ENGR 2050 / GSVS 2050
Introduction to Sustainable Energy Systems

Course details: 3 credits collab.itc.virginia.edu

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COURSE OVERVIEW

Brief Description

This course investigates a major source of human impact upon the Earth – energy consumption to fuel human activity. The course a) provides a cross-disciplinary perspective on the challenge of human-centered energy use, b) explains the historical origins of today's energy systems, c) describes current energy systems, d) examines the components of sustainable energy systems, and e) considers barriers to deployment of sustainable energy solutions.

Pre- or co-requisite courses or topics

This course is open to all University of Virginia undergraduates.

INSTRUCTIONAL MATERIALS

Sustainable Energy Systems is a no-cost course materials instructional offering. All readings, podcasts, and videos will be provided. No materials need to be purchased. Students may find the following materials relevant and interesting.

Sustainable Energy without the Hot Air
David J.C. MacKay, 2015
Available free online at: https://www.withouthotair.com/

Building a Sustainable Energy Systems web site
John C. Bean, University of Virginia
Available free online at: http://wecanfigurethisout.org/ENERGY/Energy_home.htm

Superpower: One man's quest to transform American energy
Russell Gold, 2019
Available in the UVA library

Drawdown: The most comprehensive plan ever proposed to reverse global warming
Paul Hawken, ed., 2017
Available in the UVA library

Designing climate solutions: A policy guide for low-carbon energy
H. Harvey, R. Orvis, & J. Rissman, 2018
Available in the UVA library

LEARNING OBJECTIVES

1. Students will learn and be able to use the units, magnitudes and terminology of major and emerging energy systems. They will be able to do basic calculations related to energy systems and be able to use energy terminology appropriately and in context.
2. Students will develop a foundational understanding of energy and energy system life cycles and demonstrate an ability to complete a high-level assessment of the sustainability and financial viability of a given energy choice.
3. Students will demonstrate a foundational understanding of the U.S. electrical grid and its management. They will develop an appreciation for the opportunities and challenges associated with integrating sustainable energy solutions into the grid.
4. Students will demonstrate an understanding of the magnitude of human energy use – at the personal and national level. They will develop an understanding of energy use across transportation, industrial, commercial, and residential sectors of the economy.
5. Students will learn about a sustainable energy system-related challenge space of their choice. They will describe and quantify the key elements of their challenge space. They will be able to articulate clearly and concisely how their selected challenge fits into the broader challenge of sustainable energy supplies for society, today and into the future.

COURSE CONTENT (in order of presentation)

I. Sustainable energy system foundations
II. Energy systems, climate change & human health
III. Energy system economics & labor
IV. Governance & culture
V. Electricity science
VI. The electricity grid
VII. Emerging energy system innovations
VIII. Energy end-use sectors

ASSESSMENT & MEASUREMENT

How course outcomes will be assessed

Personal energy audit (7.5%)

Homework quizzes (15%)

Midterm exam (17.5%)

Personalized learning project

- Mid-term prospectus (7.5%)
- Final project (17.5%)

Final exam (20%)

Class discussion and participation (15%)

Academic rigor

Human-engineered energy systems are shaping the future of life on Earth. Given the central importance of these systems to the future of our biosphere, this course is rigorous. While the course does not introduce concepts difficult for University of Virginia-caliber students to grasp, it expects successful students to demonstrate conceptual fluency in the course's subject matter - both the vocabulary and mathematical underpinnings of the topic. University of Virginia students need to be conversant and comfortable with the foundations of this technology-centric subject area. Students who are prepared to build upon their math and science studies from high school will be academically successful in this course. Symbolic and algebraic calculations in the course focus upon, but are not limited to, the following areas:

- Carbon footprint computations associated with fossil fuel and electricity consumption,
- Levelized cost of energy forecasts,
- Voltage drop during long-distance electricity transmission,
- Conductivity – in conductors and semiconductors, and
- Estimated power production from renewable sources, e.g., wind, water, and sunlight.

Late policy

All graded assignments in this course will have specific due dates and times listed in the weekly handouts provided by your instructor. Untimed assignments may be turned in up to 72 hours after the assigned due date and time. When such assignments are turned in late (by any amount of time), a 10% grade penalty will be assessed. After a student misses the 72 hour "late submission" window, assignments may be turned in at any time before the official end of the semester, receiving a 30% grade penalty. If students believe they need a deadline extension, they must request and receive written approval for such an extension, prior to the original submission deadline.

Course grade scale

A+	> 97%	**B+**	87 – 90%	**C+**	77 – 80%	**D+**	67 – 70%
A	93 – 97%	**B**	83 – 87%	**C**	73 – 77%	**D**	63 – 67%
A-	90 – 93%	**B-**	80 – 83%	**C-**	70 – 73%	**D-**	60 – 63%

F <60%

LEARNING COMMUNITY INTERACTION & ENGAGEMENT

Individual student engagement

Success in this course depends on *your* individual efforts and on *our* ability to work together to build a cooperative learning environment. Questions and sharing of beliefs, opinions, and feelings are strongly encouraged. To maximize learning, we need to create a safe community in which we will feel comfortable sharing thoughts and ideas even when those thoughts and ideas are not in full agreement with the thoughts of others in the course. Achieving a safe learning environment requires practice and effort. It will require each of us to behave professionally and respectfully at all times, and to adhere to our course norms. As you learn in this course and learn about your classmates, you are encouraged to respect and appreciate differences.

Learning community values
Meaningful and courteous dialogue is expected in this course. Healthy dialogue will require a degree of respectful understanding and a willingness to listen to all course participants. You may not agree with another person's point-of-view, or you may already understand a concept and feel frustrated with the pace of class discussion at times. Give others a chance to contribute and learn. Encourage one another politely. Seek to understand and appreciate the ideas of others. Learn from one another. Be patient and encouraging as we *all* seek to advance our knowledge of important sustainable energy system concepts. Since every student is entitled to full participation in this course without interruption, all students are expected to come to class sessions prepared and on time. You are always expected to refrain from undertaking any activities that might be considered disruptive.

Class schedule and time commitment
This course is a 3 credit hour college course. Students should understand that the U.S. federal government mandates a certain *minimum* student workload for each credit hour earned. By the federal definition, each credit hour should require a minimum of two hours of out of class student work each week for approximately fifteen weeks. So, in addition to attending class regularly (as part of class participation), set aside 6+ hours per week outside of class to engage with this course. The course content is not difficult, yet there is much to learn. Organize your schedule to allow you to put in the expected study time! The expectation is that you will attend class every day. Class session recordings will be available for illness and emergency misses.

Use of email
Your instructor will minimize course related emails. Still, email messages will be necessary from time-to-time. Your instructor expects you to check your university email account at least one time each day, Monday – Friday during the semester. If an email includes a specific request for a response, your instructor expectation you to respond in two business days from the time that the email was *sent*. Failure to read and respond to emails in a timely manner (as defined here) will have a negative impact upon your class participation grade.

The Honor System and the School of Engineering and Applied Science
The School of Engineering and Applied Science relies upon and cherishes its community of trust. We firmly endorse, uphold, and embrace the University of Virginia's Honor principle that students will not lie, cheat, or steal, and we expect all students to take responsibility for the System and the privileges that it provides. We recognize that even one Honor infraction can destroy an exemplary reputation that has taken years to build. Acting in a manner consistent with the principles of Honor will benefit every member of the community both while enrolled in the Engineering School and in the future.

If you have questions about the Honor System or would like to report suspicions of an Honor offense, please contact Professor Groves <jgroves@virginia.edu>. For more information on the UVA Honor System, please visit the following web resource: http://www.virginia.edu/honor/

Accessibility

It is my goal to create a learning experience that is as accessible as possible. If you anticipate any issues related to the format, materials, or requirements of this course, please meet with me outside of class so we can explore potential options. Students with disabilities may also work with the Student Disability Access Center to discuss a range of options to removing barriers in this course, including official accommodations. Please visit their website for information on this process and to apply for services online: sdac.studenthealth.virginia.edu. If you have already been approved for accommodations through SDAC, please send me your accommodation letter and meet with me so we can develop an implementation plan together.

Discrimination and power-based violence

The University of Virginia is dedicated to providing a safe and equitable learning environment for all students. To that end, it is vital that you know two values that I and the University hold as critically important:

1. Power-based personal violence will not be tolerated.
2. Everyone has a responsibility to do their part to maintain a safe community on Grounds.

If you or someone you know has been affected by power-based personal violence, more information can be found on the UVA Sexual Violence website that describes reporting options and resources available - www.virginia.edu/sexualviolence.

As your professor and as a person, know that I care about you and your well-being and stand ready to provide support and resources as I can. As a faculty member, I am a responsible employee, which means that I am required by University policy and federal law to report what you tell me to the University's Title IX Coordinator. The Title IX Coordinator's job is to ensure that the reporting student receives the resources and support that they need, while also reviewing the information presented to determine whether further action is necessary to ensure survivor safety and the safety of the University community. If you wish to report something that you have seen, you can do so at the **Just Report It** portal (http://justreportit.virginia.edu/). **The worst possible situation would be for you or your friend to remain silent when there are so many here willing and able to help.**

Religious accommodations

It is the University's long-standing policy and practice to reasonably accommodate students so that they do not experience an adverse academic consequence when sincerely held religious beliefs or observances conflict with academic requirements.

Students who wish to request academic accommodation for a religious observance should submit their request in writing directly to me as far in advance as possible. Students who have questions or concerns about academic accommodations for religious observance or religious beliefs may contact the University's Office for Equal Opportunity and Civil Rights (EOCR) at UVAEOCR@virginia.edu or 434-924-3200.

Recording of classroom activities

I will be recording the live sessions in this course to ensure equitable access to course content. Because recorded sessions will include fellow students, you and they may be personally identifiable on the recordings. These recordings may only be used for the purpose of individual or group study with other students enrolled in this class during this semester. You may not distribute them in whole or in part through any other platform or to any persons outside of this class, nor may you make your own recordings of this class unless written permission has been obtained from the instructor and all participants in the class have been informed that such recording will occur. For additional details, see Provost Policy 008 which is expected to be updated for the Fall 2020 semester.