

# CHE 450: SUSTAINABLE ENERGY

Fall 2021

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<b>Instructor:</b>	Shaama Mallikarjun Sharada	<b>Time:</b>	M/W 12:00 – 13:50
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## 1 Main References

The main reference is titled 'Sustainable Energy, Choosing Among Options' by Tester, Drake, Driscoll, Golay, and Peters, 2<sup>nd</sup> Ed. MIT press. The Ebook is available through USC Libraries (<https://ebookcentral.proquest.com/lib/socal/detail.action?docID=3339517>).

Lectures will be supplemented with research, news articles, case studies, and material from other textbooks on specific topics. All relevant material will be provided on Blackboard.

**Discussion:** Mondays 9:00-9:50am.

**Office hours:** TBA.

## 2 Course Objectives

Upon completion of this course, students will be able to

1. Appreciate the need for sustainable energy and processes
2. Understand the complexity associated with establishing sustainable practices and processes and the role of various spheres – science, technology, economics, and policy – in ensuring a sustainable future
3. Assess the merits of various sustainable technologies using quantitative frameworks and metrics
4. Arm themselves with the knowledge and analytical skills to make sustainable decisions
5. Gain working knowledge of state-of-the-art in various renewable energy technologies

## 3 Course Outline

The following topics will be covered

1. Global energy use and future
2. Operational definitions and measuring sustainability
3. Choosing from options – fossil fuels, solar, biomass, wind, and water
4. Sustainability and chemical engineering
5. Special topics

## 4 Grading Policy

Homework & Quizzes .....	15%
Midterm (TBA) .....	25%
Course Project .....	60%

## 5 Submissions

All homework and project-related submissions will be online (Blackboard). The first homework will be assigned on Wednesday, Sep 1<sup>st</sup> and will be due one week from the day of assignment, i.e. Wednesday, Sep 8<sup>th</sup>. Homework submitted one day late will incur a 10% penalty, and the submission window closes after that. No homework will be assigned in the week when a project-related submission is due.

The filename for submission must follow this specific format – e.g. if John Doe is submitting homework 2, the filename will be CHE450Homework2\_JohnDoe.pdf

## 6 Course Project

### 6.1 Overview

The objective of the project is to apply concepts and frameworks in sustainability discussed in the course to address a specific technology/problem. Students are expected to identify a topic, review the state of the art, and carry out independent analysis and assessment that add insight to the topic. The course project is *not* meant to be a literature review.

Students are expected to work in groups of three. Every group must compare **three** options – e.g. sustainability of three types of solar cell materials, three types of biofuel raw materials – with one student working on assessing each option. The final comparison of options to make the sustainable decision must be done collectively by all members of the group.

The workflow for the project must consist of the following components:

1. Establish a **baseline** for comparison. E.g. We will be comparing three types of solar cells meet all power needs of student residences at USC (=X kW-hr/year)
2. Gather data from **reliable sources** – research papers in peer-reviewed journals, databases, annual reports from companies, technical reports from national/international bodies (e.g. UN). Avoid websites and anything that can only be cited using a hyperlink. Most news articles cite sources, so use those sources instead
3. Establish a **life cycle** – outline all the key steps from cradle to grave. Identify the ones that are important for comparing with other options to determine the most sustainable one
4. **Quantify** sustainability across all three pillars – economic, environmental, and social impacts. This step involves identification of a uniform set of **metrics** (or indicators) and using the data gathered in step 2 to compute impacts. All assumptions must be clearly stated
5. **Compare** the three options and analyze the outcomes, using for e.g. eco-efficiency analysis

6. Carry out an **additional level** of analysis – sensitivity (to underlying assumptions) analysis or scenario analysis or uncertainty analysis or risk analysis. This step will help you determine the sensitivity of your sustainable choice to underlying parameters or assumptions

## 6.2 Sample topics

- Sustainability analysis of hybrid vehicles
- Carbon capture and sequestration from coal-fired power plants
- Sustainability of biodiesel: Environmental impact analysis

You can find out about topics chosen by students in previous years from their YouTube videos –

**Fall 2018:** <https://www.youtube.com/playlist?list=PL7M89yz20nmnjah40dfLbStuHaFmSKUho>

**Fall 2019:** [https://www.youtube.com/playlist?list=PL7M89yz20nmkUJ\\_WAq1N7iR31pcKjc2sr](https://www.youtube.com/playlist?list=PL7M89yz20nmkUJ_WAq1N7iR31pcKjc2sr)

**Fall 2020:** <https://www.youtube.com/playlist?list=PL7M89yz20nmnogMQdwwk8wvrvjLMJ2F7o>

## 6.3 Project timelines and weights

1. Identify team members (teams of 3) and topic (title).....Sep 1
2. Submit abstract and plan of work (10%)\*.....Sep 8
3. Interim reports due (20%)\* .....Oct 6
4. Project reports due (30%)\* .....Nov 10
5. Project presentations (20%)\* .....Nov 24
6. Project videos due (20%) .....Dec 3

\* indicates that there will be no homework due that week.

Project deliverables for stages 2 and 6 will be submitted and graded as a group. All interim and final reports must be written and submitted individually and will be graded individually. Project presentations will be groupwise but every student will be graded separately.

## 6.4 Project deliverables

**Stage 1 – Topic:** Report team composition, team name, and title of project.

**Stage 2 – Abstract:** (limit – 1pg) The abstract and plan of work contain the following information:

1. What is the technology/problem?
2. Why is the answer to this problem important?
3. What are the key features constituting this technology/problem?
4. How much information is available on this topic? (cite at least 6 references, not in page limit)

Submit the abstract and plan of work as a group. Grade will be assigned collectively. The instructor will provide feedback on the topics chosen, scope of work, and sources of data as well as resolve any overlap between group topics.

**Stage 3 – Interim report:** (limit – 5 pgs) The interim report must be submitted individually and will be due after the midterm. It must consist of the following components

- Abstract – with a clear description of the overall problem and the group member’s contribution to the work
- Introduction to the problem – summarize literature and cite all the sources
- Procedure – establish life cycle and key steps. State sources of data and the plan of work for analyzing the data. Clearly state all assumptions
- Results and analysis – Quantify impacts for **at least one** of the three (economic, environmental, social) impacts. Compare with results of other members of group
- Next steps – Outline plan of work for completion of the project

Grading rubrics and feedback will be provided.

**Stage 4 – Final report:** (limit – 10pgs) The final report will build on the interim report, identify gaps and uncertainties in the information available, and their implications on the conclusions from a sustainability point of view. The final report must be submitted individually. It must consist of the following sections:

- Abstract – with a clear description of the overall problem and the group member’s contribution to the work. Briefly summarize the sustainable decision in the abstract
- Introduction to the problem – summarize literature and cite all the sources
- Procedure – establish life cycle and key steps. State sources of data and the plan of work for analyzing the data. Clearly state all assumptions
- Results and analysis – Complete the analysis of three impacts, comparison with other options, and additional analysis of sensitivity/risk
- Conclusions – Summarize key findings from individual and group’s work

**Stage 5 – Presentations:** (limit – 30min) The final day of instruction will be dedicated to group presentations. Each presentation will span 30min of which 20min (+2min) is for the group to present, and the remaining time general discussion. Split the presentation time equally between members of the group. Grading will be on an individual basis. This will also serve as an exercise in peer review. Students will receive feedback from the instructor as well as their peers.

**Stage 6 – YouTube videos:** One of the primary roadblocks to establishing sustainable practices is limited public awareness. To emphasize the importance of these topics to the general public, one component of the course project is to create a short Youtube video (3-5 min long). Be creative in how you choose to present your findings in the video, but ensure that it can be easily understood by an audience consisting primarily of high school students. The videos created by this class will be shared on multiple platforms, including the instructor’s website. Submit one video per group. Grade will be assigned collectively.

## 6.5 Writing guidelines

1. Reports must use 11 or 12 pt font in Arial, Helvetica, or Times New Roman
2. Reports must be single-spaced with 1in margins
3. All figures and tables must be within the page limit
4. Only report self-created figures and tables. Do **not** use figures or tables directly from other sources
5. If you have more than one page of references, you can go over the stated page limit by one page
6. Avoid the use of hyperlinks for referencing
7. For referencing, adhere to the ACS guidelines: <https://libguides.usc.edu/c.php?g=235076&p=1561830>

## 7 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](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>.

### Support Systems:

Student Counseling Services (SCS): (213)740-7711 – 24/7 on call. Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. [engemannshc.usc.edu/counseling](http://engemannshc.usc.edu/counseling)

National Suicide Prevention Lifeline: 1 (800) 273-8255. Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. [www.suicidepreventionlifeline.org](http://www.suicidepreventionlifeline.org)

Relationship and Sexual Violence Prevention Services (RSVP): (213) 740-4900 – 24/7 on call. Free and confidential therapy services, workshops, and training for situations related to gender-based harm. [engemannshc.usc.edu/rsvp](http://engemannshc.usc.edu/rsvp)

Sexual Assault Resource Center: For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: [sarc.usc.edu](http://sarc.usc.edu)

Office of Equity and Diversity (OED)/Title IX Compliance: (213) 740-5086. Works with faculty, staff, visitors, applicants, and students around issues of protected class. [equity.usc.edu](http://equity.usc.edu)

Bias Assessment Response and Support Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. [studentaffairs.usc.edu/bias-assessment-response-support](http://studentaffairs.usc.edu/bias-assessment-response-support)

The Office of Disability Services and Programs Provides certification for students with disabilities and helps arrange relevant accommodations. [dsp.usc.edu](http://dsp.usc.edu)

Student Support and Advocacy: (213) 821-4710. Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. [studentaffairs.usc.edu/ssa](http://studentaffairs.usc.edu/ssa)

Diversity at USC: Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. [diversity.usc.edu](http://diversity.usc.edu)

USC Emergency Information: Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. [emergency.usc.edu](http://emergency.usc.edu)

USC Department of Public Safety, UPC: (213) 740-4321 , HSC: (323) 442-1000 – 24-hour emergency or to report a crime. Provides overall safety to USC community. [dps.usc.edu](http://dps.usc.edu)