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

Readings, podcasts, sample calculations and videos will be provided. Students may also find the following references helpful. No materials need to be purchased.

Sustainable Energy without the Hot Air
David J.C. MacKay, UIT Cambridge England, ISBN 978-0-9544529-3-3
Available free online at: https://www.withouthotair.com/

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

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. Energy System Foundations
II. Energy Systems, Climate Change & Human Health
III. Energy System Economics & Labor
IV. Governance & Energy Systems
V. Electricity Science
VI. The Electricity Grid
VII. Emerging Energy Systems Innovation
VIII. Energy End-Use Sectors

ASSESSMENT & MEASUREMENT

How course outcomes will be assessed

Personal Energy Audit (7.5%)

Homework Quizzes (15%)

Concept and Vocabulary Quizzes (15%)

Individualized Learning Paper

Mid-term Paper Prospectus (7.5%)

Final Paper (20%)

Final Exam, Tuesday May 7, 2019, 2 – 5 p.m. (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 15% 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 50% 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 course at the University of Virginia. Students should understand that the U.S. federal government mandates a certain *minimum* student workload for each credit hour earned while in college. 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.

While the content of this course is not difficult to understand, there is much to learn. Organize your schedule to allow you to put in the expected amount of study time!

Use of email

Your instructor will seek to minimize the number of course related messages sent to you by email. Still, email messages to the class and to individual students will be necessary from time-to-time. Your instructor expects that you will 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, it is your instructor's expectation that you will respond in no more than two business days from the time that the email was *sent* to you (not from the time that you read the email). Failure to read and respond to emails from your instructor in a timely manner (as defined above) will have a negative impact upon your class participation grade.

Special Needs

The University of Virginia strives to provide accessibility to all students. If you require an accommodation to fully access this course, please contact the Student Disability Access Center (SDAC) at (434) 243-5180 or sdac@virginia.edu. If you are unsure if you require an accommodation, or to learn more about their services, you may contact the SDAC at the number above or by visiting their website at http://studenthealth.virginia.edu/student-disability-access-center/faculty-staff.

Honor code

UVA relies upon and cherishes its community of trust. Your instructor firmly endorses, upholds, and embraces 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. I 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 this course and in the future. For more information on the UVA Honor System, visit: http://www.virginia.edu/honor/