Faculty of Environmental and Urban Change York University

RECOMMENTED UNDERGRADUATE COURSE SYLLABUS

Course: ES/ENVS 4400 Fundamentals of Renewable Energy

Term: Fall 2023

Calendar Description

The course is designed to provide students with a critical understanding of key renewable energy options for electricity generation, heating and cooling of buildings and transportation. Students will be introduced to a critical analysis of renewable energy as a strategy for climate change mitigation, community empowerment, industrial development, and energy security. This course builds on EU/ENVS 3130 3.00. PRIOR TO FALL 2020: ES/ENVS 3130 3.00.

Prerequisite(s)

Fourth-year standing or by permission of the Instructor. Students with Third-year standing may have access subject to space availability and approval from the Faculty.

Course Director

Richard Laszlo (he/him) Richard@LaszloEnergy.com

Course consultation hours: Thursdays, 11:30 am to 1:30 pm

Other Course Instructors

Office Hours provided Thursdays, 11:30 am to 1:30 pm

Or by appointment upon request

Teaching Assistants Sayeh Dastgheib-Beheshti (she/her) sayehdb@yorku.ca

Course Management

In this course the Course Director has direct responsibility for the overall shape and direction of course activities. The teaching Assistance is a member of the Course team and has responsibility for providing pedagogical support to ensure a successful course experience. As a member of the

class, you are expected to attend all lectures and consult – before every lecture – the eClass website created for this course.

Make sure to cover all assigned readings and assigned teaching materials before lectures and you are advised to plan with your colleagues if you cannot attend a class. Lectures provide the broader conceptual framework and necessary background within which the discussions/debates and assigned work can be situated.

Students are expected to meet in person at the scheduled class lecture time.

Should classes move to an online format, students will be expected to meet at the scheduled class lecture time for a live session via Zoom. Should classes move to this online format, to accommodate students who may be unable to attend live sessions (e.g., international students, students with many competing obligations, etc.), all live sessions will be recorded and made available for student viewing.

Time and Location

Lectures: Thursdays, 8:30 to 11:30 am

Bethune College Room 322

Students are expected to meet at the scheduled class lecture time in person, unless courses are moved online, in which lectures will be during live sessions via Zoom. Please note that the Zoom meetings will be recorded and posted to the course eClass for student viewing.

There are no tutorials. However, students are welcome and encouraged to join the course director in person or via zoom during office hours to discuss readings, assignments and other topics related to the course. Advance notice is appreciated, but not necessary.

Purpose and Objectives of the Course

This course is designed to allow students to explore the policy and technical dimensions of renewable energy in greater depth, with particular focus on potential contributions to sustainability of energy systems and climate change mitigation in a Canadian context.

Upon completion of this course, students should be able to:

- 1. Explain the basic concepts of renewable energy and the implications of energy conversions.
- 2. Explain the major types of renewable energy technologies.
- 3. Discuss economic, social and environmental aspects of renewable energy and the role of renewable energy in energy system planning and design.
- 4. Apply approaches to evaluating renewable energy projects.
- 5. Understand renewable energy systems in practice, including case studies of leading

Canadian and international jurisdictions.

6. Communicate complex renewable energy concepts and materials in a concise and effective manner.

Organization of the Course

The course involves formal lectures by the instructor and invited guests. The lecture sessions will include review of the required readings and time for discussion.

Students are also expected to review and prepare for weekly case study discussions. Readings listed under a date are assigned for discussion during class the following week. Topics and readings to be covered are outlined later in this syllabus.

eClass will be the main platform for organizing the course and through which students will interact with the course materials, the Course Director /TA, as well as with one another. Please check eClass often for updates.

Evaluation

The grade for the course will be based on the following items weighted as indicated:

Reading Commentaries (10)	20%	Commentaries due weekly by midnight before class
Term Paper Proposal	5%	Due by midnight October 5, 2023
In Class Quiz	15%	October 19, 2023
Case Study Presentations	20%	Jurisdictions to be confirmed before reading week
Term Paper	40%	Due by midnight December 4, 2023
Participation	5%	Based on attendance and engagement in class

Undergraduate students will receive a numerical grade. Final course grades may be adjusted to conform to Program or Faculty grades distribution profiles.

Graduate students will be graded to higher standards than undergraduate students. Final grades will be Pass or Unsatisfactory per the official grading graduate system in Environmental Studies.

Final course grades may be adjusted to conform to Program or Faculty grades distribution profiles.

Please note that graded feedback worth at least 15% of the final grade for this course will be received by students prior to November 8, 2023 (the final withdrawal date without receiving a grade), according to the policy available at https://secretariat-policies.info.yorku.ca/.

Please refer to the web link at <u>https://registrar.yorku.ca/enrol/dates/2023-2024/fall-winter</u> for the academic term and drop date corresponding to your course.

Reading Commentaries. Students will be expected to prepare ten short commentaries throughout the year, based on <u>one</u> of the required weekly readings. The commentaries should be

maximum one page (500 words) in length and summarize what the student learned from the readings and their thoughts & reflections. Commentaries are to be emailed to the Course Instructor before the start of the next class to help them engage in useful class discussions.

Case Study Presentations. Students will select a jurisdiction that will serve as their case study for the term, and each week we will hear from students regarding their progress in learning about renewable energy from that jurisdiction. This effort will result in a formal presentation of 15 minutes plus Q&A with other students <u>during the 2nd half of term (exact schedule TBD)</u>.

Term Paper. Students will prepare a term paper focused on an aspect of renewable energy. Students will submit to the instructor a one-page proposal for a term paper which examines a particular aspect of renewable energy by <u>October 5, 2023</u>. The instructor will return the proposal to students by <u>October 12</u>, either approving it or suggesting revisions with a subsequent deadline to <u>October 19</u>.

For undergraduate students, the term paper should be between 2,000 and 2,500 words in length, must list all references cited in an appropriate scholarly format, and word-processed, double-spaced. The paper will be due by midnight on <u>December 4, 2023</u>.

For graduate students, the term paper should be between 4,000 and 5,000 words in length, must list all references cited in an appropriate scholarly format, and word-processed, double-spaced. The paper will be due by midnight on <u>December 4, 2023</u>.

In-Class Quiz. There will be an <u>in-class quiz on October 19, 2023</u>, that will test students understanding of the readings assigned up to that date and the in-class discussions. Graduate students will need to complete additional questions.

Participation. Your Participation grade will be based on your attendance in lectures, contributions to discussions during lectures, awareness of issues in required readings and ability to relate issues to broader concerns of the course.

Required Reading

The required readings are listed by week for the course. All readings are available online or on the library database.

The required readings are central to the course. The lectures will serve to enrich, clarify, and illustrate crucial issues from the assigned readings. <u>Readings listed under a particular date are assigned for discussion for the following week.</u>

Schedule of Topics and Readings

The following list of lecture topics and readings is subject to change. Remember that the readings listed under each date are assigned for reading during the date of each lecture.

Part 1 of the course provides an introduction and context for renewable energy, while Part 2

dives into some of the details regarding programming and issues impacting economic sectors and target efficiency markets:

Required and Supplementary Readings

The required readings are listed by week for the course. All readings are available online or on the library database.

The required readings are central to the course. The lectures will serve to enrich, clarify, and illustrate crucial issues from the assigned readings. <u>Readings listed under a particular date are assigned for discussion for the following week.</u>

Schedule of Topics and Readings by week

The following list of lecture topics and readings is subject to change. Remember that the readings listed under each date are assigned for reading during the date of each lecture.

Part 1 of the course provides an introduction and context for renewable energy, while Part 2 dives into some of the specific technologies and issues with their development/implementation.

PART 1: Introduction to Renewable Energy Concepts and Context

Week 1 (Sep 7): Course Introduction and Energy Systems: Energy, Power & Energy Services

- Review of course syllabus.
- Student roundtable description of their course of study and how it relates to renewable energy.
- Introduction to Energy Systems: Energy, Power, and Energy Services.

Required Readings for next week:

- United Nations: Renewables: <u>https://www.un.org/en/climatechange/what-is-renewable-</u> <u>energy?gclid=CjwKCAjw_aemBhBLEiwAT98FMjVdZMFDmva7ZZ0HREgzdJ8jzzHtB</u> <u>mAjVkFMSHD3beIwZzSvoBag9hoCDggQAvD_BwE</u>
- International Energy Agency: Renewables. Poke around and read about different energy technologies. https://www.iea.org/energy-system/renewables

Week 2 (Sep 14): Introduction to Renewable Energy Technologies

• Recap and discussion on this week's reading.

- Review of course syllabus and student assignments, including jurisdiction selection (presentations), in-class quiz and term paper.
- Lecture introducing / overview of renewable energy technologies.

Required Readings for next week:

- Independent Electricity System Operator (2023). Pathways to Decarbonization Report: <u>https://www.ieso.ca/en/Learn/The-Evolving-Grid/Pathways-to-Decarbonization</u>
- Canada's Energy Future 2023. Energy Supply and Demand Projections to 2050. <u>Read the Introduction</u> and <u>Electricity</u> sections. <u>https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2023/#:~:text=Canada's%20Energy%20Future%202023%20focuses,zero%20world%20could%20look%20like</u>.

Week 3 (Sep 21): Renewable Energy, Planning & Sustainability

- Recap and discussion on this week's reading.
- Review of course syllabus and student assignments, including jurisdiction selection (presentations), in-class quiz and term paper.
- Lecture introducing renewable energy, planning and sustainability.
- Guest Lecture and Facility Tour by Steven Prince, Director of Utilities & Energy Management Facilities Services, York University

Required Readings for next week:

- Government of Ontario (2022). Net Metering Regulation. https://www.ontario.ca/laws/regulation/050541
- Ontario Energy Board. Net Metering. <u>https://www.oeb.ca/consumer-information-and-protection/net-metering</u>
- Government of Canada (2022). Clean Energy Regulations.
 <u>https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/clean-electricity-regulation.html</u>

Week 4 (Sep 28): Renewable Energy Governance, Regulations & Mandates

- Recap and discussion on this week's reading.
- Review of course syllabus and student assignments, including jurisdiction selection (presentations), in-class quiz and term paper.

- TERM PAPER PROPOSALS DUE NEXT WEEK
- Lecture introducing energy planning and renewable energy.

Required Readings for next week:

- Government of Canada. RETScreen. Download the FREE RETScreen Expert and start inputting some information to create a hypothetical renewable project. <u>https://natural-resources.canada.ca/maps-tools-and-publications/tools/modelling-tools/retscreen/7465</u>
- United States Department of Energy. Confronting the Duck Curve: How to Address Over-Generation of Solar Energy (2017). <u>https://www.energy.gov/eere/articles/confronting-duck-curve-how-address-over-generation-solar-energy</u>

Week 5 (Oct 5): Renewable Energy in Action: Field Trip to the Kortright Centre

- Recap and discussion on this week's reading.
- For this week's class we will be taking a field trip to the Kortright Centre and getting a tour of renewable energy in action at their demonstration sites.
- TERM PAPER PROPOSALS DUE.

Required Readings for next week:

- No readings for next week! Please prepare for the in-class Quiz on October 19
- Make sure you select a jurisdiction and start blocking out your class presentations
- Sayeh and I will get you feedback on your term paper proposals ASAP in case you need to make any revisions.

READING WEEK NO CLASSES Oct 12

- During Reading week please review all course lectures and materials to date
- Prepare for the in-class Quiz on October 19
- For those that received feedback on their term paper proposals, work on those for resubmission
- Start blocking out your jurisdictional in-class presentations

PART 2: Survey of Renewable Energy Technologies & Economic, Social and Environmental Issues

Week 7 (Oct 19): Solar Technologies: Photovoltaics, Concentrated Solar, and Solar Thermal

- Recap and discussion on this Kortright Field trip and Reading Week.
- Review of course syllabus and student assignments, progress on presentations and term paper.
- IN-CLASS QUIZ
- Lecture introducing solar technologies.
- Guest Lecture by Tim Short, Managing Partner, Laszlo Energy Services and Solar Enthusiast!

Required Readings for next week:

- National Geographic. Energy 101: Wind Power. View the short Video for a solid introduction and Read the Wind Power encyclopedic entry. <u>https://education.nationalgeographic.org/resource/edu-wind-turbines/</u>
- Eric R. A. N. Smith and Holly Klick (2007). Explaining NIMBY Opposition to Wind Power. Revised version of a paper delivered at the annual meeting of the American Political Science Association, Boston, Massachusetts, August 29, 2007. <u>https://smith.faculty.polsci.ucsb.edu/wind.pdf</u>
- Marco Chown Oved. Toronto Star (2023). Could offshore wind in the Great Lakes provide the cheap, clean power Ontario needs?
 <u>https://www.thestar.com/news/canada/could-offshore-wind-in-the-great-lakes-provide-the-cheap-clean-power-ontario-needs/article_b3445fa3-3abe-5798-80ac-2a73b11e616c.html</u>

Week 8 (Oct 26): Wind Power: On and Offshore, anti-wind movement

- Recap and discussion on this week's reading.
- Review of course syllabus and student assignments, progress on presentations and term paper.
- Lecture on wind power
- Guest Lecture by CanWEA/CanREA representative (TBC)

Required Readings for next week:

- Energy Information Administration. Hydropower Explained. <u>https://www.eia.gov/energyexplained/hydropower/</u>
- Engineering News-Record (2023). Canada's \$12B Site C Hydro Dam Aims for Long-Haul Completion. <u>https://www.enr.com/articles/56806-canadas-12b-site-c-hydro-dam-aims-for-long-haul-completion</u>

• Halifax Examiner (2023). Financing the Atlantic Loop: the knowns and unknowns. <u>https://www.halifaxexaminer.ca/government/province-house/financing-the-atlantic-loop-the-knowns-and-unknowns/</u>

Week 9 (Nov 2): Hydropower: Reservoir and Run-of-the-River Hydro, Tidal

- Recap and discussion on this week's reading.
- Review of course syllabus and student assignments, progress on presentations and term paper.
- Lecture on hydro power
- Finalize student presentation schedule

Required Readings for next week:

- Richard Laszlo for the Canadian Gas Association (2021). Renewable Natural Gas Handbook for Canadian Municipalities. <u>https://www.cga.ca/wp-content/uploads/2021/05/RNG-handbook.pdf</u>
- Government of Alberta (2022). Hydrogen Roadmap. <u>https://www.alberta.ca/hydrogen-roadmap.aspx</u>
- United States Environmental Protection Agency. Renewable Fuel Standard Program. <u>https://www.epa.gov/renewable-fuel-standard-program/overview-renewable-fuel-standard</u>

Week 10 (Nov 9): Renewable Fuels: Ethanol, Bio-Diesel, Renewable Natural Gas and Hydrogen

- Recap and discussion on this week's reading.
- Review of course syllabus and student assignments, progress on presentations and term paper.
- Lecture on renewable fuels
- Student Presentations

Required Readings for next week:

- QUEST Canada. District Energy 101. <u>https://districtenergy.questcanada.org/district-energy-101/</u>
- Association of Energy Engineers Canada East Chapter (2022). Wastewater Energy Transfer. <u>https://aeecanadaeast.org/2022/01/26/wastewater-energy-transfer/</u>
- Pembina Institute. Geoexchange Factsheet.

https://www.pembina.org/reports/geoexchangefactsheet.pdf

Week 11 (Nov 16): Thermal Renewables: District Energy, Geoexhange, Biomass, Solar Thermal

- Recap and discussion on this week's reading.
- Review of course syllabus and student assignments, progress on presentations and term paper.
- Lecture on thermal energy / Systems and thermal renewable technologies
- Student Presentations

Required Reading for next week:

- International Energy Agency (2020). The challenge of reaching zero emissions in heavy industry. <u>https://www.iea.org/articles/the-challenge-of-reaching-zero-emissions-in-heavy-industry</u>
- Canadian Climate Institute. BUILDING HEAT. https://climateinstitute.ca/reports/building-heat/

Week 12 (Nov 23): Bringing it Together Part 1: Review of Energy Technologies & Storage and Discussion of Economic, Social and Environmental Issues

- Recap and discussion on this week's reading.
- Review of course syllabus and student assignments, progress on presentations and term paper.
- Lecture reviewing and synthesizing concepts and identifying economic, social and environmental issues
- Student Presentations

Required Reading for next week:

- International Energy Agency (2022). Canada 2022 Energy Policy Review. Executive Summary: <u>https://www.iea.org/reports/canada-2022/executive-summary</u>
- Canada's Energy Future 2023. Energy Supply and Demand Projections to 2050. Re-read the report, focusing on sections of interest and reflecting on . https://www.cerrec.gc.ca/en/data-analysis/canada-energyfuture/2023/#:~:text=Canada's%20Energy%20Future%202023%20focuses,zero%20worl d%20could%20look%20like.

Week 13 (Nov 30): Bringing it Together Part 2: Review of Energy Technologies and

Discussion of Economic, Social and Environmental Issues

- Recap and discussion on this week's reading.
- Last Chance to Discuss Term Papers!!! Due December 4
- Lecture reviewing and synthesizing concepts and identifying economic, social and environmental issues
- Student Presentations

Grading Scheme, Assignment Submissions, and Lateness Penalties

The grading scheme for ENVS courses conforms to the 9-point system used in other undergraduate programs at York. Assignments and tests will bear either a letter grade designation (e.g., A, B, C+, etc.) or an equivalent percentage grade. (See detailed descriptions in the FES *Regulations* or in the BES *Handbook*). The final grade for the course will be calculated using the weighting formula established above for this course.

Instructions for Submission and Return of Final Assignments

For the Fall 2023 term, all assignments will be submitted, graded and returned electronically, preferably by email to the course instructor or via eClass.

Proper academic performance depends on students doing their work not only well, but on time. Accordingly, the assignments for ENVS courses must be received by the Instructor or Teaching Assistant on the due date specified for the assignment.

Lateness Penalty

Assignments received later than the due date will be penalized 5% of the value of the assignment *per day* that the assignments are late. For example, if an assignment worth 20% of the total course grade is a day late, 1 point out of 20 (or 5% per day) will be deducted. Exceptions to the lateness penalty for valid reasons such as illness, compassionate grounds, etc. will be entertained by the Course Director **only** when supported by written documentation (e.g., a doctor's letter). **Please note Faculty policy on electronic submission of material**, "*That all written or visual work that is submitted as part of an academic program must be submitted in hardcopy (not electronically), unless previously agreed to by the instructor or advisor."* Submission must be received in hard copy form on due date or will be considered late.

Missed Tests

Students with a documented reason for missing a course test, such as illness, compassionate grounds, etc., which is confirmed by supporting documentation (e.g., doctor's letter) may request accommodation from the Course Instructor, and arrangements will be made for the student to write a makeup test during the next available office hours (the next Thursday between 11:30am and 1:30 pm). Further extensions or accommodation will require students to submit a formal petition to the Faculty.

ADDITIONAL INFORMATION

Group Work. This course may require group work. Group work, when done well, can teach collaborative skills that are essential in many work contexts. It can enrich everyone's learning by making all students resources for each other and can create a synergy based on the diversity of histories and perspectives of the group members. To ensure that group work is a positive experience, each group should first discuss and agree to ground-rules for effective group work such as: 1) active listening and facilitating equal participation of all; 2) respecting different opinions and different ways of knowing or communicating; 3) considering issues of power, difference and discrimination; 4) identifying a clear path of communication with Course Director should there be issues/concerns; and 5) making clear a path of action for issues regarding equity-related or harassment concerns.

<u>Useful articles on working through equity issues in groups:</u> Burke, Bev et al. "Thinking Equity." *Education for Changing Unions*. Toronto: Between the Lines, 2002, 74-77.

Narayan, Uma. "Working Together Across Differences: Some Considerations on Emotions and Political Practice." *Hypatia*, Vol. 3, No. 2 (Summer, 1998), pp. 31-47.

Inclusivity in the EUC Undergraduate/Graduate Programs

Our programs strive to include a broad range of perspectives and substantive material in its course offerings. Central to a clear understanding of environmental problems is the link between exploitation of the natural world, and justice issues related to racism, gender inequity, and poverty. An inclusion of non-western perspectives is therefore essential to a fruitful discussion of North-South issues, and environmental debates generally.

Religious Observance Days

York University is committed to respecting the religious beliefs and practices of all members of the community and making accommodations for observances of special significance to adherents. Should any of the dates specified in this syllabus for in-class test or examination pose such a conflict for you, contact the Course Director within the first three weeks of class. Similarly, should an assignment to be completed in a lab, practicum placement, workshop, etc., scheduled later in the term pose such a conflict, contact the Course Director immediately. Please note that to arrange an alternative date or time for an examination scheduled in the formal examination periods (December and April/May), students must complete an Examination Accommodation Form, which can be obtained from Student Client Services, W120 Bennett Centre for Student Services or online at

http://www.registrar.yorku.ca/pdf/exam_accommodation.pdf

Student Representation

To facilitate the expression of student views, the Course Director will allow for class time to elect a student representative from the class list to represent student views and promote dialogue. This representative will also act as a liaison between the Office of Student Academic Services and the Undergraduate Program Director.

Academic Honesty

York students are required to maintain a high standard of academic integrity and are subject to the Senate Policy on Academic Honesty as set out by York University and by the Faculty of Environmental Studies. Please read the *Senate Policy on Academic Honesty* (which can be found as Appendix One of the *Academic Regulations of the Faculty of Environmental Studies* or in the University Policies and Regulations section of the *York University Undergraduate Programs Calendar*), available at: https://www.yorku.ca/unit/vpacad/academic-integrity/

There is also an academic integrity website with complete information about academic honesty. Students are expected to review the materials on the Academic Integrity website at: https://spark.library.yorku.ca/academic-integrity-what-is-academic-integrity/

HPRC Review Process

York students are subject to the York University Policy for the ethics review process for research involving Human Participants. All research activity with human participants and minimal risk as part of this course has to undergo ethical review. Please consider the following definitions:

- "Human participants" in research will be defined as persons who provide data or information to the researcher which are typically not part of their professional capacity.
- The draft **definition of funded research** from the Human Participants Review Sub-Committee [HPRC] is: "'Funded' will refer to all research that is receiving money that is in response to a specific proposal and administered by the university. Research using monies not administered by the University, and/or not in response to a specific proposal, will be considered 'unfunded'."
- The **definition of minimal risk** being used is the one given in the SSHRC/NSERC/MRC *Tri-Council Policy Statement Ethical Conduct for Research involving Humans* (August, 1998): "If potential subjects can reasonably be expected to regard the probability and magnitude of possible harms implied by participation in the research to be no greater than those encountered by the subject in those aspects of his or her everyday life that relate to the research, then the research can be regarded as within the range of minimal risk." (p. 1.5)

HPRC review forms are available at: <u>http://fes.yorku.ca/students/bes/forms/</u> HPRC review for Graduate students must be submitted in the Graduate Dossier System.

Student Conduct

Students and instructors are expected to maintain a professional relationship characterized by courtesy and mutual respect and to refrain from actions disruptive to such a relationship. Moreover, it is the responsibility of the instructor to maintain an appropriate academic atmosphere in the classroom, and the responsibility of the student to cooperate in that endeavour. Further, the instructor is the best person to decide, in the first instance, whether such an atmosphere is present in the class. A statement of the policy and procedures involving disruptive and/or harassing behaviour by students in academic situations is available on the York website at: http://www.yorku.ca/secretariat/policies/document.php?document=124

Access/Disability

York provides services for students with disabilities (including physical, medical, learning and psychiatric disabilities) needing accommodation related to teaching and evaluation methods/materials. It is the student's responsibility to register with disability services as early as possible to ensure that appropriate academic accommodation can be provided with advance notice. *You are encouraged to schedule a time early in the term to meet with each professor to discuss your accommodation needs*. Failure to make these arrangements may jeopardize your opportunity to receive academic accommodations.

Additional information is available at <u>www.yorku.ca/disabilityservices</u> or from disability service providers:

• Office for Persons with Disabilities: Room N110 of the Bennett Centre for Student Services , 416-736-5297,

• Learning and Psychiatric Disabilities Programs - Counselling & Development Centre: Room N110 of the Bennett Centre for Student Services, 416-736-5297, http://cds.info.yorku.ca/

• Glendon students - Glendon Counselling & Career Centre: Glendon Hall 111A, 416-487- 6709, <u>http://www.glendon.yorku.ca/counselling/</u>

For details on Grading Schemes, Assignment submissions, Lateness Penalties, Missed Tests, Group Work, Inclusivity in EUC, Religious Observance Days, Academic Honesty, Intellectual Property Notice, Student Conduct, Student Support and Student Accessibility Services. See <u>https://euc.yorku.ca/academic-policies-procedures-petitions/</u> and go to "Undergraduate Courses Common Instructions".