Yale College

Yale Summer Session

CENG S105E (SB25): Introduction to Green Energy Systems (GES)
Summer 2025, Session B, Tuesday: July 1 – Thursday: July 31
Tuesday and Thursday 6:30 -8:00 pm (EST)
Course Syllabus

Course Instructor: Professor Yehia Khalil

- Member of Connecticut Academy of Science & Engineering (CASE).
- Chairman of the Technologies Board of Connecticut Academy of Science & Engineering (CASE).
- Recipient of the Senior Moulton Medal from the United Kingdom's Institution of Chemical Engineering (IChemE) for excellent fundamental research in the chemical field.
- Elected Technical Fellow at the University of Oxford, United Kingdom.
- CJBS Alumnus, the University of Cambridge, UK
- Chairman of the Hydrogen Technologies R&D Programs of the International Energy Agency (IEA), Paris, France.
- Past Yale faculty advisor of the Students Chapter of the American Institute of Chemical Engineers (AIChE) and a faculty advisor of Yale Community Based Learning (CBL).
- Editor-in-Chief, Hydrogen Safety Journal, the International Energy Agency (IEA), Paris, France.

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Course prerequisite: Instructor's permission

Course TA: Aurora (Xiang) Zhanhong

Scope

The course topics covers renewable (green) energy systems including concentrated solar power (CSP), solar photovoltaics (solar PV), wind, bio-based energy, hydropower, geothermal, nuclear power, ocean thermal energy conversion (OTEC), harvesting tidal and wave energy. The topics also cover life cycle impact of assessment (LCIA) of renewable energy sources, energy storage technologies to offset the intermittency of solar PV and wind power, role of the smart-grids and distributed energy generation in reducing CO_2 emissions from fossil-based electricity

generation, carbon capture, utilization, and storage (CCUS), role of the hydrogen economy in reducing greenhouse gas emissions from the transportation sector, understanding business sustainability and the circular economy.

Main textbook

Godfrey Boyle (Editor), Renewable Energy: Power for Sustainable Future, Second Edition, Oxford University Press, UK, ISBN# 0-19-926178-4, 2004.

Handouts

Khalil, Y. F., Lectures given at Lincoln College and Harris Manchester College, *Climate Change and Sustainability Program*, the University of Oxford, UK.

Lecture Topics

1. Introduction to renewable energy sources, primary criteria for sustainable energy technologies, life cycle impact assessment (LCIA) using the state-of-art computational tools such as *SustainableMinds*, *GABI*, and *OpenLCA*,
2. Corporate sustainability and social responsibility.
3. Sustainable businesses and the circular economy.
4. Wind power.
5. Concentrated solar power (CSP).
6. Solar photovoltaic (PV) power.
7. Bio-based energy sources.
8. Hydropower.
9. Ocean thermal energy conversion (OTEC)
8. Tidal energy conversion (TEC).
9. Wave energy conversion (WEC).
10. Geothermal energy.
11. Energy storage to offset intermittency of wind and solar power.
12. Nuclear power.
13. Carbon capture, utilization, and storage (CCUS).
14. Fuel cell technologies.

Grade Distribution

Homework = 15 points, participation in class discussions = 15 points, mid-term exam = 20 points, team-based project = 50 points.

Nature and Purpose of the Course

Enhance the students' understanding of environmental sustainability, corporate social responsibility, and the role of renewable (green) energy technologies in mitigating impact of greenhouse gases and the resulting global warming. The students will be assigned reading

materials on environmental sustainability and will learn how to calculate the system-level performance, overall efficiency, cost, and environmental impact assessment of integrated renewable (green) energy systems.

Active class participation

Active class participation is expected in this course. Accordingly, during the first 45 minutes in each class the course instructor will review the key points and takeaways from the assigned lecture notes & recorded video lectures, and will answer questions that the students may have based on their readings of the course materials. During the second 45 minutes of each class, students will discuss their own perspectives and insights gained from the assigned homework. During lecture 1 of Week 1, the course instructor will provide additional clarification on the mechanics of required active participation expected of the students.

Attendance Policy: Class attendance is mandatory including on all holidays.

Green Energy Systems (GES) Course Schedule, Summer 2025			
Week Number	***Date***	***Lecture Topic***	***Assignment***
1	Tuesday July 1	• Lecture 1: Introduction to Green Energy Systems	
	Thursday July 3	• Lecture 2: Introduction to Renewable Energy and Sustainability	C1 assignment posted
2	Tuesday July 8	• Lecture 3: Wind Power • Selection of project teams	C1 assignment due 6:30 pm
	Thursday July 10	• Lecture 4: Life Cycle Impact Assessment (LCIA); Eco Design	C2 assignment posted
3	Tuesday July 15	• Lecture 5: Ocean Thermal Energy Conversion (OTEC)	C2 assignment due 6:30 pm Midterm posted
	Thursday July 17	Lecture 6: Geothermal Energy	
4	Tuesday July 22	Lecture 7: Fuel Cell Technologies	C3 assignment posted
	Thursday July 24	Lecture 8: Green Energy and the Electricity Delivery System	Midterm due 6:30 pm
5	Tuesday July 29	Lecture 9: Wave Energy Conversion (WEC) and Tidal Energy Conversion (TEC)	C3 assignment due 6:30 pm
	Thursday July 31	Lecture 10: Nuclear Power	Team project due 11:59 pm