Understand Energy: Essentials

(CEE 107S/207S) Way-SI

Course Syllabus for Summer 2024

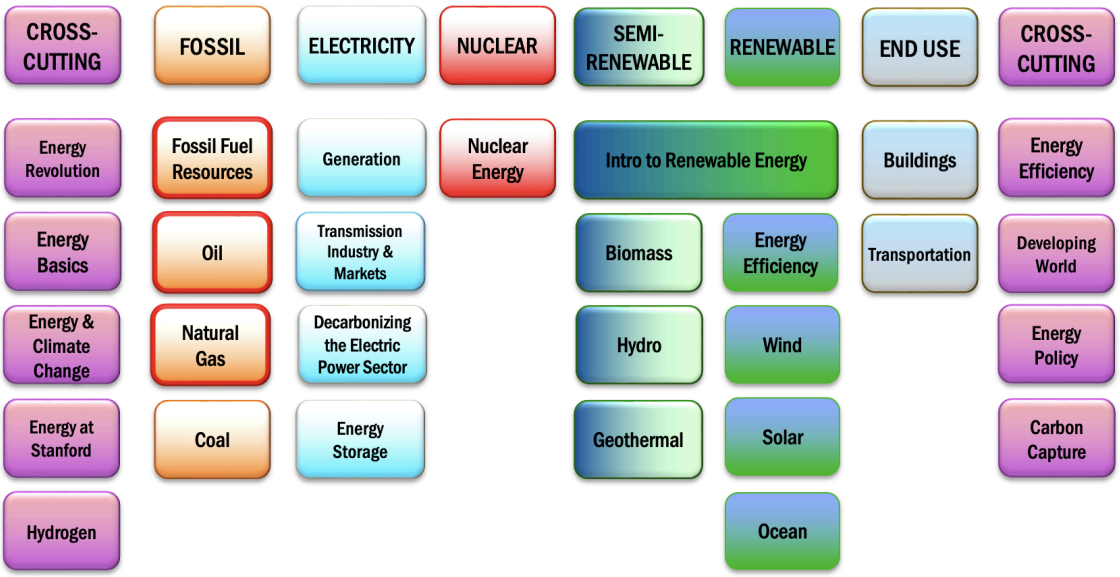
Build your energy knowledge! At virtually every moment of the day, from home to work or school, we are embedded in a complex web of energy, environment, commerce, and geopolitics. Whether boarding an airplane, flicking the light switch, or refueling a car, our collective choices as a society influence global outcomes.

Explore how energy resources underpin our way of life. Learn how proven and emerging technologies—from solar photovoltaics to batteries to biomass—are changing the planet. **Energy is, after all, the number-one driver of climate change.**

This course will **build your literacy around the fundamentals of energy**; **and empower you to make better decisions**, personally and professionally, by expanding your knowledge about energy in the United States and globally.

Students of all backgrounds are welcome! We are passionate about the energy challenge because we care about **people, our common prosperity, and maintaining a habitable planet.** You will join an international network of students and alumni, who have shared the experience of this class, which has been taught at Stanford for over 30 years.

Course Topics



About the Course

This course provides students with an in-depth understanding of each energy resource, from fossil fuels to renewable energy. It consists of lectures twice per week, with accompanying reading and video assignments *to be completed prior to each lecture*. You will have an opportunity to apply your knowledge and solve problems through in-class discussions, homework sets, a local energy research report, a midterm exam and a final exam.

A 10-week version of this course is taught in fall and spring quarter (CEE 107A/207A, ENERGY 107A/207A, EarthSys103) with additional detail and field trips. Students can only take one version of the course for credit (you cannot take both CEE107S and CEE107A).

Only current graduate students should take CEE 207S. If you sign up for the wrong version of the course, your assignments will not be recorded, and the TAs cannot grade your homework. **If you are <u>not</u> a graduate student, you should select CEE 107S.**

Course Details

Lecture: MW 9:30 AM - 11:20 AM
June 24 to August 17, 2024
Location: TBD

Instructors: Diana Gragg, moongdes@stanford.edu, Kevin Fan Hsu, khsu@stanford.edu
TAs: TBD
Admin Support: Justine Dachille, justined@stanford.edu

Contact for Instructors and TA:

- Contacting the teaching team via Slack (Channels or Direct Messages) is strongly preferred and will get you the speediest response. We *do not* check Canvas for messages, so unfortunately you won't be able to reach us through Canvas.
- Instructor and TA Office Hours: see Canvas for times & locations, starting Week 2

Course Websites:

- Canvas: https://canvas.stanford.edu .Click the **Modules** tab for readings, videos, and lecture slides, each week.
- Slack workspace: UESum2024
- Course overview: https://understand-energy-course.stanford.edu
- YouTube channel: https://www.youtube.com/user/EnergyResourcesVideo

Your Recipe for Success in This Class

For this **3-unit** course, you will:

- Complete the assigned readings and videos **before** lecture (check **Modules** in Canvas)
- Attend lecture 9:30 am - 11:20 am MW. We cover **A LOT** of material in this class; please be sure to stay on top of the lectures. It is easy to fall behind and hard to catch up.
- Complete weekly **homework assignments**. There are six problem sets in total.
- Post one **Energy-in-the-News article** and respond to another one, via Slack
- Complete the take-home **midterm exam**
- Write a **Local Energy Research Report**

- Participate in class discussions, energy-in-the-news, energy videos
- Complete the take-home **final exam**
- Attend a **local field trip**
- Check Canvas weekly to make sure your assignments have been received

Why Do We Teach '*Understand Energy*' ?

Energy is a **fundamental driver of human development and opportunity**. At the same time, our energy system poses **significant consequences** for our society, political system, economy, and environment. In taking this course, you will not only understand the fundamentals of each energy resource—including significance and potential, conversion processes and technologies, drivers and barriers, policy and regulatory environment, and social, economic, and environmental impacts—you will also consider the **broader context of the energy system** and think critically about how and why society makes choices around particular energy resources.

Specifically, you will:

- **Develop a greater awareness** about the energy flows and systems that allow us to turn on the lights, have cold drinks, and take hot showers.

- **Think in terms of energy systems** and grasp the complex interactions between energy resources and end uses, including the technological, scientific, policy, and economic considerations, and the private, social, and natural capital impacts along the entire energy resource life cycle.

- Apply this knowledge to…
    - think critically about the role of energy resources within our broader society.
    - analyze policies and regulations.
    - estimate, calculate, and synthesize energy information.
    - understand the significance and potential bias of energy-related news
    - communicate about energy use and environmental impacts in meaningful ways.
    - make informed energy decisions, from voting to consumption.
    - be a change agent and innovate solutions that improve our energy use patterns.

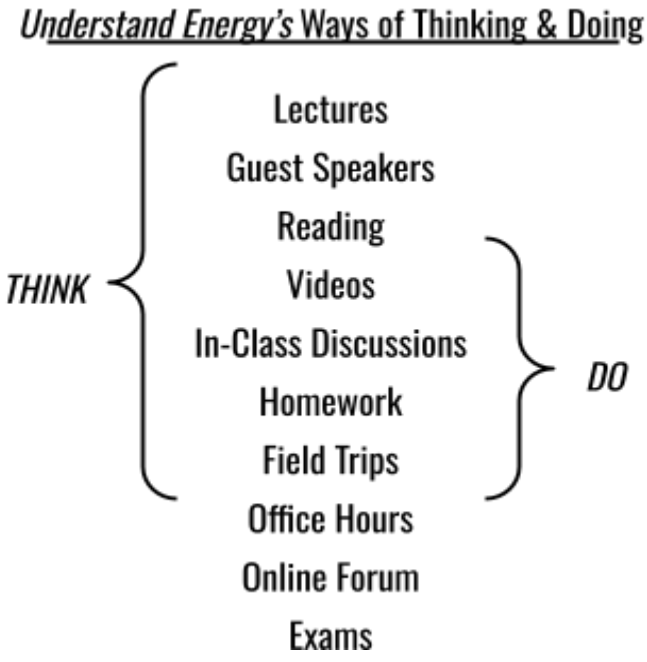
- **Have fun** and remember the class as a great and challenging learning experience.

Who Should Take This Course?

Anyone with an interest in energy or environmental issues! There are no prerequisites for this course except a basic grasp of algebra. Students with and without a technical background are encouraged to enroll.

More than half of the course content focuses on how society makes decisions about, and is impacted by, energy resources (including policy and regulatory decision-making; environmental, health and justice considerations; and economics). The remainder of the course covers the technical and engineering aspects of energy resources (technology innovation, resource formation and potential, conversion processes, and system dynamics).

The teaching team and your peers will be available to provide assistance on more challenging aspects of the course, via in-class discussion, the online forum (Slack) and office hours. We are here to support you!



Course Resources

Information about the course is posted on **Canvas** (https://canvas.stanford.edu/), including the syllabus, readings and videos, calendar, homework, policies, math review sheets, and grades.

Preparatory readings and videos for each lecture are available under the **Modules** tab and also on the first slide of each lecture, along with questions to think about during the readings or to prepare for in-class discussions. **The required readings and videos should be completed before the corresponding lecture**. We will discuss the readings and other questions during lecture, challenging you to think critically about how society approaches issues related to energy resources. You should be prepared to debate and deliberate—we want to know what you think! Example questions you might be asked to consider for the readings or in-class discussions (see the lecture slides on Canvas for the specific questions for each lecture):

1) What are the potential and realized social, environmental, political, and economic implications of the energy resource?
2) How is society dealing with the consequences or encouraging the benefits? What policies and regulations are in place, and what is missing? How do policies and regulations differ around the world, and how does that change the benefits and consequences of using that energy resource?
3) How do we as a society value the different aspects of the energy resource? Do we do a good job of balancing the costs and benefits?
4) What are your recommendations concerning the energy resource and how society should be valuing it?

Additional, optional videos are hosted on our YouTube channel:
http://www.youtube.com/user/EnergyResourcesVideo

Slack is the online forum for this course where students can ask questions and discuss and analyze energy resource topics outside of lecture. You can ask questions about the course material, homework, and energy in general and receive rapid responses from the teaching team. You are encouraged to respond to your peers' questions too!

Slack is also where students and instructors will post **"energy in the news"** to share and analyze with your classmates (in the *#energy-in-the-news* channel). You will be invited to Slack via your Stanford email by one of the TAs, so look out for that email (and check your Spam folder!) You should be aware that Stanford does not consider Slack to be compliant with the Family Educational Rights and Privacy Act of 1974 (FERPA). You can find more information here https://registrar.stanford.edu/students/student-record-privacy

Office Hours will be held by the teaching team (timing and location listed on Canvas). Join the sessions and chat with us—we love talking about your energy questions, and seeing your faces.

Lectures

The basic outline of lectures is listed below. **Please check Canvas for schedule changes.**

Week/Date	Topic
Week 1 M 6/24 W 6/26	Introduction: The Accelerating Energy Transition, Climate Change, Environment & Equity
	Intro to Fossil Fuels, Prospecting for Oil & Natural Gas
	Oil & Natural Gas: Drilling, Completing, Producing.
Week 2 M 7/1 W 7/3	Oil: Refining. Transportation Fuels & Pollution Control.
	Natural Gas. Electricity Generation. (Hwk #1 due 7/5)
Week 3 M 7/8 W 7/10	Coal. CCS.
	Nuclear Fission and Fusion. (Hwk #2 due 7/12)
Week 4 M 7/15 W 7/17	Intro to Renewable Energy & Wind Energy.
	Energy in Cities. (Hwk #3 due 7/19)
Take-Home Midterm Released Thursday 7/18 at 5 pm	
Week 5 M 7/22 W 7/24	Electricity Transmission & Markets, Decarbonization in the Electric Power Sector.
	Energy Efficiency & Energy for Buildings.
Take-Home Midterm due Thursday 7/25 at 5 pm	
Week 6 M 7/29 W 7/31	Solar Energy. Energy Storage.
	Biomass and Biofuels. (Hwk #4 due 8/2)
Week 7 M 8/5 W 8/7	Hydroelectricity & Ocean Power.
	Geothermal. Hydrogen. (Hwk #5 due 8/9)
Local Energy Report due Thursday 8/8 at 5 pm	

Week 8 M 8/12 W 8/14	Geopolitics. Federal Policy (BIL, IRA). Equity Review.	
	Electrification of Transportation and Course Wrap-up	(Hwk #6 due 8/16)
Final Exam Released Wednesday 8/14 at 5 pm, due Saturday 8/17 at 5 pm		

Assignments & Grading

3 Units	
Homework	40%
Midterm Exam	20%
Final Exam	25%
Local Report	15%
Extra Credit Slide	+0.5%

Final letter grades are assigned based on a curve. The undergraduate course (CEE 107S) is curved separately from the graduate course (CEE 207S).

Please make sure the submitted assignments are legible, otherwise points may be taken off. Either type all of your homework or exam, showing all work, in Word and **export to PDF** at the end; or hand-write your assignment and take photos and convert to **PDF** at the end. Some students have found that using scanning software makes it easier to submit their hand-written homework assignments as one document (e.g., TurboScan or GeniusScan).

Homework

Problem Sets

- Students are assigned **6 homework sets,** one in each non-exam week. Students taking the graduate level course (CEE 207S) will have additional problems on the homework sets. You are encouraged to collaborate with your peers on homework assignments but each student must turn in an individual assignment **in your own words**: **plagiarism or copying is a serious violation of the Honor Code.** Please refer to the Homework Policy on Canvas.

- Homework assignments are due on **Fridays at 5 pm**:

  HW1, due Friday 7/5
  HW2, due Friday 7/12
  HW3, due Friday 7/19

  Midterm: due Thursday, 7/25 — no HW

  HW4, due Friday 8/2
  HW5, due Friday 8/9
  HW6, due Friday 8/16

- All assignments should be **submitted online to Gradescope via Canvas.** Do not e-mail us any assignments; please submit them on Gradescope.

Energy in the News

- Students must **post an 'Energy-in-the-News' article** on Slack in the *#energy-in-the-news* channel once during the quarter. They must also **respond to one post** from another student once during the quarter. This assignment can be completed any time before the end of the quarter. More information is provided on Canvas.

Local Energy Field Trip

- Attendance and answering a question on the last homework assignment for a field trip will count toward the homework grade.

Midterm Exam

- The exam will be open-book, take-home, and remote. The material covered includes all lectures, reading, and homework assignments prior to the midterm exam.
- **No collaboration is allowed on the take-home exam.** While the take-home exam is NOT "open other people," you can ask clarifying questions **privately** in Slack or in office hours (which we will ensure are private, i.e. one student at a time).
- **The take-home exam will be released on Thursday 7/18 at 5 pm and is due Thursday 7/25 at 5 pm. Your exam must be submitted online through Gradescope via Canvas.**

Local Energy Research Report

- A 1,500- to 2,000-word report about your local energy system (the country or city you come from)
- **Due Thursday 8/8 at 5 PM.** More info is in the Local Energy Research Report doc on Canvas.

Final Exam

- The exam will be open-book, take-home, and remote. The material covered includes all lectures, reading, and homework assignments from throughout the quarter.
- **No collaboration is allowed on the take-home exam.** While the take-home exam is NOT "open other people," you can ask clarifying questions **privately** in Slack or in office hours (which we will ensure are private, i.e. one student at a time).
- **The take-home exam will be released on Wednesday 8/14 at 5 pm and is due Saturday 8/17 at 5 pm. Your exam must be submitted online on Canvas.**

Extra Credit

- **Create a Personal Slide.** Submit a single slide about yourself and your interest in energy for the slide show on the last day of class (updated from the slide you submit with the first homework assignment). This is worth 0.5% of extra credit.

Instructors

Kevin Fan Hsu: Kevin is a Lecturer in Civil and Environmental Engineering (CEE) at Stanford. He has worked on energy, sustainability, and urban planning on both sides of the Pacific, including the United States, China and Singapore, and specializes in equitable and resilient development. Kevin earned an M.S. from the CEE Atmosphere/Energy Program and later received an M.A. in Cultural Heritage Management from Johns Hopkins University. He took this class in 2007 and helped organize multiple versions of the China Energy Systems class. Aside from energy and environment, he enjoys playing music (he's a cellist), dance (waltz, swing and lindy hop), and wandering around new neighborhoods.

Diana Gragg: Diana is a Core Lecturer in Civil and Environmental Engineering (CEE) and the Explore Energy Managing Director at the Precourt Institute for Energy. She received her M.S. and PhD in the CEE Atmosphere/Energy program in 2012, a postdoc at the Precourt Energy Efficiency Center in 2015 and has a background in the oil and chemical industry, air pollution, and sustainable transportation. She took this class way back in 2004 — it changed her life! — and she joined the teaching team in 2015. She loves animals, running, hiking, water polo, skiing — and anything that involves spending time with her family.

Jane Woodward: Jane has been an Adjunct Professor in CEE at Stanford and teaching a version of this course since 1991. In addition to Understand Energy, she supports the teaching of Stanford Climate Ventures. Jane also serves on Stanford's Precourt Institute for Energy Advisory Council and founded and or funds a variety of sustainable energy education initiatives at Stanford. Jane is a founder and Managing Partner of WovenEarth Ventures, an early-stage energy climate venture and project fund of funds. Jane is also a Founding Partner at MAP Energy, an energy investment firm currently focused on oil and gas royalty interests.

Kirsten Stasio: Kirsten is the CEO of the Nevada Clean Energy Fund (NCEF) and an Adjunct Professor in CEE at Stanford. She graduated from Stanford in 2014 with an E-IPER MS degree and an MBA. Her background includes working for 7 years to scale wind, solar, and energy storage investments at MAP Energy, implementing commercial energy efficiency initiatives at Pacific Gas and Electric (PG&E) and at Apple, and advancing climate policy at the World Resources Institute (WRI).

Other guest lecturers will be featured during the quarter.

Honor Code

Violating Stanford University's Honor Code is a serious offense, even when the violation is unintentional. The Honor Code is available at:
https://communitystandards.stanford.edu/policies-guidance/honor-code

Specifically, adhering to the Stanford Honor Code implies that all work in exams and quizzes must be done individually. For homework, students may consult with TAs and with other students, but must write up solutions independently based on their own understanding. All references and sources (e.g., in your local energy report) must be clearly identified and properly referenced. Lastly, if you work with other students on a homework set, you must acknowledge their names on the front page of your submission. Please refer to the Homework Policy posted on Canvas regarding collaboration on homework assignments.

Students with Documented Disabilities

Students who may need academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty. Unless the student has a temporary disability, Accommodation Letters are issued for the entire academic year. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, URL: https://oae.stanford.edu)

COVID-19

If you **feel sick, do not come to class, even if you suspect you just have a cold or allergies**. Please do this out of an abundance of caution and out of respect for your peers and the teaching team and guests. We will be very accommodating on illness-related absences and will help you make-up for any missed work.