**ENST 320b Julymester 2023**

**The Science, Policy, and Business of Energy and Air Sustainability**

**COURSE INSTRUCTOR:**

Dr. Victoria Petryshyn.

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She/her/hers

Location: Wrigley Marine Science Center, Catalina Island

Time: July, 2023

**COURSE OVERVIEW:**

This class presents an overview of issues related to energy and air sustainability, including the science, policy, and business aspects (with a focus on the science part). Everyone who considers themselves an environmentalist has opinions on which sources of energy are “bad” and which are “good”, but what does that mean? How are these forms of energy harnessed by people, especially in the US, and how exactly are they good or bad? This course explores these questions, considering “cradle-to-grave” issues ranging from extraction of the energy resources from the environment to pollution from emissions or disposal of wastes. For four weeks, at USC’s Wrigley Marine Science center on Catalina Island, students will take a special section of this course, which is normally taught on UPC. Students in this Julymester will get an immersive, hands-on look at energy production and distribution on the island. Typical coursework will be supplemented with lab activities, field trips, and guest lectures from experts in different aspects of traditional and renewable energy. A final project and presentation to the cohort will occur in the last week, when students present the energy project they have worked on in the course.

**Recommended preparation:** ENST 100 and CHEM 103 or its equivalent.

**COURSE TEXTS:**

Wolfson, R., Energy, Environment, and Climate, W.W. Norton, 2017, ISBN  978-0-393-62291-1

**PROBLEM SETS**

The transformations of energy among different forms, and the transformation from energy to work are governed by quantitative physical principles. So yes, there will be math. It is important for us to carry out calculations in this course. Problem sets will be assigned most lectures. Additional problems will be assigned for group practice during discussion sections.

**COURSE GRADING:**

You will be graded on the basis of your performance on a midterm, problem sets, lab activities, and a semester long team project. Test questions will be drawn from the material presented in lecture. Missing more than one or two lectures for other than illness or approved travel will be detrimental to success. At least 30% of the graded material will be quantitative analyses. We will be dealing with large numbers, so you will need a calculator that has scientific notation. **Cell phones ARE NOT practical as calculators in this course**. The lecture presentations will be posted on the Blackboard system for download and subsequent study. Test questions will include short essay questions and quantitative analysis. Below is a list of the graded assignments and their weighted value.

Problem Sets (5x3% each)` 15%

Midterm 20%

Project Proposal 10%

Lab/Discussion Activities 20%

Final Team Project 25%

Individual Project write-up 10%

**COURSE SCHEDULE**

Lectures will be held daily in the mornings. Afternoons will be for labs, discussion, and field trips. Wednesdays will be a ½ day with lecture in the morning and no afternoon sessions. Weekends will be free for students. The last week of the course will be lighter on labs and discussions as students will be working on their final project, which will be presented at the Julymester Symposium

*Lecture Schedule*

Week 1: Introduction to Energy and Underlying Theories

 Read: Syllabus; Wolfson Chapters 1-4

 Topics covered:

 Energy use in society

 Energy intensity and its historic trends

 Basics of kinetic vs potential energy

 Heat energy and its transformations

 Convection, Conduction, and Electromagnetic Radiation

 Energy quality; energy density

 Insolation and energy efficient building

Week 2: Traditional Energy

 Read: Wolfson, Chapters 5-7

Topics covered:

 Discovery, use and pros/cons of coal, oil, ad natural gas

 Conventional vs. unconventional reserves

 Estimations of how long each fuel will last

 Costs of fossil fuels

 Traditional power plant design

 Internal, external, and continuous combustion technology

 Formation of pollution in the atmosphere

Societal impacts of combustion of fossil fuels

 Radioactivity, nuclear energy generation, and nuclear accidents

 Feasibility of Nuclear Fusion

***Midterm exam will be taken at the end of Week 2***

Week 3: Renewable Energy

 Read: Wolfson Chapters 9 and 10

 Topics Covered:

 Passive solar design

 Solar Heating

 Concentrated solar electricity generation

 PV cells

 Maximum extractable wind energy

 Wind turbine design and sighting

 Hydropower- water impoundment vs. run-of-the-river vs. tidal systems

 Biofuels – biomass, biodiesel, bioethanol

 Waste-to-Energy power plants

Week 4: Energy distribution and storage

Read: Wolfson Chapter 11

Topics Covered:

 AC vs DC current

 Transformers and their use

Power loss in our electric grid

Smart grids and their pros/cons

Pumped storage

Battery technology and the physical resources it demands

Hydrogen and its potential

Hybrid, fully electric, and hydrogen car options

*Lab, Discussion, and Field Trip Schedule:*

Week 1: Introduction to Energy and Underlying Theories

 Field trip to Avalon Pebbly Beach Generating Station

 SI prefixes for large numbers

 Conversions between Joules, Watts, calories, and kWhs

 Using kinetic and potential energy equations

 Power radiated from an object

 Earth’s energy balance

Week 2: Traditional Energy

 Overview of energy use/generation at WMSC

Air quality equipment use

 Monitoring of ozone, NOx, and PM

 Interpretation of different pollutant trends over a 24-hour period

 Calculation of mass of pollutant released per kg of different fuels

 Nuclear binding energy; mass defect; energy released during fission/fusion

Week 3: Renewable Energy

 Solar panel assembly and sighting lab (multiple days)

 Extractable wind energy equations

Panel discussion with outside experts: Algal Biofuels, microbial fouling of biofuels

Week 4: Energy distribution and storage

 Project work time

**FINAL PROJECT:**

So often we focus on the ways that humans are destroying the planet, leading to eco-depression. For this project, rather than focus solely on negatives, groups will be asked to focus on solutions to the problems we face. Students will work collaboratively to propose ways of making real change and bettering the environment. Groups of ~3 will be assigned in the first week of the course. Each group will identify an energy challenge on Catalina Island or specifically at the WMSC, and propose a sustainable solution to that problem. Groups may focus on power generation, consumption side issues, or efficiency. Students will be expected to collect real data and/or interface with the staff of WMSC or permanent residents in order to understand the challenges faced on the island. Each individual student must also provide a written account of the process and information/sources they used to complete the project, based on a provided template. The project will be evaluated for originality, accuracy and thoroughness of research, attention to detail, and quality of finished project. Project proposals will be due after the second week of the semester.

**CLASSROOM DISCUSSION GUIDELINES**

We in the ENST Program are committed to making our classrooms as inclusive and diverse as possible. Students are encouraged to share their opinions and experiences. Increasing our knowledge of these issues from different perspectives enhances the learning experience. In order to facilitate vibrant and respectful discussion, the following guidelines should be adhered to (by both myself and students in the course)

* Share responsibility for including all voices in the conversation.
* Listen respectfully.
* Be open to changing your perspectives based on what you learn from others.
* Understand that we are bound to make mistakes in this space.
* Understand that your words have effects on others.
* Take pair work or small group work seriously.
* Understand that others will come to these discussions with different experiences from yours.
* Make an effort to get to know other students. Introduce yourself to students sitting near you.
* Understand that there are different approaches to solving problems.

**SUPPORT SYSTEMS**

*Student Health Counseling Services - (213) 740-7711 – 24/7 on call*

[engemannshc.usc.edu/counseling](https://engemannshc.usc.edu/counseling/)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call*

[suicidepreventionlifeline.org](http://www.suicidepreventionlifeline.org/)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 – 24/7 on call*

[engemannshc.usc.edu/rsvp](https://engemannshc.usc.edu/rsvp/)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED) | Title IX - (213) 740-5086*

[equity.usc.edu](https://equity.usc.edu/), [titleix.usc.edu](http://titleix.usc.edu)

Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

*Bias Assessment Response and Support - (213) 740-2421*

[studentaffairs.usc.edu/bias-assessment-response-support](https://studentaffairs.usc.edu/bias-assessment-response-support/)

Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

*The Office of Disability Services and Programs - (213) 740-0776*

[dsp.usc.edu](http://dsp.usc.edu/)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Support and Advocacy - (213) 821-4710*

[studentaffairs.usc.edu/ssa](https://studentaffairs.usc.edu/ssa/)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity at USC - (213) 740-2101*

[diversity.usc.edu](https://diversity.usc.edu/)

Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

*USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu/), [emergency.usc.edu](http://emergency.usc.edu/)

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

*USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu/)

Non-emergency assistance or information.