EID247: Introduction to Sustainability and Alternative Energy Technologies
Course Syllabus
Spring 2022

Course Meeting Times: Mondays 4:00 – 4:50 PM and Fridays 11:00 AM – 12:50 PM (Eastern Time)
Course Meeting Location: Room 504 Mondays, Room 506 Fridays, or Zoom link (Meeting ID: 939 4680 5435, Passcode: CO2)
Course Website: Course materials, videos, and slides will be posted on Microsoft Teams

Instructor Information:

Dr. Benjamin Davis Email: ben.davis@cooper.edu Office Hours: M12-1, T4:30-5:30, F1-2	Dr. Amanda Simson Email: amanda.simson@cooper.edu Office Hours: M12-1:30 pm, W10-11:30 am

Course Description:
Sustainability, sustainable development, alternative energy and how they relate to culture, politics, and design of our built environment. Review of the technological history of fossil fuel use and how it has affected Earth's climate. Global warming potential, radiative forcing, carbon cycle, and carbon budget. Life Cycle Assessment (LCA) and its application to sustainability / minimizing environmental impact. Alternatives to fossil fuel energy (including nuclear, geothermal, solar, hydropower, and bioenergy sources) and potential consequences of these technologies.

Prerequisites:
The course has no prerequisites; all material needed to understand the various topics will be covered in class. The class is aimed towards 2nd year students of all majors (Architecture, Art, and Engineering) but all students are welcome.

Course Objectives:
There are three primary sections of the course:

1. Sustainability and Climate Change
2. Basics of Alternative Energy Technologies, and
3. Life Cycle Assessment of Environmental Impacts

We will first cover the concepts of sustainability and sustainable development then consider how they relate to the science underlying climate change. We will then survey *alternative* energy technologies, comparing them to how electricity has *traditionally* been generated on a large-scale. Later in the course, we will introduce and explain an engineering concept called life-cycle assessment, which is a method for measuring the environmental impact of an object (when made in a certain way) through every step of its existence. By the end, students should be able to:

- Explain what sustainability is and how it is affected by time, geography, and people
- Understand the history of climate change and how it impacts us currently

- Explain the concept of climate justice
- Define different forms of energy and explain how energy is converted into electricity or other forms of work
- Explain the technological, social, and economic impacts of switching to different alternative energy technologies from more common fossil fuel based processes
- Explain what a life cycle assessment is and what needs to be considered to create one
- Apply basic material and energy balances to quantifying environmental impact of a product or process using an LCI
- Use LCA as a tool to compare two alternative processes or products

Course Format:
The course will be delivered in a hybrid format; some classes will be held online via Zoom, others will be in person. Students will collaborate on group projects in person, in breakout rooms on Zoom, as well as via Teams. Typically two-hour sessions will involve a significant amount of group work and discussion. Students will be expected to submit classwork, quizzes, project reports, videos, and homework in hard copy or via Teams.

Online Etiquette and Suggestions:
There are many challenges to online instruction and remote learning; it is helpful for us to see and/or hear from you during class. We understand it is not always possible to have cameras on, but please try and join us with your camera/video on whenever possible and let us know if any issues arise that make you unable to join with camera. In breakout rooms, it is helpful to be able to share work by sharing your screen using a tablet with stylus or a computer with a mouse, or by using a marker or dark pen on paper. Calculators may be useful for activities but are not required. We suggest preparing and using a consistent workspace for class if possible.

Expectations of the Instructors:
We expect that students will be taking their own notes during class time. We will review or post answers to classwork or homework within 2 weeks of their due dates. We will grade projects within 2 weeks of completion.

Office Hours:
Office Hours are on a first come, first serve basis. For virtual office hours, use MS Teams to chat us during the appointed hours to join the queue. Appointments may also be made via email ahead of time.

Learning Environment:
We hope to make all students feel respected and recognized in this course. We plan to have classes be active, engaging, and times where you are participating with the other students and the instructors. We look forward to creating a supportive and inclusive learning environment with you and for you. We invite student feedback at any time and we will ask you for feedback via course surveys at least once during the semester. Please email or chat us in Teams to discuss any issues that arise.

Required Text:
Our Energy Future: Introduction to Renewable Energy and Biofuels by Carla S. Jones and Stephen P. Mayfield (University of California Press, 2016). Other assigned readings will be provided as needed via Teams.

Course Requirements and Assessment:
Your grade will be calculated as follows:

Participation and Attendance	*Homework and Classwork Assignments*	*Paper on Alternative Energy Case Study*	*Final Project / LCA Video*
10%	35%	30%	25%

Attendance and Participation:
You are expected to attend and actively participate in all classes. Excused absences should be discussed with either of the Professors (CCing the other) prior to class time via email. Exceptions will be made for extreme emergencies, but please let us know when you will not be able to attend class as soon as you can. Lateness and missed classes will count towards your participation grade.

Assignments:
Assignments are due on the date listed on the assignment and should be submitted in hard copy or through Teams as specified. You should discuss classwork or homework with the other students in your group, but **you must complete your work individually unless noted on the assignment**. All submissions must be entirely your work product and plagiarism will not be tolerated. According to the Cooper Union course catalog "the presentation of another person's 'work product' (ideas, words, equations, computer code, graphics, lab data, etc.) as one's own" is plagiarism and will be referred to the Engineering Dean's Office.

Course Outline/Schedule:
Our planned course schedule is below, but it may change based on how long we end up spending on the different topics; updates will be posted on Teams. Please note the add/drop deadline on 1/25, the class withdrawal deadline on 3/22, and the project due dates.

TENATIVE COURSE SCHEDULE:

Please check MS Teams for updates, but we will do our best to stick with this.

Week	Hour	Day	Date	Class Topics	Due	Reading
1	1	Tues	1/18	**MONDAY SCHEDULE:** Course Introduction and Framing		
1	2,3	Fri	1/21	Introduction to Sustainability and SD	Proj. 1 posted	
2	4	Mon	1/24	Natural resources and services, Carbon cycle, Quantifying impact / climate change		
2	5,6	Fri	1/28	History of greenhouse effect, In-class discussion of Losing Earth	Quiz 1: Sustainability and SD	Losing Earth (NYT)
3	7	Mon	1/31	Planetary boundaries		Nine Planetary Boundaries (Stockholm Research Centre)
3	8,9	Fri	2/4	Forms of energy, overview of types of energy and typical methods for producing electricity and power. The chemistry of energy conversion vs energy sources.	HW1: Losing Earth Reflection	Ch. 1 of Our Energy Future
4	10	Mon	2/7	**GUEST LECTURE:** Nathaniel Rich		
4	11,12	Wed	2/9	**FRIDAY SCHEDULE:** The basics of fossil fuels – forms, history, current status		
4	13,14	Fri	2/11	Impacts of GHG, Sources of carbon emissions, Climate impacts (scientific)	HW2: Basics of Energy conversion	Ch. 2 of Our Energy Future
5	15	Mon	2/14	Overview of alternatives	Proj. 1 proposal	
5	X	Fri	2/18	**NO CLASS:** Founder's Day / Presidents' Day		Ch. 3 of Our Energy Future
6	X	Mon	2/21	**NO CLASS:** Founder's Day / Presidents' Day		
6	16,17	Fri	2/25	Case studies on alternative power: geothermal, energy in our homes, solar		Ch. 4 of Our Energy Future
7	18	Mon	2/28	**GUEST LECTURE:** Dr. Sander Mann		
7	19,20	Fri	3/4	Linking food and fuel (fertilizer)	Quiz 2: Alternative Energy	Ch. 5 of Our Energy Future
8	21	Mon	3/7	Concept of carbon-negativity and negative emissions technologies.	Proj.1 Draft Report	Simson&Rabinowitz article
8	22,23	Fri	3/11	Report edits / individual meetings (virtual)		
9	X	Mon	3/14	**NO CLASS: Spring Break**		

9	X	Fri	3/18	**NO CLASS: Spring Break**	Proj. 2 posted	Ch. 6 of Our Energy Future
10	24	Mon	3/21	Overview of carbon-based alternatives to fossil fuels	Proj.1 slide for presentation	
10	25,26	Fri	3/25	Project 1 Presentations	Proj. 1 presentation	Ch. 12 of Our Energy Future
11	27	Mon	3/28	Biofuels: 1st gen. and 2nd gen.		
11	28,29	Fri	4/1	Environmental impacts of biofuels		
12	30	Mon	4/4	Basics of Material and Energy balances		
12	31,32	Fri	4/8	LCA: Goal and Scope	Proj. 1 final	Ch. 13 of Our Energy Future
13	33	Mon	4/11	LCA: Goal and Scope		
13	34,35	Fri	4/15	LCA: LCI and Spreadsheet workshop	Pick Proj. 2 Goal and scope	
14	36	Mon	4/18	LCA: LCI		LCA 101
14	37,38	Fri	4/22	LCA: LCIA	HW3: LCA 101	
15	39	Mon	4/25	LCA: Reading LCA Literature		
15	40,41	Fri	4/29	LCA: Results, Conclusions, and visualization		
16	42	Mon	5/2	LCA: Results, Conclusions, and visualization		
16	X	Fri	5/6	**NO CLASS: Study day**		
17	43	Mon	5/9	Report edits / individual meetings	Proj. 2 video	
17	44,45	Fri	5/13	Project 2 Final Discussion (in class) - grades due 5/16	Proj. 2 Discussion	