

Sustainable Energy in Nature and Society

PHYS188/IOES188

Winter 2026

Building a sustainable future is an existential challenge for humankind. Any path forward depends on a deep understanding of a broad set of issues, ranging from the laws of nature, to human culture and behavior, to economic realities. In this course the students will learn to think about these problems in an interdisciplinary way via the analysis of case studies: solar power, nuclear power, transport, and food systems. The course is targeted at students across campus who are juniors and seniors.

High school level math and physics are sufficient. There will be no calculus, no differential equations, and physics will mostly be based on concepts, simple algebra, and order of magnitude/dimensional calculations.

Lecture: Tuesday/Thursday 11-12:15, FRANZ 2258A

Instructors: Prof. D. Rajagopal rdeepak@ioes.ucla.edu; Prof. T. Treu; 3-718 Physics & Astronomy Building; tt@astro.ucla.edu

Meeting ID: 950 2212 7799

Passcode: 775826

Office Hours: Monday: TT 11am; Tuesday: DR 10-11am; TT 3pm; Wednesday: DR 11:30-12:30
on zoom:

Meeting ID: 950 2212 7799

Passcode: 775826

IMPORTANT NOTE: If you email the professors, be sure to include “ESPH188” in the subject line, or we may not get the email!!!

Course Webpage: <https://bruinlearn.ucla.edu/courses/222317>

Prerequisites: none

Grading and Exams:

- Midterm: 2/19
- Final Exam: 3/17 3-6PM
- Weekly homework is **required**; the best **five** will count towards your homework grade, to allow for missed assignments. If you turn in less than five homework assignments you will receive a lower grade for homework (i.e. 20/25 for 4 perfect assignments)

- Grading scheme: 40% for midterm, 40% for final, 20% for homework, 5% extra credit for class participation

Homework:

- Homework will be assigned weekly
- Homework is due at 11:00AM on Thursdays.
- You must turn in at least **FIVE** homework assignments or suffer a grade penalty. It is not my responsibility to track how many assignments you have turned in: *keep track of your work.*
- If you turn in six or more homework assignments we will **only count the best five**, so you can afford to miss up to three assignments if you are away or sick (or join the course late).
- You should try to do the homework as independently as possible. You are allowed (and encouraged) to talk to others about the problems. But blind copying of answers is academic dishonesty. As a guideline, you should be able to *explain* your solutions to other students.

General Requirements:

- **You are responsible for ALL material covered in lectures, including announcements!**
- There are **NO** excuses for cheating, and **ALL work in this class MUST BE YOUR OWN.** We follow the UCLA policies on intellectual integrity, which can be found at <http://www.deanofstudents.ucla.edu/studentconductcode.pdf>
- **There will be no makeup midterms.** If a valid written medical excuse e.g. COVID-related (or serious family tragedy) is presented, your final exam score will be substituted for your midterm grade.
- **There will be no makeup final exam, so you cannot miss it,** except in case of a documented emergency.

Preliminary Plan (to be updated regularly)

Day/ W26 date	Topic	Subtopic	Emphasis	Lead Instructor	References
1 1/6/26	Introduction: why this course?	Goals of the course. Methodology. Physics: What is Energy? Entropy?	Economics/Engineering/Physics/Policy	TT/DR	
2 1/8/26	Introduction: why this course?	Goals of the course. Methodology. Economics: Policy: Discounting.	Economics/Engineering/Policy	DR/TT	

Day/ W26 date	Topic	Subtopic	Emphasis	Lead Instructor	Referenc es
3 1/13/26	Sustainable Energy. The energy budget.	Statistics and trends; "Peak oil"; Past energy transitions; desirable uses of energy. Current Examples. US. Japan. Europe. India	Physics/Policy	DR/TT	
4 1/15/26	Energy History and Issues. II	Global Warming	Physics/Economic s/Policy	TT/DR	
5 1/20/26	Sustainable Energy: Solar power	How does the Sun work? How do solar panels work? Why are some sites better than others? How much solar power?	Physics	TT/DR	
6 1/22/26	Sustainable Energy: Solar power	Pros and cons. The problem of storage and backup	Physics/Policy/Ec onomics	DR/TT	
7 1/27/26	Sustainable Energy: Solar power	The economics and policy of solar panels and solar power.	Economics/Policy	DR/TT	
8 1/29/26	Nuclear Power	Fission and fusion basics	Physics	TT/DR	
9 2/3/26	Nuclear Power	Pros and cons. Accidents and waste storage.	Physics/Economic s/Policy	TT/DR	
10 2/5/26	Nuclear Power	The economics and policy of nuclear power	Economics/Policy	DR/TT	
11 2/10/26	Transport	Fundamentals. How do cars/plans/public transport work? Pros and cons of means of transportation.	Physics	TT/DR	
12 2/12/26	Transport	The economics and policy of transport.	Economics/Policy	DR/TT	
13 2/17/26	Transport	Cultural aspects. Externalities	Economics/Policy	DR/TT	

Day/ W26 date	Topic	Subtopic	Emphasis	Lead Instructor	Referenc es
14 2/19/26	Midterm	Up to Nuclear power included			
15 2/24/26	Food	Fundamentals of food energetics. Thermodynamics.	Physics	TT/DR	
16 2/26/26	Food	The economics and policy of food.	Economics/Policy	DR/TT	
17 3/3/26	Developing a sustainable Energy Program	How much can we improve things? Physical and technological limits. Balancing the Energy Budget. Climate engineering.	Physics	TT/DR	
18 3/5/26	Developing a sustainable Energy Program	Economics. How much will it cost? Prevention vs mitigation. Unintended consequences.	Economics	DR/TT	
19 3/10/26	Developing a sustainable Energy Budget	Policy. How to induce behavioral changes. Social Justice.	Policy	DR/TT	
20 3/12/26		Ask us anything! Review for the final and pressing questions			