

Energy Course Syllabus

TECH-GB 2385 / CE-GY 7723: Energy – Technologies, Business, Regulations

Mondays, 6:00 – 9:00 pm [first lecture Monday, February 6]

Lectures: Kaufman Management Education Center, 44 West 4th Street in the Square

Room tbd

Prof. [Steven E Koonin](#)

Course Description

This course will cover energy – the technologies that produce, store, transmit, and use the energy that provides heat, light, and mobility to modern society; the businesses that provide those services; and the regulations that govern energy activities. The state of the world and US energy systems will be described, as well as the drivers to improve their environmental, economic, and security aspects. The abilities of current and nascent technologies and business models to satisfy those drivers will also be discussed. A variety of government and private sector reports will serve as texts, supplemented by the original research literature and media coverage.

This course should be of interest (and accessible) to students interested in energy businesses, energy technologies, and sustainability. Prerequisites are only numeracy, simple algebra, and general science/technology knowledge.

Learning Goals

Upon completion of the course, successful students will understand:

- The structures and scales of the global and US systems for heat, mobility, and electricity, as well as the diversity of energy circumstances around the globe
- Something of the businesses involved, including those dealing with fossil fuels, electrical utilities, vehicles, and buildings, as well as the constraints under which they operate
- The drivers for change, including local pollution and greenhouse gas emissions, economics, and energy security
- The potential of existing and selected new technologies (including energy storage, fusion and advanced fission, carbon capture, wind and solar, biofuels, and efficiency measures) to satisfy those drivers
- The structural recalcitrance of energy systems
- The US energy innovation system and the ways in which businesses interact with it

Readings

Primary course material will be drawn from recent US government, National Academies, and industry reports. The original research literature and media coverage will be invoked as supplements.

All of this material will be freely available on the web, so that no purchase of materials will be required.

Course structure and policies

Here is the (approximate) lecture sequence:

- I. **Course overview:** What is energy and why is it important? Different forms and uses of energy; energy “quality”; energy units; Sankey diagrams for the US and globe; drivers for change
- II. **The Carbon Challenge:** Energy system essentials (resource endowment; price volatility; security of supply); Drivers for energy change [local impacts; greenhouse gases (science requirements, Paris accord, COP26)]; Transport (transport demand, why liquid hydrocarbon)
- III. **Oil and alternatives:** the oil value chain, the oil business, exotic oils, will we run out?; alternative vehicle fuels (biofuels, ethanol, CNG, LPG, ammonia, ...)
- IV. **Vehicles:** measuring vehicle efficiency, CAFÉ standards, ICEs, LDVs; technologies to improve efficiency; consumer choice modeling; electrification (batteries, charging, cost of ownership); hydrogen as a fuel
- V. **Fossil fuel generation:** electricity basics, grid overview, coal and coal-fired plants, gas and gas fired plants, LNG and the gas trade; carbon capture and storage (technology, geology, costs); biomass generation
- VI. **Nuclear energy:** nuclear basics, fission power plants, nuclear value chain, fission fuel, fission safety, near future and opportunities for innovation; fusion energy (fusion basics, government efforts, private sector efforts)
- VII. **Water and wind power:** hydropower basics, US deployment and potential, global hydropower, drawbacks and issues, hydrokinetics; wind power (wind basics, turbine evolution, wind farms, US onshore deployment, environmental impacts, offshore wind)
- VIII. **Geothermal and solar power:** Geothermal basics, US deployment, global deployment, enhanced geothermal, ocean thermal; solar basics, concentrated solar power, photovoltaics (PV basics, module evolution, costs, US and global deployments)
- IX. **Generation intercomparison and the grid:** Generation economics (CAPEX, OPEX, LCOE, dispatchability, emissions, PPAs); incentives, effects of carbon pricing; grid overview, physical organizational, and economic grids, energy and other grid markets, grid safety and security

- X. **Grid storage and all-renewables?:** applications of grid-level storage, technologies, US and Global storage deployments; all-renewable grid? (requirements and trade space, wind/solar resources, generation/storage trade, persistent unmet demand)
- XI. **End use efficiency and buildings:** definition of efficiency, potential of technology, efficiency economics, barriers and incentives to efficiency, rebound; scale and determinants of building energy, residential vs commercial, HVAC technologies, ESCOs, LEED certification
- XII. **Decarbonization plans and strategies:** requirements, California strategy, CO2 removal, costs; critical minerals; US Administration plans, the current energy “crisis”

Readings will be suggested in advance of each 3-hour weekly session, as well as several short problems (simple calculations, deeper research, fact-checking media coverage).

Each session will begin with a ~1.5 hour lecture amplifying and enriching the readings. [There might be an occasional guest lecturer with experience in the private sector or government.] After a short break, we’ll discuss a few recent energy-related news stories presented by students.

Attendance at each of the 12 class sessions will be important to getting the most out of the course, as will be doing the readings in advance.

Course grade will be based upon

- attendance at 10 or more of the 12 lectures (to be self-reported on an honor system at the end of the term) – 15%
- good-faith attempts at the weekly problems (again, self-reported at the end of the term) – 20%
- Participation in Climate News presentations and discussion
- A take-home midterm exam – 25%
- A term paper of 5-10 pages covering some topic in energy. The topic may be chosen from a list of suggestions that will be distributed at one of the early lectures, or proposed by the student (and approved by Koonin). The paper will be due at the final lecture, and will be judged by the depth of research/thinking and quality of presentation. – 40%

Some boilerplate required for all Stern courses

[applicable to all students in this course]

ACADEMIC INTEGRITY

Our undergraduate [Academics Pillar](#) states that ***we take pride in our well-rounded education and approach our academics with honesty and integrity***. Indeed, integrity is critical to all that we do here at NYU Stern. As members of our community, all students agree to abide by the [NYU Academic Integrity Policies](#) as well as the NYU Stern Student Code of Conduct, which includes a commitment to:

- Exercise integrity in all aspects of one's academic work including, but not limited to, the preparation and completion of exams, papers and all other course requirements by not engaging in any method or means that provides an unfair advantage.
- Clearly acknowledge the work and efforts of others when submitting written work as one's own. Ideas, data, direct quotations (which should be designated with quotation marks), paraphrasing, creative expression, or any other incorporation of the work of others should be fully referenced.
- Refrain from behaving in ways that knowingly support, assist, or in any way attempt to enable another person to engage in any violation of the Code of Conduct. Our support also includes reporting any observed violations of this Code of Conduct or other School and University policies that are deemed to adversely affect the NYU Stern community.

The Stern Code of Conduct and Judiciary Process applies to all students enrolled in Stern courses.

For graduate students, information can be found here:
<https://www.stern.nyu.edu/uc/codeofconduct>.

For undergraduates, information can be found here:
<https://www.stern.nyu.edu/portal-partners/current-students/undergraduate/community/community-expectations>

To help ensure the integrity of our learning community, prose assignments you submit to NYU Brightspace will be submitted to Turnitin. Turnitin will compare your submission to a database of prior submissions to Turnitin, current and archived Web pages, periodicals, journals, and publications. Additionally, your document will become part of the Turnitin database.

GENERAL CONDUCT & BEHAVIOR

Students are also expected to maintain and abide by the highest standards of professional conduct and behavior. Please familiarize yourself with Stern's Policy in Regard to In-Class Behavior & Expectations

(<https://www.stern.nyu.edu/portal-partners/registrar/policies-procedures/general-policies/code-conduct>)

(<http://www.stern.nyu.edu/portal-partners/current-students/undergraduate/resources-policies/academic-policies/index.htm>) and the NYU Student Conduct Policy (<https://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/universitystudent-conduct-policy.html>).

GRADING GUIDELINES

At NYU Stern, we strive to create courses that challenge students intellectually and that meet the Stern standards of academic excellence. To ensure fairness and clarity of grading, the Stern faculty have agreed that for elective courses the individual instructor or department is responsible for determining reasonable grading guidelines.

STUDENT ACCESSIBILITY

If you will require academic accommodation of any kind during this course, you must notify me at the beginning of the course and provide a letter from the Moses Center for Student Accessibility (212-998-4980, mosescsa@nyu.edu) verifying your registration and outlining the accommodations they recommend. If you will need to take an exam at the Moses Center for Student Accessibility, you must submit a completed Exam Accommodations Form to them at least one week prior to the scheduled exam time to be guaranteed accommodation. For more information, visit the CSA website: <https://www.nyu.edu/students/communities-and-groups/student-accessibility.html>

STUDENT WELLNESS

Our aim is for students to be as successful academically as they can, and to help them overcome any impediments to that. Bookmark the NYU Stern Well-being Resource Hub (<https://www.stern.nyu.edu/wellbeing>) for existing services at NYU and Stern covering a wide variety of topics including financial well-being, relationship well-being, mental well-being, and more. Any student who may be struggling and believes this may affect their performance in this course is urged to contact the Moses Center for Student Accessibility (see also the Student Accessibility section of this syllabus) at 212-998-4980 to discuss academic accommodations. If mental health assistance is needed, call the NYU's 24/7 Wellness Exchange hotline 212-443-9999. Furthermore, please approach me if you feel comfortable doing so. This will enable me to provide relevant resources or referrals. There are also drop in hours and appointments. Find out more at <http://www.nyu.edu/students/health-and-wellness/counseling-services.html>

NAME PRONUNCIATION AND PRONOUNS

NYU Stern students now have the ability to include their pronouns and name pronunciation in Albert. I encourage you to share your name pronunciation and preferred pronouns this way. Please utilize this link for additional information: [Pronouns & Name Pronunciation](#)

RELIGIOUS OBSERVANCES AND OTHER ABSENCES

NYU's [Calendar Policy on Religious Holidays](#) states that members of any religious group may, without penalty, absent themselves from classes when required in compliance with their religious obligations. You must notify me in advance of religious holidays or observances that might coincide with exams, assignments, or class times to schedule mutually acceptable alternatives. Students may also contact religiousaccommodations@nyu.edu for assistance. NYU Stern is committed to ensuring an equitable educational experience for all students regardless of identity or circumstances and strives to recognize the obligations its students have outside of Stern. Please review all class dates at the start of the semester and review all course requirements to identify any foreseeable conflicts with exams, course assignments, projects, or other items required for participation and attendance. If you are aware of a potential conflict, please contact me as soon as possible to discuss any potential conflicts to determine whether/how they can be accommodated.

LAPTOPS, CELL PHONES & OTHER ELECTRONIC DEVICES

The use of electronic devices (e.g., tablets or laptops), for the purpose of note-taking [and lecture-relevant web-exploration] only, is permitted. However, students should make every effort to avoid distracting their classmates or disrupting the class, including arriving early and choosing a seat that is less distracting for peers.