Energy Storage Integration: Vehicles, Renewables, and the Grid

CEE 176C Summer 2026

This syllabus is preliminary and subject to change.

Lecturer:

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Office Hours: After class in Y2E2 398

TAs:

TBD

Course Summary:

This course will provide an in-depth introduction to existing energy storage solutions being used for grid and vehicular applications, with a primary focus on batteries and electrochemical storage. We will discuss the operating characteristics, cost and efficiency of these technologies and how tradeoff decisions can be made. Special attention will be given to system-level integration of new storage technologies—including chargers, inverters, battery management systems and controls—into the existing vehicle and grid infrastructure. Further investigations include issues relating to integration of electric vehicle charging with demand-side management, renewable energy integration and local grid balancing.

Course Learning Goals:

- Gain more intuitive understanding of energy, power, the grid and energy storage
- Understand characteristics, pros and cons of energy storage technologies
- Learn about electric vehicle storage applications, charging and grid interface
- Analyze energy storage economics and the business landscape around storage
- Apply system-level aspects of energy storage integration to a full renewable energy and energy storage design

Lectures:

Class will be held in person. Location and time will be announced.

Grading & Assignments:

Final grades will be determined according to the following rubric:

Problem Sets	20%
Final Project	40%
Final Exam	30%
Participation	10%

Problem Sets:

There will be four problem sets given out during the quarter, to be completed individually. Students may discuss general approaches, but all work and calculations should be completed alone. Problem sets will be released one week in advance of the due date and should be submitted via Canvas. There is no penalty for late assignments for 72 hours (no questions asked). After 72 hours you receive 0 credit.

Final Exam:

The class final will be during the end quarter period. A make-up final may potentially be offered depending on course conflicts. Arrange your travel accordingly in order to be present in person. Exact modalities are to be determined.

Final Project:

Individual students or small teams (2-3 students) will follow a model template to design an integrated energy storage system in a location/scope of their choice. The project will culminate in a final report. A brief progress update will be due as a midterm deliverable. More details will be announced in class.

Recommended Background:

No prerequisites. It will be helpful for prospective students to have a basic understanding of electricity and energy concepts from introductory science or engineering coursework.

Course Website:

Canvas will be used as the course website and for all communications. Please use Ed Discussion to ask any questions regarding the material, problem sets, etc. In this way all students can benefit from seeing the answer to what are most likely common questions (questions can be posed anonymously as well). Please come to office hours to ask more lengthy questions, or you may email the teaching team to set up an appointment.

Recommended Reading:

There is no main textbook for the course. The following textbooks can serve as good resources for the courses, and should be accessible online and through the library. Additional supplemental readings may be posted on Canvas throughout the quarter.

EPS Alexandra von Meier. Electric Power Systems: a conceptual introduction. Hoboken, NJ: Wiley-Interscience (2006).
REEPS Gil Masters. Renewable and Efficient Electric Power Systems. Hoboken, NJ: Wiley IEEE Press (2004).
LIBS Shriram Santhanagopalan, et. al. Design and Analysis of Large Lithium-Ion Battery Systems. Boston, MA: Artech House (2015).

Schedule:

The course will be split into three main units, covering batteries, vehicles, and the grid (stationary storage) as well as an introductory unit. Each unit will include a problem set. Additional details will be posted on Canvas as appropriate.

Students with Documented Disabilities:

Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty. Unless the student has a temporary disability, accommodation letters are issued for the entire academic year. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, URL: https://oae.stanford.edu/). Please communicate with the course teaching team directly regarding your disability.

The Stanford University Honor Code is a part of this course:

It is Stanford's statement on academic integrity first written by Stanford students in 1921. It articulates university expectations of students and faculty in establishing and maintaining the highest standards in academic work. It is agreed to by every student who enrolls and by every instructor who accepts appointment at Stanford.

The Honor Code states:

1) The Honor Code is an undertaking of the students, individually and collectively
   - that they will not give or receive aid in examinations;
   - that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading;
   - that they will do their share and take an active part in seeing to it that others as well as themselves uphold the spirit and letter of the Honor Code.
2) The faculty on its part manifests its confidence in the honor of its students by refraining from proctoring examinations and from taking unusual and unreasonable precautions to prevent the forms of dishonesty mentioned above. The faculty will also avoid, as far as practicable, academic procedures that create temptations to violate the Honor Code.
3) While the faculty alone has the right and obligation to set academic requirements, the students and faculty will work together to establish optimal conditions for honorable academic work. Penalties for violation of the Honor Code can be serious (e.g., suspension, and even expulsion). So re-read the Honor Code, understand it and abide by it [Stanford Office of Community Standards].