

GEOS 24705/34705, ENST 24705, ENSC 21100 (2017)

**Energy: Science, Technology, and Human Usage**

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*Teaching assistant:* TBD

*Field trip coordinator:* TBD

*Website:* <http://geosci.uchicago.edu/~moyer/GEOS24705/2017>

*For 2016 course website see* <http://geosci.uchicago.edu/~moyer/GEOS24705/2016>

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**Description**

This course covers the technologies by which humans appropriate energy for industrial and societal use, from steam turbines to internal combustion engines to photovoltaics. We will discuss the physics and economics of the resulting human energy system: fuel sources and relationship to energy flows in the Earth system, the history of human appropriation of energy, costs and feasibility of alternative technologies. The course is intended to provide a technical foundation for students interested in careers in the energy industry or in energy policy.

Besides lectures and problem sets, the course involves experiences with energy technology in labs and field trips. Both labs and field trips are intended to be enriching opportunities to explore technology in a hands-on way: visiting, touching, using, dis-assembling. Neither labs nor field trips involve write-ups, only participation. Students are required to participate in a minimum of 3 field trips and 4 labs during the quarter, but in practice many students attend nearly all field trips and labs. Enrollment is limited to 35 students to make trips and labs possible.

Past field trips have included Fisk, Crawford, and Pleasant Prairie coal-fired power plants, Grand Ridge wind farm, Dresden Nuclear Plant, BP Whiting oil refinery, Argonne Advanced Automobile Laboratory (and solar photovoltaic research facilities), the Gas Technology Institute (research facility developing gasification technologies), an Arcelor Mittal steel mill, and building sites in downtown Chicago, as well as local options: the U. Chicago's own steam and chilled water plants, building sites on campus, and the Museum of Science and Industry for cogeneration, solar panels, and steam locomotives. Labs include human power, electric motors, internal combustion engines, radiation and lighting, and solar photovoltaics.

The course grade is determined by bi-weekly problem sets and by a final group project. Typical group projects are research papers involving some investigation of feasibility or cost-effectiveness of an energy system, but groups are also permitted to opt for design-and-build projects. In 2010 one group built a wind turbine and another a bicycle-powered electrical generating system. Some funding is provided for materials in the case of build projects.

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## Prerequisites

The course is intended for students with some background in physics, or with strong motivation to learn. A year of undergraduate-level physics is the recommended preparation, but students with less science preparation can take the course and do well - the teaching assistants are committed to working with each student as needed to bring them to the same level - though those coming from thinner science backgrounds should plan their schedules appropriately to manage the time commitment. In practice, course enrollment tends to be split between students from the sciences, from public policy, and from economics or the business school. Problem sets have a base of questions that require no calculus, but there are additional optional problems for science majors and those wishing to go deeper into the material.

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## Course components summary

- Class T, Th 3-4:30 PM (Office hours TBD)
- Labs (TBD depending on student schedules, requirement 4 or more labs)
- Field trips (requirement to attend 3 or more field trips, max one local)
- Problem sets (2/week, quick problem on Tuesdays, real PS on Thursdays)
- Final group research project & paper (each group must include both science and non-science students)

*Field trip notes:* Most field trips are scheduled for early Friday mornings with return times before lunchtime. (Bus meeting times may be as early as 7 AM.) Dresden Nuclear tends to run long, because of all the security involved, and Grand Ridge wind this year will run late because they ask for a later-morning time. We do accommodate students before who have unbreakable Friday conflicts. When possible we will arrange additional alternate "unofficial" trips, and students can also develop new substitutes for field trips. There will also be at least one trip during reading week. U. Chicago will provide free transportation (bus + driver) for all "official" trips (Fridays plus alternate trips with large attendance). Signing up for field trips several weeks in advance may be required for those trips that are space-limited. (Facilities cannot always accommodate large groups.) Suggestions of additional field trips are welcome: I'd like to expand our list, and it's fun to generate trips that respond to particular student interests.

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