

Syllabus
GEO 302T
CLIMATE AND THE ENERGY TRANSITION
Fall 2024
Unique #26585
JGB 3.120
MWF 1:30 p.m. – 2:30 p.m.

Short Course Description

This course will explore one of the greatest challenges of your generation: how can we transition to a carbon neutral world. We will review basic concepts of energy. We will explore the energy balance that controls Earth's temperature and discuss how our use of fossil fuels has altered this balance. We will review how carbon-based fuels underpinned the industrial revolution, driving an extraordinary increase in living standards. We will then review potential pathways to a carbon neutral future including solar, wind, geothermal, hydrogen, and nuclear. We will visit local sources of energy production including solar, hydroelectric, and natural gas. Through these examples, we will explore the concept of energy density, footprint, and intermittency. We will close with an exploration of possible strategies for how to bridge the gap to a carbon free future.

Prerequisites

None. This course is intended for the general student in any discipline at UT Austin. There will be simple mathematics applied (e.g. multiplication and division).

Objectives

To instill in you a deeper understanding of the challenge that we face in the energy transition as we strive to limit CO₂ emissions. To teach you objective approaches to understand the practical steps that will be necessary as we shift to the energy transition. To provide you an opportunity to advance your writing and communication skills through exploring the topic of the energy transition.

Instructors

Peter B. Flemings

Professor

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Office Hours

TBD and by appointment

Textbooks

Wolfson, R., Energy, Environment, and Climate, W.W. Norton & Company.

We will also have articles and papers curated from public sources.

Method of Instruction

All instruction will be held in person. In class instruction will be a combination of on paper and displayed on a document camera, powerpoint, and open discussion.

Method of Evaluation

30%: Writing: 2 writing exercises over semester.

40%: Exams. Two exams will be held over the course of the semester.

10%: Discussion: There will be extensive discussion during the course lectures. In addition, there will be multiple field trips to different energy developments in and near Austin. The approach to these trips will be discussion-based.

20%: Homeworks and in class exercises.

Grading scale:

We use the +/- grading system.

>93A; 90-93 A-; 87-89 B+; 83-86 B; 82-80 B-; 79-77 C+; 76-73 C; 72-70 C-; 63-70 D;

<63 F. If the median on a test is below 80, it is scaled so the median is an 80.

Course Schedule

Module 1: Energy Fundamentals

Overview

This module introduces energy-related terminology, including units and metrics. We explore different types of energy. We explore the concept of heat and heat transfer.

➤ Learning Objectives

- Convert between units of energy and power
- Understand how heat is transferred
- Understand radiation, conduction, and convection.

Week	1		
Class	Day	Date	Topics
1	Mon	8/26	Course Introduction and Background:
2	Wed	8/28	No Class
3	Fri	8/30	Energy and Power
Week	2		
4	Mon	9/2	No Class-Labor Day
5	Wed	9/4	Energy Usage
6	Fri	9/6	Forms of Energy
Week	3		
7	Mon	9/9	Energy and Heat
8	Wed	9/11	Energy and Heat
9	Fri	9/13	Field Trip: UT Power Plant

Module 2: Climate Science

Overview

This module summarizes what controls the temperature of our planet. We explore how Earth's atmosphere controls the temperature of our planet. We explore the role of greenhouse gasses impact Earth's temperature. We review the increase in CO₂ during the last several hundred years is impacting the Earth's temperature. We discuss projections of future increase in Earth's temperature.

➤ Learning Objectives

- Understand the Earth's energy balance.
- Understand controls on Earth's temperature
- Describe recent global temperature change
- Estimate global temperature as a function of greenhouse gas production

Week	4		
Class	Day	Date	Topics
10	Mon	9/16	Earth Energy Balance-No Atmosphere
11	Wed	9/18	What is a greenhouse
12	Fri	9/20	What is a greenhouse gas
Week	5		
13	Mon	9/23	No Class-Labor Day
14	Wed	9/25	Earth Energy Balance-Atmosphere
15	Fri	9/27	Climate Forcing
Week	6		
16	Mon	9/30	A Warming Earth
17	Wed	10/2	Ongoing climate change
18	Fri	10/4	Ongoing climate change

Module 3: Fossil Fuels

Overview

This module summarizes hydrocarbons as an energy resource and the role it has played as our primary energy source since the dawn of human civilization.

➤ Learning Objectives

- Understand where hydrocarbons come from
- Understand the history of our usage of hydrocarbons
- Understand energy density

Week	7		
Class	Day	Date	Topics
19	Mon	10/7	What are fossil fuels and where do they come from
20	Wed	10/9	Coal, oil, and gas
21	Fri	10/11	History of fossil fuel usage
Week	8		

22	Mon	10/14	Fossil fuels and CO ₂ production
23	Wed	10/16	Projections of Fossil Fuel usage
24	Fri	10/18	Impact of fossil fuels

Module 4: Alternatives to Fossil Fuels

Overview

This module reviews alternative sources of energy This module summarizes the potential for wind energy as a resource

➤ Learning Objectives

- Understand how solar energy is converted into electricity
- Understand the footprint of solar energy
- Understand solar heating
- Understand how wind energy is extracted
- Understand the wind in the energy mix
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Week	9		
25	Mon	10/21	The solar resource
26	Wed	10/23	Photovoltaic solar energy
27	Fri	10/25	Field Trip solar
Week	10		
4	Mon	10/28	Solar Energy Calculations
5	Wed	10/30	Solar
6	Fri	11/1	Solar
Week	11		
25	Mon	10/21	The wind resource
26	Wed	10/23	The wind footprint
27	Fri	10/25	Where is he resource

Week	12		
28	Mon	10/28	Geothermal Energy Calculations
29	Wed	10/30	Electric generation
30	Fri	11/1	Home heating
Week	13		
31	Mon	11/4	The source of nuclear energy
32	Wed	11/6	Challenges of nuclear energy
33	Fri	11/8	Nuclear energy

Module 5: Energy Carriers

Overview

This module summarizes the potential of electricity and hydrogen as energy carriers.

➤ Learning Objectives

- The potential of hydrogen as an energy resource
- The role of batteries
- The grid

Week	14		
31	Mon	11/4	The Grid
32	Wed	11/6	The Grid
33	Fri	11/8	Batteries
Week	15		
34	Mon	11/11	Batteries
35	Wed	11/13	Hydrogen
36	Fri	11/15	Hydrogen

Module 6: Other Paths to Reduce CO2 Footprint

Overview

This module summarizes the potential for CO2 sequestration and for reduced emissions of CO2 through better technology.

➤ Learning Objectives

- The potential of CO2 sequestration
- The role of reduced consumption

Week	16		
28	Mon	11/18	CO2 Sequestration
29	Wed	11/20	CO2 Sequestration
30	Fri	11/22	CO2 Sequestration

Week	17		
31	Mon	12/2	Using Less Energy
32	Wed	12/4	Using Less Energy
33	Fri	12/6	Using Less Energy

Week	17		
40	Mon	12/9	Last Day of Classes

Other Info

The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. Call Office of Dean of Students 471-6259 471-4241.

Web-based, password-protected class sites are associated with all academic courses taught at The University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of the sites. Students who do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1.

Course Policies

Assignments will be submitted on Canvas before due date time. Papers should be submitted in word format. No zip files.

After the due date papers can still be submitted for 1 week with being marked off 40%. No assignments will be accepted 1 week from the due date. However, each student will have the lowest grade dropped for the semester, which will alleviate this obligation in the event of an emergency.

In solving any problems, it is your responsibility to show enough detail and intermediate steps that the grader can tell that you are using correct principles in your solution.

SI units are the units of choice for this class, although often pressures will be in other units. For consistency, all homework and exam work should be converted to and worked out in SI units and, if required, converted to other units for the final answer.

You are expected to attend all class sessions.

Canvas is available at <http://courses.utexas.edu>.

Please note the following College and University Policies:

- Academic dishonesty is a serious breach in the code of ethics for The University of Texas. Any student caught in an act of scholastic dishonesty will be given an F for a course grade and will have his/her case referred to the Dean of Students Office for additional disciplinary action. I do not expect to have to confront this issue, but unfortunately have had to in the past.

Important Safety Information: If you have concerns about the safety or behavior of fellow students, TAs or Professors, contact BCAL (the Behavior Concerns Advice Line): <https://safety.utexas.edu/behavior-concerns-advice-line>. Your call can be anonymous. If

something doesn't feel right—it probably isn't. Trust your instincts and share your concerns.

Title IX Reporting: Title IX is a federal law that protects against sex and gender-based discrimination, sexual harassment, sexual assault, sexual misconduct, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms. When sexual misconduct occurs in our community, the university can:

1. Intervene to prevent harmful behavior from continuing or escalating.
2. Provide support and remedies to students and employees who have experienced harm or have become involved in a Title IX investigation.
3. Investigate and discipline violations of the university's relevant policies. Faculty members and certain staff members are considered "Responsible Employees" or "Mandatory Reporters," which means that they are required to report violations of Title IX to the Title IX Coordinator.

We are a Responsible Employee and must report any Title IX related incidents that are disclosed in writing, discussion, or one-on-one. Before talking with me, or with any faculty or staff member about a Title IX related incident, be sure to ask whether they are a responsible employee. If you want to speak with someone for support or remedies without making an official report to the university, email advocate@austin.utexas.edu For more information about reporting options and resources, visit titleix.utexas.edu or contact the Title IX Office at titleix@austin.utexas.edu.