**GEOL 241: Energy Systems - Past, Present, and Future**

**SAL 101; 9:30-10:50 AM**

**Syllabus for Spring 2022\*
\****Draft, subject to change*

Instructor: Prof. Victoria Petryshyn

Office hours: Wednesday, 3:00-5:00 pm; or by appointment (arrange via email). Given the fluid COVID-19 situation, office hours will start via zoom: https://usc.zoom.us/j/3060818965

Email petryshy@usc.edu — You can reach me by email, but given the size of this class, I may not be able to reply to all messages in detail. Please consider contacting your TA in the first instance. Also, please check the syllabus before asking a question. I encourage in-depth questions about content, but please try to ask in or after lecture or lab, or during office hours held by me or a TA.

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TAs will announce their office hours during the first lab section meetings.

Lectures: Tues & Thurs, 9:30-10:50 am, online via Zoom for the first week (or more! Who knows!) — links available via Blackboard page for this class; please contact us if you have difficulty connecting and *make sure to log in to your USC Zoom account* (“login via SSO”) before you connect. After we go back in person, lectures will no longer be automatically recorded and archived. After the first week, USC expects you to be ***in class as you would have done in the beforetimes.***

Labs: 2 hours per week, varying times (see online Schedule of Classes)

 ***Please don’t switch lab times/sections without approval of the TAs***

* + - Details about lab structure, grading, etc., will be provided during the 1st lab
		- The first labs will meet during the 2nd full week of the semester, the week beginning Jan. 19th — DO NOT MISS THE FIRST LAB MEETING!

Readings: There is no textbook for this class. Readings will be provided on a weekly basis, as part of lectures and labs. **These readings are not a substitute for attending lectures and labs** and do not cover exactly the same material; they provide complementary viewpoints intended to enhance your learning.

Polling Software: After the first week, This class will use an online response system, Poll Everywhere, during lecture. You will receive an email asking you to register. You need to register and answer the polling questions to get credit for the polling portion of the class (see below, and more info during the first lecture). This service is free to you.

Synchronous? The lectures will be delivered during the scheduled lecture time (“synchronous”), and you are expected to attend during that time and ask questions (and answer the polling questions). Currently, there is no plan for asynchronous learning. *Labs will be entirely synchronous unless LA or USC tells us otherwise* — you will need to attend your scheduled lab time to receive credit.

**About this course**

*Catalogue Description:* Energy resources from a global perspective, including fossil fuels, nuclear, and renewable energy. Lecture - 3 hours/wk; laboratory - 2 hours/wk.

*More detail:* Demand for energy continues to rise even as the supply of non-renewable sources is progressively depleted and environmental consequences of their extraction and use hit the headlines. This makes energy one of humanity’s greatest challenges. But how quickly are non-renewable resources being exhausted? What actually are the consequences? And what other options are there? This course introduces the basic science of energy as it relates to our everyday lives. We begin by considering the ways we all use energy, and how that is changing with growing technologies such as electric cars. We then look at where that energy comes from, beginning with fossil fuels — learning about their origin and formation, history of development, nature of extraction, global distribution, current status of depletion, and impacts on the Earth’s environment. The next section deals with nuclear energy, addressing its origin and history, current use on both a U.S. and global scale, and its own environmental issues. The course then turns to renewable energy, including wind, solar, hydroelectric, biomass, geothermal, and tidal sources, as well as the potential role of fuel cells. Throughout, the emphasis will be on the scientific underpinnings of energy systems.

There are several themes that we intend to develop in this class, and these will unite the material we cover. These include:

* viewing **energy as a system**, including the need to consider energy supply, distribution, and use, and the links between these;
* understanding the **amount of energy that is available** from different sources, and what determines these amounts;
* exploring the **trade-offs** inherent in using different energy sources; and
* gaining an appreciation that there is not one solution to the energy problem but rather a need for an **integrated approach employing many different solutions**.

By the end of the class, you should have gained a greater appreciation for the importance of energy and its role in our daily lives, and you should have developed scientific understanding of energy sources and uses, as well as associated environmental consequences (from oil spills to climate change to nuclear accidents and beyond). Overall, I hope that this class will make you better informed citizens, decision makers, and future leaders. You may even be inspired to make a career out of solving some of our greatest energy problems!

This course is intended for students with little or no science background, but it will require scientific and numerate thinking. In the process of exploring energy, the class will meet the *learning objectives* of the [USC General Education program](https://dornsife.usc.edu/2015ge/2015ge-requirements/) related to the Physical Sciences ([Category GE-E](https://dornsife.usc.edu/2015ge/ge-e)), including:

* understanding how models of the natural/living world are established and how researchers test the validity of these models using empirical evidence;
* gaining familiarity with major scientific ideas;
* learning the techniques of scientific investigation, analysis and problem‐solving, that provide the basis for discovery and validation as part of the “scientific method”; and
* understanding how data are generated, presented and interpreted and how scientific discovery spurs technology growth and impacts society.

*You will get the most out of the class if you attend and ask questions in the lectures, and participate actively in the labs.* Energy is a newsworthy subject, and there is lots written about it; if you are inspired to delve deeper into topics, please share what you learn with the class. As instructors, the TAs and I are here to help you make the most of your learning experience, so please do not hesitate to approach us.

 **Class logistics**

1. Grading will be based on the following breakdown:

Midterm Exam 1: 75 points

***Final letter grades will be determined based on where your point total at the end of the semester falls within the distribution of point totals for the class.*** *In other words, grades are curved. We will try to give an indication around the middle of the semester about where each student stands at that stage.*

Midterm Exam 2: 75 points

Final Exam: 100 points

Labs ( including presentation): 175 points

In class poll responses: 50 points

Homework essay: 25 points

**Total: 500 points**

There will be no provisions for earning “extra credit” in this class. We provide numerous opportunities to earn credit, as above, so take advantage of these throughout the semester!

1. Lectures – A schedule of lecture topics is below. ***Attend – and engage yourself in – the lectures.*** Taking notes and asking questions will put you in the best position to do well on the exams (and thus get the best grade you can). Exams will primarily be drawn from lecture material, and labs.
2. Labs – Labs are an integral part of this course and give you hands-on experience related to the lecture topics, as well as the opportunity to discuss key issues. *The purpose of the labs is for you to engage directly in scientific discovery, rather than just ingesting information.* ***Show up for labs!*** They account for a significant portion of your grade (35% of the total) and will be assessed based on the work that you complete during lab sessions. Material from labs will show up on the exams, even if it was not directly discussed in lecture.
3. Exams – The exams will combine multiple-choice and short answer sections. You will be given examples of exam-style questions during the lectures as part of the PollEverywhere responses, so that you can get familiar with the format. Review sessions will be held prior to each exam. As required for classes at USC, the final exam will be an integrative evaluation, drawing on your knowledge from the whole course. Make‐up exams are generally not permitted except in extreme circumstances such as a medical emergency. If you have to miss an examination because of illness or a USC‐sanctioned event (such as athletic competition), you must provide notice (email is OK) before the exam start time,and you must provide documentation (afterwards is fine). Exams will be held during the lecture time, administered via Blackboard.
4. Final presentations – On the last day of your lab meeting, you will have a 3-minute slot for an oral presentation to your lab section. More details will be provided closer to the time.
5. Blackboard – We will try to keep your grade record updated on Blackboard. I will also try to keep PDF copies of lecture slides posted there (typically the morning prior to each lecture). However, ***the PDFs of the lecture slides do not provide all of the information that will be covered in lectures, so do not try to use them as a substitute for attending lectures.*** The best way to do well in this class is to attend lectures, and to take notes. Hand-writing notes will help you to learn most effectively.
6. Missed a lecture? *–* You may have a sick day or an extra-curricular event that forces an absence. To catch up, look over lecture slides posted on Blackboard, then come to office hours to ask any questions. The policy for missed labs is outlined on the separate lab syllabus that you will receive during the 1st lab session.
7. PollEverywhere – This is an interactive platform that will be used for questions during lectures. The student guide is available here: <https://www.polleverywhere.com/student-guide>. If you have questions, please start there! You can also contact support (https://support.polleverywhere.com/hc/en-us).

The goal of including this component is for you to actively engage with the lecture material and get a sense of how you are comprehending the material. You will be scored for completing an answer (not for correctness), allowing you to test your knowledge. PollEverywhere may also be used for lab quizzes, at your TA’s discretion and as described more in your first lab meeting.

*What device do I need?* You can use PollEverywhere with a smartphone, tablet, or web browser on a laptop. Or you can answer questions through text message if you register your number. You can answer from the same device you use to connect to Zoom for the lectures (or a separate device).

*Have trouble?* Try connecting with a web browser rather than your phone. Or see: <https://www.polleverywhere.com/guides/student/troubleshooting>, or contact support (see above).

*How to register?* A link should be sent to your USC email account with information about how to register. More details will be provided in the first lecture.

*How will lecture absences or technical glitches (e.g., an uncharged device) affect the polling portion of my grade?* You will be given a **25% waiver** on PollEverywhere answers, sufficient to allow for university approved absences, as well as a generous provision in case of technical glitches, job interviews, extracurricular conflicts, or sickness. If you answer 75% of the questions over the semester, you will receive 100% of the credit for this portion of the class. If you do not provide answers more than 25% of the time, your score will reflect the proportion that you have answered.

1. Grade Appeals *–* If you wish to appeal a grade on an exam or other assignment, you may do so in the first instance with your TA. If the issue is not resolved with your TA, you may approach Prof. Petryshyn with the issue. If you appeal a grade, be aware that you may end up with a lower grade than you started with on a given question or assignment!
2. Reflection essay – Part way through the semester, you will be responsible for writing a short essay that asks you to engage with the class material beyond the exams and labs; this essay is an opportunity for you to think about and independently explore the topic of this class. More details on scope will be announced closer to the time. The essay will be due on Monday, March 15th, no later than 5pm, via Blackboard. You will be responsible for uploading your assignment in electronic form (as a PDF) by that time. ***Late submissions will be penalized by a 5 pt deduction for each week, beginning immediately after the due date*** (e.g., the deadline is 5pm, so if you submit at 5:01pm, you will be penalized by 5 pts). The essay should be between 3-4 pages typed, double-spaced, either 11 pt Arial or 12 pt Times New Roman font, and with 1-inch margins. Deviations from this format, including going beyond the 4-page limit or not uploading in the correct font/format, will lose you points at the discretion of the TA who grades your essy. Grades for your essay assignment will be assigned by the TAs based on the following six elements:
* Thesis/argument – Is the main argument clearly stated, interesting, and incisive, and carried consistently throughout the essay?
* Structure – Is the structure of the essay logical? Does the argument develop progressively through the text? Are the points linked together coherently? Are the paragraphs well organized?
* Evidence/Content – Is the content sufficient and appropriate to substantiate the arguments being made? Is the evidence presented in a way that can be easily understood?
* Analysis – Does the essay establish how the evidence being presented supports the thesis? Does the analysis include novel insight, beyond paraphrasing prior work?
* Sources – Are the sources well-chosen to support the argument? Are they used in more than one way? Are they cited appropriately?
* Style – Is the writing clear, and free of typographical and grammatical errors? Is the essay a pleasure to read? Does it conform to the formatting guidelines, including the page limit?

**Other important information, including academic conduct and support systems**

***Academic Conduct***

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” <http://policy.usc.edu/scampus-part-b>. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>. *Academic misconduct will not be tolerated in this class and will be subject to disciplinary action.*

***Support Systems***

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

<http://studenthealth.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

<http://suicidepreventionlifeline.org>

Free and confidential emotional support to people in suicidal crisis or emotional distress (24/7)

Relationship & Sexual Violence Prevention (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call

<http://studenthealth.usc.edu/sexual-assault>

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

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298

<http://equity.usc.edu>, <http://titleix.usc.edu>

Information about getting help or helping someone affected by harassment or discrimination, rights of protected classes, reporting options, & additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

<http://usc-advocate.symplicity.com/care_report>

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity |Title IX for appropriate investigation, supportive measures, and response.

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

<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 Campus Support and Intervention - (213) 821-4710

<http://campussupport.usc.edu>

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

<http://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

<http://dps.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

<http://dps.usc.edu>

Non-emergency assistance or information.

***Statement for Students with Disabilities***

Any student requesting academic accommodations (including extended exam time) based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to Prof. Petryshyn (or to your TA) as early in the semester as possible. If you approach us the day before an exam, it may be difficult to accommodate all of your needs! Information about registering with DSP can be found at their website: <https://dsp.usc.edu>

***Statement of University and Instructor Responsibilities and Liabilities***

Laboratory activities have associated risks. We have worked to minimize these, but neither USC nor the instructors (Prof. Petryshyn or the TAs) can assume liability. For the lab activities, you will be provided safety warnings and safety equipment, as appropriate. It is your responsibility to maintain safe practices.

***A final note on teaching during the covid-19 pandemic***

The TAs and I appreciate the many challenges of teaching and learning during this period of time. As much as we will try to proceed as normal, we know very little is normal for anyone. We hope to make this class as engaging, educational, and rewarding as possible. Please let us know if you are having a hard time with anything, whether that be related to this class or otherwise — and especially if you are facing hurdles coming to lectures or labs.

**GEOL 241 Schedule of Lectures and Labs (these are subject to change!)**

|  |  |  |
| --- | --- | --- |
| Lecture and Date | Lecture Topic | Lab Topic for the Week |
| 1 (1/11) | Intro and Energy: How disconnected are we? | No lab (first week) |
| 2 (1/13) | Energy and Society – An Overview |  |
|  |  |  |
| 3 (1/18)  | Consumption of Energy, Part 1 | Lab 1: The Energy System |
| 4 (1/20)  | Consumption of Energy, Part 2 |  |
|  |  |  |
| 5 (1/25) | Energy for Transportation, Part 1 | Lab 2: Your Energy Footprint I |
| 6 (1/27) | Energy for Transportation, Part 2 |  |
|  |  |  |
| 7 (2/1) | Electricity: What is it & where does it come from? | Lab 3: Your Energy Footprint II |
| 8 (2/3) | Fossil Fuels Overview |  |
|  |  |  |
| 9 (2/8)  | Coal: How it forms, how we mine it, how we use it | Lab 4: Electricity |
| 10 (2/10) | Where Do Oil and Natural Gas Come From? |  |
|  |  |  |
| -- (2/15) | **Midterm 1 (normal lecture time**\***)** | No lab (exam week) |
| 11 (2/17) | “Unconventional” Fossil Fuels & “Peak Oil”? |  |
|  |   |  |
| 12 (2/22) | Local Consequences of Fossil Fuels | Lab 5: Fossil Fuels |
| 13 (2/24) | Climate & Global Consequences of Fossil Fuels |  |
|  |  |  |
| 14 (3/1) | Carbon Capture and Storage | Lab 6: Peak Oil Game |
| 15 (3/3) | The Science of Nuclear Power |  |
|  |  |   |
| 16 (3/8) | Nuclear Power: Promise vs. reality | Lab 7: Ocean Acidification |
| 17 (3/10)  | Fusion: The Miracle Solution? |  |
| *(3/12-3/20)* | ***Spring Break*** |  |
|  |  |  |
| 18 (3/22) | Power Plants, Energy Transformation, Efficiency | Lab 8: Nuclear (Radioactivity) |
| 19 (3/24) | Midterm review |  |
|  |  |  |
| -- (3/29) | **Midterm 2 (normal lecture time**\***)** | No Lab, midterm week |
| 20 (3/31) | Wind Energy |  |
|  |  |  |
| 20 (4/5) | Hydropower |  |
| 21 (4/7)  | Solar Energy | Lab 9: Renewable Energy |
|  |  |  |
| 22 (4/12) | Biomass Energy |  |
| 23 (4/14)  | Geothermal & TEnergy | Lab 10: Biofuels |
|  |  |  |
| 24 (4/19) | Energy Demand and The Grid | Lab 11: Batteries |
| 25 (4/21) | The Energy Storage Problem |  |
|  |  |  |
| 26 (4/26) | Costs of Renewables: Land, money, and beyond | Oral Presentations in Lab Sections |
| 27 (4/28) | The Future of Energy? |  |
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| **FINAL EXAM:** | **Tuesday, May 10th, 8am-10am**\***, via Blackboard** |  |

*\* if you need an alternative exam time, please email Prof. Petryshyn and your TA at least one week in advance*