# INDEV 606 – Energy Sustainability – Fall 2018

**Course Instructor:** Juan Moreno-Cruz
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**Office Hours:** By appointment

**Class Meetings:** M 08:30 - 11:20 EV1 132

**Course Description:** Renewable and non-renewable energy supply systems are compared using economic and environmental measures. Topic include energetics of natural systems and agriculture; formation, extraction, and transformations of fossil fuels; nuclear power; modern renewables such as biomass, solar and wind; electricity generation, transmission and economics. Energy systems operate within environmental constraints, most importantly the need to reduce carbon dioxide emissions to slow climate change. We will analyze the technical options for reducing $CO_2$ emissions. Case studies are used to demonstrate the economic and environmental challenges in the design of sustainable energy systems.

**Course Main Objectives:**

- Introduce students to the concepts of energy systems, energy transitions and the many options to meet energy demand with more sustainable supply options, including conservation;
- To learn a web of interrelated facts sufficient to enable sound judgment about energy related technology and policy.
- To understand the basic science, engineering and economics that underlie assessments of energy resources, and of the most important energy transformations in industrial society.
- To develop a unified, scientific understanding of energy flows and transformations in industrial society and the natural world.
- Develop skills with tools to study and better understand energy flows such as Sankey diagrams. national energy balance tables and on-line analytical tools;
- Provide foundational knowledge of various energy systems, including energy conversions and carbon intensity;
- To gain a rough scientific overview of some of the most important links between energy and environmental systems.
- Introduce energy policy options and develop writing skills.

**Expectations:** In order to gain maximum benefits from this course, you should

- Read assigned material prior to class sessions
- Always attend class
- Contribute meaningfully to class discussions
- Listen when others are speaking
- Be present for the entire class period

### Required Textbooks:

There is no required textbook for this course. All required readings and other relevant materials will be made available via LEARN or accessed via the Internet.

### Course Requirements and Grading:

There will be 4 case studies. To access the case studies, you need to visit the following website: https://hbsp.harvard.edu/import/568210. Each group will prepare a short presentation of their analysis. Groups will be graded on presentation, participation and writing.

Case study 1: Natural Gas and Its Role in the New Energy Dynamics. Due Oct 1st.
Case study 2: $CO_2$ to $H_2O$: Transition to Sustainable Energy. Due Oct 22nd.
Case study 3: Oregon's Wind Energy Health Impact Assessment. Due Nov 5th.
Case study 4: Buildings and Energy. Due Nov 26th.

### Grade determination:

Each case study is worth 20% (total 80%). Class participation is worth 20%.

### Grade scale:

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|---|---|
| A's | Above 90% |
| B's | Between 80%-90% |
| C's | Between 60%-80% |
| D's | Between 50%-60% |
| F's | Below 50% |

## Tentative Course Schedule

| Date | Topics we learn | Deliverables |
|---|---|---|
| Sep 10 | Introduction | |
| Sep 17 | Energy Overview | |
| Sep 24 | Fossil Fuels | |
| Oct 1 | Renewables | Case study 1 |
| Oct 8 | No class – Thanksgiving | |
| Oct 15 | Costs | |
| Oct 22 | Air-quality | Case study 2 |
| Oct 29 | Climate Change | |
| Nov 5 | Nuclear Energy | Case study 3 |
| Nov 12 | End-use, Conservation and Efficiency | |
| Nov 19 | Urbanization and the Environment | |
| Nov 26 | SDGs and Global Change | Case study 4 |
| Dec 3 | Synthesis | |

Note: I will generally follow the above sequence. I may add or subtract topics.

## 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/ 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/

**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.

ENV students are strongly encouraged to review the material provided by the university's Academic Integrity office (see: 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.

**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. For typical penalties, check Guidelines for Assessment of Penalties, 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

**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, the please contact the course instructor for guidance and see: www.research.uwaterloo.ca/ethics/human/

**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.