

# Physics 217: Energy Future, The Technical and Social Barriers to Large-Scale Sustainable Energy

Based on Spr17 & W18 as taught by Gerald Seidler

## Overview

PHYS217 is a 5-credit class addressing renewable energy and its relationship with climate change mitigation efforts and with national and global models for sustainability in the face of global climate change and scarcity of traditional energy resources. The course includes broad coverage of the large-scale implementation of solar, wind, geothermal, tide, wave, and nuclear energy, in addition to the social barriers and remaining scientific challenges to their large-scale implementation. A key feature of the course is the insistence that realistic assessments be used when discussing the relative costs and conceivable benefits of each renewable energy modality.

Some of the social challenges discussed include: local opposition to large-scale renewable energy facilities; the complexity of regulatory issues; the absolute environmental impact of renewable energy facilities and their impact relative to fossil-fuel based modalities; and the difficulties posed by the simultaneous international competition for market-share of renewable energy products and control of traditional resources. Energy efficiency measures spanning the micro-scale (e.g., individual residences) and macroscale (e.g., market rationalization of electricity prices through international grid connections) will also be addressed.

## Evaluation

Quizzes for all class meetings, in-class reports on guest lectures and media discussions, take-home final exam, final course project on sustainability entrepreneurship.

## Texts

1. **Required:** "Sustainable Energy Without the Hot Air", David Mackay, available free online or as hardcopy.
2. **Required:** Extensive reading of NAS and United Nations reports on energy generation/consumption and linked issues of land use and climate change; Extensive reading of popular press coverage of these issues.

## Topics by week

1. Energy, power, units, big picture of energy consumption and production in the US and the world, two-phase relationship between energy consumption and GDP.

2. Present transportation modes and energy consumption, wind power, land use issues in wind power development, air travel, greenhouse effect, first discussion of term project.
3. Solar energy resource potential, photovoltaics, new technology, photovoltaic use in developing countries, public policy and subsidies for renewable energy in the US and the world, global history of GHG levels and man-made emissions.
4. Hydroelectric power, resource potential, environmental impact, geopolitics of hydroelectric power, lighting energy consumption, entrepreneurship discussions, first cycle of proposed term projects, ozone regulation as example of science-driven global cooperation for environmental issue.
5. Embedded energy in consumer products, energy consumption in agriculture, wave and tide power, case studies: regulatory barriers to renewable energy development.
6. Geothermal power, traditional geothermal vs enhanced geothermal, summary of resource potential for renewables, entrepreneurship discussions, first cycle of proposed term projects.
7. Improved transportation, United States and world regulation on automobile efficiency, Carnot cycle, district heating, heat pumps.
8. Energy efficiency, nuclear power, nuclear weapons, public perception and policy for nuclear power, final choice of term project topic and teams.
9. Energy storage, renewable energy fluctuations, climate adaptation vs mitigation and impact of developing countries and their energy portfolios, team-specific meeting for final focus of term projects.
10. Energy plans for the US, the UK, and the world, carbon sequestration, additional end of term project discussions.