



USC University of Southern California

GESM-150: PHYSICS OF ENERGY

Units: 4

Term—Day—Time: TBD

Location: TBD

Instructor: Aaron Wirthwein

Office: TBD

Office Hours: TBD

Contact Info: wirthwei@usc.edu

Teaching Assistant: Not yet assigned

Office: TBA

Office Hours: TBA

Contact Info: TBA

Course Description

“When you change the way you look at things, the things you look at change.”

- Max Planck, theoretical physicist

In this course we will discuss the basic physical principles behind various energy sources and the consequence of their usage on environmental, social, and economic systems. This course is designed for the non-science major with little-to-no background in science or mathematics at the university level. The central goal of this course is to develop a deeper understanding of energy *from the perspective of a physical scientist*, but we will also integrate complex questions regarding energy usage. Through guided exercises and real-world examples, we will evaluate our individual roles in using energy more effectively.

Learning Objectives

By the end of this course, students will be able to:

1. Think like a scientist. Students will learn and practice the scientific method. We will construct models of physical systems and test those models using empirical evidence.
2. Conduct a survey of peer-reviewed scientific literature. Students will learn how data is generated, presented, and interpreted.

3. Identify different forms of energy and how they relate to one another. Students will categorize energy forms and learn how they relate to simpler physical quantities (such as mass, speed, and temperature).
4. Utilize basic algebraic and quantitative reasoning to understand relationships between energy forms and simpler physical quantities.
5. Think critically about contemporary issues in energy usage and conservation.
6. Draw conclusions from empirical data and communicate results and observations to others.
7. Write a scientific article that illustrates the application of course knowledge to a contemporary issue or topic of scientific interest.

Prerequisite(s):

None

Co-Requisite(s):

None

Concurrent Enrollment:

None

Recommended Preparation:

None

Communication

Announcements, illustrative material, grades, etc. will be posted on Blackboard.

Technological Proficiency and Hardware/Software Required

Students are expected to be proficient in using Blackboard. Students will require a hand calculator (e.g., on smartphone or personal computer) to do some of the laboratory and examination exercises.

USC technology rental program

We realize that attending classes online and completing coursework remotely requires access to technology that not all students possess. If you need resources to successfully participate in your classes, such as a laptop or internet hotspot, you may be eligible for the university's equipment rental program. To apply, please [submit an application](#).

USC Technology Support Links

[Zoom information for students](#)

[Blackboard help for students](#)

[Software available to USC Campus](#)

Required Materials

Energy – Its Use and the Environment by Hinrichs & Kleinbach (Thomson 5th Edition). Most assigned readings will come from this textbook.

Optional Materials

Optional materials will be posted on Blackboard.

Grading Breakdown

Laboratory assignments: Students must register separately for laboratory sections. There will be 7 labs throughout the semester and each will take approximately 2 hours to complete. The labs will provide students with hands-on experience as they explore physical principles surrounding energy, its conservation, and its usage. Students will learn how to design an experimental apparatus and make quantitative measurements. Students will learn how to handle experimental uncertainties and present their numerical results in terms of confidence intervals. Laboratory sessions will begin during the week of [date]; no labs will be held during the first week of classes. Lab exercises can be downloaded from Blackboard. The Teaching Assistant will grade all lab work; the instructor will intervene only in the case of conflicts.

Homework assignments: Approximately 7 assignments will be posted to Blackboard over the course of the semester. The due date for the assignment will be clearly posted and no late submissions will be allowed without instructor approval. The cumulative homework score, up to 15 grade points, will be computed for each student after dropping the student's lowest score. The primary purpose of the homework assignments is to guide you through active participation with the course material on a personal level, and although discussing the homework with your peers is allowed (and encouraged), each student will submit their own assignment.

Examinations: The three examinations will evaluate student comprehension of the lecture and textbook material:

- Midterm Exam 1 will be given at [time on day, date]. It will cover the lectures and reading assignments from [date] to [date].
- Midterm Exam 2 will be given at [time on day, date]. It will cover the lectures and reading assignments from [date] to [date].
- Final Exam will be given at [time on day, date]. It will be a *comprehensive examination*, covering all lectures and reading assignments throughout the term.

If you want to do well on the exams, we encourage you to attend class faithfully, take notes in class, read the assigned materials, and review the lectures.

Missed examinations: *If you have to miss an examination because of illness or an academic conflict, you must inform the instructor by email in advance, and provide documentation.* Make-ups of examinations will, in general, NOT be permitted except for extraordinary circumstances (e.g., documentable conflicts with other USC-related commitments). In the case of a missed midterm, where a reasonable excuse exists, the midterm may be waived with a score assigned that reflects the average of your work done on the other two exams.

Final report and presentation: Beginning the first week of classes, students will make progress on an individual project of their choosing that must have relevance to a contemporary issue in

energy usage (personal, societal, or environmental) or a topic of scientific interest. Students will meet regularly with the instructor to discuss their progress. The students must submit a written report and give an oral presentation. Requirements and grading rubrics for the final report will be posted to Blackboard.

Maximum Scoring for Each Grade Element

Student grades are based on the cumulative score of 100 grade points summed over five graded elements: laboratory work, homework assignments, two mid-term exams, and a final exam. The maximum number of points that can be earned for each element is given in the following table:

Graded Element	% of Grade
Laboratory Assignments	15
In-Class Quizzes	15
Midterm Exam 1	15
Midterm Exam 2	15
Final Exam	20
Final Report + Presentation	20
Total	100

Although the lab component counts for only 15% of the final grade, students must pass the laboratory component to receive a passing grade in the class.

Disability Services

Students requesting academic accommodations based on a disability are required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP when adequate documentation is filed; please be sure the letter is delivered to the instructor as early in the semester as possible. DSP is open Monday-Friday, 8:30-5:00. The office is in Student Union 301 and the phone number is (213) 740-0776.

Grading Scale

Each student will receive a final grade based on their cumulative score. The grading curve will have an *approximate* distribution as follows:

A: 15% of total enrollment

B: 35% “ “

C: 35% “ “

D: 15% “ “

Based on previous classes, a grade of F is typically assigned to a cumulative score that is less than 50% of the highest score in the class.

Assignment Submission

All assignments will be posted on Blackboard, and all completed assignments will be submitted via Blackboard.

Communication Policy

To communicate with the instructor outside of class or office hours, email the instructor from your USC email account. In the subject line, indicate the course number and your full name. Simple questions will be answered by email, but for more complex discussions students may be instructed to visit office hours.

Sharing of course materials outside of the learning environment

USC policy prohibits sharing of any synchronous and asynchronous course content outside of the learning environment.

Residential and Hybrid Streaming Model Courses

The latest COVID-19 testing and health protocol requirements for on campus courses can be found on the [USC COVID-19 resource center website](#).

Course evaluation

Course Schedule: A Weekly Breakdown (tentative as of June 7, 2022)

	Lecture & Discussion Topics	Readings	Laboratory
Week 1	Philosophy of science, the scientific method, definition of energy	Posted materials Ch. 1 Hinrichs	No lab first week
Week 2	Forms of energy and energy conversions, energy of motion	Ch. 2 Hinrichs	Basic Aspects of Physics
Week 3	Conservation of energy, energy efficiency	Ch. 3 Hinrichs	
Week 4	Heat and work, laws of thermodynamics and heat engines	Ch. 4 - 5 Hinrichs	Conservation Laws of Motion & Energy
Week 5	Energy from solar radiation and fossil fuels	Ch. 6 - 7 Hinrichs	
Week 6	Home energy conservation and heat-transfer control	Ch. 5 Hinrichs	Heat Engines
Week 7	Electricity; charges, currents, batteries	Ch. 10 Hinrichs	
Week 8	Generation and transmission of electrical energy	Ch. 11 Hinrichs	Circuits
Week 9	Electricity from solar, wind, and hydro	Ch. 12 Hinrichs	Electromotors
Week 10	Energy use and air pollution	Ch. 8 Hinrichs	
Week 11	Global warming and thermal pollution	Ch. 9 Hinrichs	Solar Cells
Week 12	The building blocks of matter, the atomic model	Ch. 13 Hinrichs	
Week 13	Mass-energy equivalence, nuclear power, fission & fusion	Ch. 14 & 16 Hinrichs	Spectroscopy
Week 14	Effects and impacts of nuclear power and radiation, case study in Chernobyl disaster	Ch. 15 Hinrichs	
Week 15	Energy and the economy, future energy alternatives	Ch. 16 Hinrichs	FINAL PRESENTATIONS
FINAL	FINAL EXAMINATION		

Statement on 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” 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, policy.usc.edu/scientific-misconduct.

Support Systems:

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

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

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) 740-9355(WELL), press “0” after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and 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

equity.usc.edu, titleix.usc.edu

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

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

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

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

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

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, 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

Non-emergency assistance or information.

Supplemental resources and further reading

<https://www.epa.gov/energy>

<https://www.energy.gov/>

<https://www.eia.gov/>

Energy and the Environment, Ristinen, Kraushaar, & Brack (2022)

Taking on Technocracy: Nuclear Power in Germany, 1945 to the Present, Augustine (2021)

Energy: A Human History, Richard Rhodes (2018)

Energy, Environment, and Climate, Richard Wolfson (2017)

The Grid: The Fraying Wires Between Americans and Our Energy (2017)

The Revenge of Gaia, James Lovelock (2006)

Out of Gas, David Goodstein (2004)

The Skeptical Environmentalist, Bjørn Lomborg (2001)