounting for all forms of business travel (e.g., form or survey to collect this information).
- Account for emissions associated conferences as well as flights under scope 3.
- Include all faculty, staff, and students in a commuting survey.
- Research methods of incorporating more scope 3 factors in their accounting:
    - Transportation of purchased materials or goods, transportation of waste, extraction and production of purchased materials, waste disposal, disposal of waste generated in the production of materials

Appendix 1: Methodology

Scope 1:
Estimates of emissions associated with heating Simard for 2019 and 2020 were obtained from The University of Ottawa's Energy Analyst Javier Calle. These estimates were calculated first by determining the energy used to heat of Simard building based on the energy from the steam supplied to the building from uOttawa's power plant. These numbers were then multiplied by appropriate emissions factors from Canada's Greenhouse Gas Quantification Requirements and Ontario's Guide to Greenhouse Gas Emissions Reporting. It is important to note that this method of calculating emissions provides an estimate because it does not consider the efficiency of the boiler used to heat the steam supplied to Simard, nor any potential losses between the power plant and the Simard building. Data on total energy consumption in Gj were converted into kWh to present energy data in the same unit of measurement using an online calculator tool provided by the University of Ottawa Energy Analyst. Energy consumption data and associated emissions were divided by four to obtain an estimate of the heating emissions associated with the two floors occupied by the department.

Scope 2:
Electricity
Data on the electricity consumption in the Simard building for 2019 and 2020 were obtained from Javier Calle and multiplied by an emissions factor for electricity consumption intensity for Ontario. The emissions factor was obtained from Canada's National Inventory Report to the United Nations Framework Convention on Climate Change under *Electricity Generation and GHG Emission Details for Ontario*.
Cooling
Data on the energy consumption associated with cooling the Simard building for 2019 and 2020 were obtained from Javier Calle. As with the heating emissions, it is difficult to calculate emissions associated with cooling the Simard building since it is cooled by chilled water supplied by the University's power plant. However, these estimates on the energy consumption from cooling were converted from gigajoules into kilowatt hours to be multiplied by the same emissions factor used for emissions associated with electricity. This number does not consider several factors including the efficiency of the chiller used at the power plant, its age, nor any possible energy losses between the power plant and the Simard building, but it provides the best current estimate possible.

The data on electricity consumption and associated scope 2 emissions were divided by four to obtain an estimate of emissions associated with the electricity consumption of the two floors occupied by the department.

Scope 3:
Air travel
Data on business flights was gathered from submissions to Concur, the expense claim system used by the University of Ottawa. The associated emissions were calculated using the

International Civil Aviation Organization's Carbon Emissions Calculator, selected since it is from an internationally recognized body and follows a rigorous methodology. The calculator draws from databases of aircraft types, flight schedules and destinations, among other key factors in calculating emissions (ICAO, 2018). It is important to note that the ICAO Emissions calculator does not include emissions from gases other than carbon dioxide, nor does it account for radiative forcing. [12]

Commuting Survey:
Data on commuting was collected through a survey sent to part and full-time professors within the department that asked about main mode of travel used to get to campus, the distance they travel, the class of vehicle they drive, if applicable, and the number of times they are on campus during the week during the fall, winter, and spring/summer terms. Distance travelled was multiplied by the number of campus visits for a given year and then by an emissions factor associated with the mode of travel used.

Emissions factors:
Emissions factors for driving were gathered from British Columbia's Ministry of Environment and Climate Change Strategy's Methodological Guidance for Quantifying Greenhouse Gas Emissions guide. This guide is informed by several other Emissions Inventory methodology guides and is based on emissions factors and other data from authoritative sources such as Natural Resources Canada, Environment Canada, and the US Environmental Protection Agency (Ministry of Environment and Climate Change Strategy, 2019).

To estimate emissions from bussing, data on Urban Transit was taken from NRCAN's Comprehensive Energy Use Database for Ontario. Total GHG emissions in CO_2e for 2018 was divided by total passenger kilometers in order to get an average emissions factor of kg Co_2e / pkm (passenger km). To calculate the final estimate of emissions due to bussing, this figure was then multiplied by total kilometers associated with bus travel.

There are no emissions factors specifically for the O-Train, so we drew on the GHG Protocol's 2017 Emission Factors from Cross-Sector Tools. This emissions factor was multiplied by the given kilometers travelled by light rail.

[12] Radiative forcing can be understood as the impact on the total energy balance of Earth due to pollutants other than CO_2 (Timperley, 2017).

Appendix 2: References

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