GEMCC 603 / GEOG 679 Climate Change Mitigation

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Class Time / Location: Mondays, 3:30-4:50pm
LEARN online

Course Description

This course examines the anthropogenic sources of greenhouse gas emissions and the range of strategies to reduce these emissions and to enhance carbon sequestration. The policy frameworks governing climate change mitigation are critically appraised from geopolitical, economic and ethics perspectives. This course also considers the potential role of climate remediation strategies.

Learning Objectives

The key learning objectives of the course are as follows:

- Introduce students to key concepts related to energy systems, carbon intensity and the many options to reduce emissions with more sustainable supply options, including conservation;
- Provide foundational knowledge of various energy systems, carbon intensity and mitigation options;
- Develop skills with tools to study and better understand mitigation options such as national emissions inventories, Retscreen and on-line analytical tools;
- Ensure a foundational understanding of key concepts and tools, including community climate action planning, net-zero energy / zero carbon designs and quantitative performance measurement;
- Introduce climate change mitigation policy options at multilateral, national, community and household scales and develop writing and presentation skills.

The course will be managed via LEARN. Please visit the LEARN site regularly for notices and updates to the course materials.

Land Acknowledgement

“We are on the Traditional Territory of the Anishinaabeg (Mississauga Nations), the Haudenosaunee (Six Nations of the Grand River) and the Huron Wendat as well as those who exist only in blood memory to remember the ancestors who are before recorded time.” Peter Schuler, Mississaugas of the Credit First Nation

Required Text and Readings
Recommended Texts:
Miller, D. 2020. *Solved: How the world's great cities are fixing the climate crisis*, University of Toronto Press. [https://utorontopress.com/ca/solved-3](https://utorontopress.com/ca/solved-3)
RETScreen International 2005 *Clean Energy Project Analysis: RETScreen Engineering and Cases Third Edition*
Or *Energy for Sustainability*, Second Edition

There is no required textbook for this course. No single text covers all the material. Students are encouraged to read widely, starting with the readings and web sites listed on the LEARN course site.

Electronic Communication Policy

E-mail: All electronic communication for the course should be sent through LEARN. The instructor will try to reply to legitimate inquiries from students within 3 business days. Please ensure that you include the course number in the subject line, as well as a meaningful descriptor of the topic of your inquiry.

Lecture and Assignment Schedule

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<th>Week</th>
<th>Lecture Topic</th>
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<td>Course Overview / Energy Flows and Carbon: National, Community, Residential Scales</td>
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<td>Nuclear Energy: Sustainable?</td>
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<td>Efficiency: Building Envelop Solutions</td>
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<td>Residential Energy Systems</td>
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<td>Conventional Solutions: Fossil Fuel</td>
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<td>Transportation</td>
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<td>Climate Mitigation Debates: Sustainable Aviation?</td>
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Assessment and Evaluation: Summary, Weighting and Due Dates

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<th>Component</th>
<th>Due Date</th>
<th>Value (%)</th>
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<td>National Pathways: Deep Decarbonization</td>
<td>Monday, week 3</td>
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Net Zero Carbon Residential Plan

Community/Corporate Energy Plan

Transition to Low Carbon

Presentations

Participation

Total

Monday, week 7

Monday, week 12

weeks 3, 7, 12

all term

30

30

10

10

100

Assessment and Evaluation: Details

Deep Decarbonization Pathways (20%) – Pathways have been identified for deep GHG emission reductions for 15 of the largest emitting countries. Select one of the 15 countries that you want to study. National trajectories are shown for the 2010-2050 national reductions by sector. Assume that your selected country has a new leader who wants to achieve these deep reductions, not just talk about it. As a graduate of the Climate Change program, you have been hired to prepare a concise brief for the government (5 pages of text – graphs and appendices are extra). How big a change is the new pathway to previous trends? The UNFCCC collects reports on annual GHG emissions. https://di.unfccc.int/time_series What is the trend for your country 1990 to 2017? To see the trends for individual fuels see the IEA Sankey resource: https://www.iea.org/sankey/ You are asked to first identify the policies and initiatives that your country introduced during the 1990-1999, 2000-2009 and 2010-2019 decades. Then calculate the energy and associated GHG emission trends during each decade by your country (at the sectoral level). Evaluate how effective past policies and initiatives were? Next identify the key components of the deep decarbonization pathway. Are some of the sectoral initiatives similar to those in the earlier decades? What is needed to achieve effective implementation? Are there important lessons from previous government initiatives?

Note: Support your brief with appendices that include key details and trends. The brief should demonstrate your capability for independent thinking and effective communication. Include a critical appraisal of previous policies. Base your appraisal on a broad reading of the relevant reports and studies. Synthesize and analyze the complexities of drivers for and barriers to change. In addition to the written report, you are asked to make a short 4 minute verbal presentation (no ppt). Submit both the report and presentation on LEARN.

Here is a policy simulator to help:

https://www.climateinteractive.org/tools/en-roads/

Net Zero Carbon Residential Plan (30%) – Let’s shift from advocacy for policy to action for carbon reduction. The first policy listed, and the largest financial allocation ($13B), in the 2020 Task Force for a Resilient Recovery Final Report is expand financing for building retrofits. At the level of the individual or family, our house is a major source of greenhouse gas emissions and consumption decisions. All new buildings are expected to be net zero energy by 2030, and Toronto has announced that we need to retrofit to net zero by 2050. So move your family to this sustainability goal early with a retrofit or new design to achieve net zero carbon (go beyond operational net zero energy to achieve net zero carbon by offsetting embodied greenhouse gases as well, in this case target net positive 5% of operational energy for the offset). Choose a location for your house and prepare an energy profile for its space heating, space cooling, water heating and electrical loads. Identify ways to reduce your demand by increasing the energy efficiency of your house: including insulation options for the foundation, main walls and attic; window and door choices;
air leakage and ventilation, water heating, space heating and cooling equipment. Then consider your on-site supply options: including solar and heat pump options. What size of supply capacity is required to meet your annual demand? What is the cost of your proposed energy system, total, per tonne of CO$_2$e avoided and per kWh? Do costs vary with your different decisions? Compare the average and marginal cost of achieving net zero. If a carbon market is created, at what price would you buy or sell? The presentation class will include a carbon auction. You are expected to participate.

This assignment can be completed either as an individual or group assignment (two people). Individual assignments must achieve net zero carbon for the largest type of energy demand, i.e. space heating in Canada, space cooling in the tropics. Group assignments must achieve net zero carbon for the whole house: space energy, water heating and electrical loads. A typical individual report is 10-15 pages in length while a group project is typically 20-25 pages. The Plan will be presented in class: 4 minutes individual, 8 minutes group (ppt recommended).

How do I make the calculations? Compare two ways. First, use a simple carbon calculator like Project Neutral https://app.projectneutral.org/login or the handy spreadsheet from Environment and Climate Change Canada. Second, make calculations from simple principles. (See the tools in the assignment folder.) Compare the results. How good was the simple calculator or general spreadsheet with its assumptions?

Community / Corporate Climate Action Plan (30%) – Prepare a climate action plan for a community or corporation of your choice. Start by critiquing three climate action plans for similar communities / corporations. Select the criteria that you will use to evaluate the plans. Include consideration of local resources (RETScreen is a good tool), appropriate technology selection, social costs and benefits and community / employee engagement. Identify elements of good design, content and effective communication, and/or areas that are poorly prepared and need improvement. Then, prepare a climate action plan for the selected community / corporation with an 80% reduction in greenhouse gas emissions by 2050. Identify the approximate population size of your community (town of 5,000; small city of 50,000; mid-size city of 500,000; metropolitan centre of 5 million).

This assignment can be completed either as an individual or group assignment (maximum of three people). Individual assignments must cover emission planning for at least one major sector (transportation, residential, commercial/industrial). Group assignments should include all of the community’s major emission sources. A typical individual report is 10-15 pages in length while a group report is typically 25-30 pages. The Plan will also be presented to the class, 4 minutes for an individual, 8 minutes for a group (ppt recommended). Have fun and be creative. The future depends on it.

Resources:

Alternative Assignment 3: Volunteer Experience with REEP Green Solutions or Climate Action WR – REEP six positions where students can work as volunteers. 1. Energy Marketing Volunteer Coordinator x2 – Responsible for developing key messaging for energy programs and services, and analyze customer insights from our feedback survey. 2 Energy Program Development Volunteer Coordinator x2 – Responsible for exploring low-income programs and leverage our EGH housing stock research to assist with an RFP for the Enbridge’s Weatherization Low-Income Program. 3. Sustainable Buildings Project and Engagement Coordinator x2 - The Sustainable Buildings Project & Engagement Coordinator is responsible for assisting the ClimateActionWR team in developing partnerships, tracking success, and engaging the
community in both the residential and commercial sides of the sustainable buildings pilot project. If interested, send your resume and cover letter to the instructor who will forward it to REEP or CAWR for consideration by September 21st. The expected time commitment is 40 hours, e.g. 4 hours for 10 weeks. For an introduction to the REEP House for Sustainable Living, its insulation display, (and its heat pumps), visit the website.

**Presentation Techniques (10%)** - Your grade will be based on presentation techniques used throughout the term, including: clarity of argument, word selection; referencing of sources; voice control; audio-visual support; humour; and other techniques to effectively convey your message to the audience.

**Participation (10%)** – All members of the class are expected to have completed (at minimum) readings prior to class and are expected to be active participants in on-line discussions. While the instructor will provide weekly readings, students can also participate by posting newspaper articles, policy reports, links to journal articles or other current materials related to the weekly topic via LEARN to share with other members of the class. You can also participate by posting interesting items to class discussion boards.

**Preparation Course Work: Referencing, Citations and Writing**

Students are expected to present all of their work (written, oral) in a professional manner. The quality of students' writing and presentations should reflect this. Students are expected to draw upon the relevant academic and policy literature in their discipline when conducting research.


When referencing the work of others, be consistent in the style you choose. There are several different referencing and citation styles that are used when preparing written work in a university setting. Two of the most common formats used in this field are: the APA (American Psychological Association) style and the Council of Science Editors (CSE) style.

**Grading and Late Policy**

**Handing in assignments:** All assignments must be submitted electronically in Microsoft Word (or equivalent) format by the beginning of class on the due date via the appropriate LEARN dropbox. If a student encounters a problem with LEARN, it is their responsibility to 1) email the instructor before the submission deadline, and 2) submit the paper via email to the instructor before the start of class. By submitting an assignment to LEARN, you are agreeing to the following:

- You have properly referenced and footnoted all ideas, words or other intellectual property from other sources used in the completion of this assignment.
- You have included a proper reference list, which includes acknowledgement of all sources used to complete this assignment.
- The assignment was completed by your own efforts. (with the exception of any group project)
- This is the first time you have submitted this assignment (either partially or entirely) for academic evaluation.

Your assignments (including marks and comments) will be returned to you via LEARN.

**Late and/or missed assignments:** Late submissions will be penalized 10% per day unless you have made arrangements with the instructor in advance of the deadline. Failure to make a submission or a submission
that is five days late or more will receive a grade of zero. An assessment of lateness will be based on the
time stamp produced through LEARN.

**University Requirements**

**Academic Integrity:** To create and promote a culture of academic integrity, the behaviour of all members of the University of Waterloo is based on honesty, trust, fairness, respect and responsibility. Check [www.uwaterloo.ca/academicintegrity/](http://www.uwaterloo.ca/academicintegrity/) for more information. Students who are unsure what constitutes an academic offence are requested to visit the on-line tutorial at: [http://www.lib.uwaterloo.ca/ait/](http://www.lib.uwaterloo.ca/ait/)

**Consequences of Academic Offences:** Within ENV, those committing academic offences (e.g. cheating, plagiarism) will be placed on disciplinary probation and will be subject to penalties which may include a grade of 0 on affected course elements, 0 on the course, suspension, and expulsion. Students are strongly encouraged to review the material provided by the university’s Academic Integrity office (see: [http://uwaterloo.ca/academicintegrity/Students/index.html](http://uwaterloo.ca/academicintegrity/Students/index.html)).

**Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4, [www.adm.uwaterloo.ca/infosec/Policies/policy70.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm).

**Discipline:** A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course professor, academic advisor, or the Graduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline, [www.adm.uwaterloo.ca/infosec/Policies/policy71.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm). For typical penalties, check Guidelines for Assessment of Penalties, [www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm](http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm)

**Appeals:** A student may appeal the finding and/or penalty in a decision made under Policy 70 - Student Petitions and Grievances (other than regarding a petition) or Policy 71 - Student Discipline if a ground for an appeal can be established. Read Policy 72 - Student Appeals, [http://www.adm.uwaterloo.ca/infosec/Policies/policy72.html](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.html)

**Research Ethics:** Please note that the University of Waterloo requires all research conducted by its students, staff, and faculty which involves humans as participants to undergo prior ethics review and clearance through the Director, Office of Human Research and Animal Care (Office). The ethics review and clearance processes are intended to ensure that projects comply with the Office’s Guidelines for Research with Human Participants (Guidelines) as well as those of provincial and federal agencies, and that the safety, rights and welfare of participants are adequately protected. The Guidelines inform researchers about ethical issues and procedures which are of concern when conducting research with humans (e.g. confidentiality, risks and benefits, informed consent process, etc.). If the development of your research proposal consists of research that involves humans as participants, please contact the course instructor for guidance and see: [www.research.uwaterloo.ca/ethics/human/](http://www.research.uwaterloo.ca/ethics/human/)

**Turnitin.com:** Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students’ submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin® in this course. It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit the alternate assignment.
Note for students with disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term. Once registered with OPD, please meet with the course instructor, in confidence, to discuss your needs.

Religious Observances: Please inform the instructor at the beginning of term if special accommodation needs to be made for religious observances that are not otherwise accounted for in the scheduling of classes and assignments.

LEARN: Users can login to LEARN via: http://learn.uwaterloo.ca/ using your WatIAM/Quest username and password.