School of Public Policy (PUBP)
School of Industrial and Systems Engineering (ISYE)
University of Tennessee-Knoxville (UT-K)

Energy Technology and Policy
ISYE 6701 and PUBP 6701

Energy Policy
UT-K ESE 597
Wednesday 1:55-4:40 pm
Location: ESM 210

Instructors:

Dr. Valerie Thomas
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Course Description:
This course examines the policies and technologies affecting the production and use of energy, focusing in particular on innovative and sustainable energy options. The course provides a fundamental understanding of energy systems, including historical trends of supply and demand, resources and technologies, and related economic, global climate change, and security issues. Policies and technologies associated with different energy systems will be examined including electric vehicles, ethanol, and other alternative transportation fuels; smart buildings and solid state lighting; industrial ecology approaches; solar and wind systems; and the next generation of nuclear energy.

Energy policies and investments will be examined at the national and international scale, and at the state and local level where novel approaches are often first introduced. Reflecting the need to design policies to address the market and other barriers faced by different types of technologies, the course examines technology-policy bundles. These include, for example, low-carbon fuel standards to promote biofuels and plug-in electric vehicles; real-time electricity pricing to promote renewable, distributed power, and a smart grid; building standards and product labeling to encourage high performance buildings; renewable electricity standards and tax credits to promote renewable technologies (solar power, wind energy, etc.); and the role of loan guarantees for nuclear, carbon capture and sequestration, and other large-scale energy projects.

Given the ubiquitous nature of energy in modern society, this course will offer insights for students pursuing a diversity of careers.

Video overview: http://b.gatech.edu/2B18eAd

Texts:

- M. A. Brown and B. K. Sovacool. 2014. *Climate Change and Global Energy Security: Technology and Policy Options* (MIT Press).
- M. A. Brown and Y. Wang. 2015. *Green Saving: How Policies and Markets Drive Energy Efficiency* (Praeger Press).
- B. K. Sovacool, M. A. Brown, and S, Valentine. 2016. *Fact and Fiction in Global Energy Policy: 15 Contentious Questions* (Johns Hopkins Press)

Grades and Examinations:

Class Participation:	5%
Class project:	30%
Mid-term exam:	15%
Final exam:	20%
2 Exercises:	30%

Because of the interactive nature of the course, 5 percent of the student's grade depends on general class participation. Atlanta and UT-K students are expected to attend class having read the assigned readings and having seen the assigned videos. That way you can be prepared to discuss the material in class. Distance students are expected to participate in discussions by sending email or powerpoint responses or comments. The instructors will encourage dialogue by helping the students lay out the facts, pose questions, and help the class discover and understand the underlying principles.

Students will work in teams to complete a class project researching the energy technology and policy dimensions of a current energy problem or opportunity. The results will be summarized in a presentation to the class near the end of the semester. The team project is worth 30 percent of each student's grade.

Schedule for Class Projects:

January 24: 250-word Summary of Topic for Class Project
March 28: Quality Outline of Class Project Report
April 18: Final Project Report Due

Assignments for distance students will be on a one-week delay, following the Georgia Tech-ATL and UT-K students. UT-K students will have longer to do Exercise 2 (see below). All final project reports are due on April 18.

There will be two exams: *15 percent* of the grade is based on a mid-term exam and *20 percent* of the grade is based on the final exam.

The remaining *30 percent* of the grade is based on two exercises:

1. Exercise 1: Two engineering calculation homework sets 15%
2. Exercise 2: Design of a Metropolitan Energy Program 15%

Note for UT-K students: Instead of completing Exercise 1, the scope of Exercise 2 will be more expansive and will constitute 30% of your grade.

Office hours:

Dr. Brown: Tuesdays 1 – 2 pm & Thursdays 11 am – noon most weeks, and by appointment
Dr. Thomas: Tuesdays 2:30 – 4:30 pm most weeks, and by appointment

Schedule and Reading Assignments

Week 1. (January 10). MB and VT (Exercise 1a posted)
Energy Overview

- Overview of energy and climate change issues; history and projections of energy use; energy data sources.
- Basic power relationships (Earth Sun People Food). Heat engines, electricity, and efficiency (Primary v delivered energy, Energy-water nexus, Carbon dioxide emissions calculations)
  - Thomas, Valerie. *Energy Sources*
  - Thomas, Valerie. *Earth Systems* and *Significant Figures*.
  - Energy Information Administration. 2017. *Annual Energy Outlook 2017,* DOE/EIA-0383(2017). http://www.eia.gov/forecasts/aeo/executive_summary.cfm Power point, pp. 3-30.
  - International Energy Agency. 2017. *World Energy Outlook 2017*, pp. 63-67.

Week 2. (January 17). MB (Introductory slide due for all students)
Overview of Fossil-Fired Electricity Generation and Pollution Standards

a. Electricity generation in the U.S. and abroad
  - Brown and Sovacool. 2014. Chapter 2: "A Tale of Five Challenges" pp. 13-53.
  - Brown and Sovacool. 2014. Chapter 3: "Energy Supply" pp. 65-69 and pp. 84-102.

c. Market failures and barriers to clean energy
  - Brown and Sovacool. 2014. Chapter 5: "Barriers to Effective Climate and Energy Policies," pp. 147-177.

d. Rationale for government intervention in markets
  - Sovacool, Brown, and Valentine. "Question 3: Should Governments Intervene in Energy Markets?" pp. 60-79.

b. Pollution standards and the U.S. Clean Air Act

Week 3. (January 24). VT & MB (Exercise 2 posted). (250-word summary of group project due for all students)
Overview of Renewable Electricity and Tax Subsidies

a. Wind and Solar Energy, Biopower.
b. Levelized cost of electricity
  - Brown and Wang, Sections 2.5, 2.6
  - Thomas, Valerie. *Cost-Benefit Analysis*

c. Non-heat engine electricity (solar, wind, hydro, electrochemical, piezo-, thermo-)
d. Renewable Electricity Standards and Tax Subsidies

Week 4. (January 31). MB (Exercise 1a due for ATL students) (Exercise 1b posted)
Overview of Energy Efficiency and Labeling Programs

a. Energy-Efficient Buildings
b. Instrument choices in energy policy
  - Goulder, Lawrence and Ian Parry. 2008. "Instrument Choice in Environmental Policy," *Review of Environmental Economics and Policy*, Vol. 2: pp. 152-174.
  - Brown and Sovacool. 2014. Chapter 6: "Overcoming Barriers to Effective Climate and Energy Policies" pp. 179-214.

- Brown and Wang, Sections 3.1 & 3.2, pp. 45-58.

c. Appliance and equipment standards
d. Energy benchmarking and labeling

Week 5. (February 7). MB and VT (Exercise 1a due for DL students)
Overview of Industrial Energy Use and Financing Options

- Sovacool, Brown, and Valentine. "Question 1: Is Industry the Chief Energy Villain?"

a. Combined Heat and Power
b. The logic of policy design

- Brown and Wang, Section 3.4, pp. 62-63

c. Overview of policies and programs

- Chapter 4, pp. 65-113

d. Clean Energy Financing Options

Week 6. (February 14) MB & VT (Exercise 1b due for ATL students)
The Electric Grid & Electricity Poverty

a. The Smart Grid: Technologies and Policies.
b. Program evaluation, controlling for rival explanations, and alternative views of success

- Brown and Wang, Chapter 5, pp. 115-129

c. Watts, amps, volts and VARs

- Levin, T. and Thomas, V. M. Utility-maximizing Financial Contracts for Distributed Rural Electrification. *Energy* **69**: 613-621, 2014. http://dx.doi.org/10.1016/j.energy.2014.03.057
- Brown and Sovacool. 2014. Section 8.1 on Denmark's Electricity Policy

d. Electricity Poverty and Fuel Subsidies

Week 7. (February 21). VT with Guest Lecture by Professor Kim Cobb
Climate Science and Climate Adaptation and Geoengineering
(Exercise 1b due for DL students)

a. Climate Science

- Intergovernmental Panel on Climate Change, "Summary for Policymakers" in *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, T. F. Stocker and D. Qin, eds., 2013.

b. Climate Adaptation and Geoengineering

- Sovacool, Brown, and Valentine. "Question 9: Is Mitigation or Adaptation the Best Way to Address Climate Change?"
- Brown and Sovacool. 2014. Chapter 4: "Technologies for Geo-Engineering and Adaptation" pp. 125-146.
- National Academy of Sciences. 2015. Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration. (Washington, DC: National Academies Press), Summary: pp. 1-14. http://nap.edu/18805

c. The Environmental Kuznets Curve

- Brown and Wang, Chapter 1, pp. 11-13.

d. Review of Key Concepts for Midterm

Week 8. (February 28). MB & VT Midterm Exam

a. Climate Policy and Carbon Pricing

b. The Paris Agreement and Nationally Determined Commitments
   - International Energy Agency. 2016. *World Energy Outlook 2016*. Chapter 8: Energy and Climate Change, pp. 313-346.

Week 9. (March 7). VT & MB (Project Summaries Due)
Mitigation Options

a. Carbon Dioxide and Other Greenhouse Gases
   - Socolow, R. and S. W. Pacala (2006) "A Plan to keep Carbon in Check", *Scientific American*, 195 (3), 50-57.
   - Thomas, Valerie. *Greenhouse Gas Emissions*.
b. Polycentric Governance
   - Brown and Sovacool. 2014. Chapter 7: "The Case for Polycentric Implementation" pp. 215-240.
   - Brown and Wang, Section 6.3 (on leading states California and Massachusetts): pp. 152-163.
c. Biogenic Carbon Lifecycle Greenhouse Gas Emissions
   - "Relation of Biofuel to Bioelectricity and Agriculture: Food Security, Fuel Security, and Reducing Greenhouse Emissions," V. M. Thomas, D. Choi, D. Luo, A. Okwo, J. H. Wang, *Chemical Engineering Research and Design*, **87**, 1140-1146, 2009. http://dx.doi.org/10.1016/j.cherd.2009.06.017

Week 10 (March 14) MB & VT (Exercise 2 Due for ATL students)
Overview of Clean Transportation Options

a. Life cycle assessment
   - Thomas, Valerie. *Life Cycle Assessment* and *Transportation Energy*
b. Gasoline versus Electric Vehicles
   - Brown and Sovacool. 2014. Section 2.2: "Transportation" pp. 25-33
   - Brown and Sovacool. 2014. Section 8.3: "Brazil's Biofuels Program"
   - Sovacool, Brown, and Valentine. 2016. "Question 7: Is the car of the future electric?"
   - In Battle over Biofuels, a Rare Setback for Oil https://www.nytimes.com/2017/11/30/climate/trump-ethanol-biofuel.html
c. Automotive Efficiency Standards
d. Alternative Transportation Fuels

Spring Break (March 21 for GT, March 14 for UT-K) (Exercise 2 Due for DL students)

Week 11. VT & MB (March 28).
Transportation: Petroleum and Natural Gas

a. Oil Economics and the U.S. oil export ban
   - International Energy Agency. 2017. *World Energy Outlook 2017*. pp. 68-77.
   - "Oil Prices: What's behind the drop? Simple Economics"
   - International Energy Agency. 2015. *World Energy Outlook 2015*. Chapter 5: Natural gas market outlook: in Shape for the Long Haul?
   - "GE to Cut 12,000 in its Power Business" https://www.bloomberg.com/news/articles/2017-12-07/ge-is-said-to-plan-12-000-job-cuts-as-new-ceo-revamps-power-unit
   - Yergin, Daniel. 2015. Who will rule the oil market? *The New York Times*.
b. Socio-technical approaches and competing frames of reference
   - Sovacool, Brown, and Valentine. "Question 5: Is Shale Gas a Bridge to a Clean Energy Future?"

- Sovacool, Brown, and Valentine. "Conclusion: Values and Truth, Fact and Fiction"

c. The U.S. oil export ban

Week 12. (April 4). MB & VT (Exercise 2 Due for UT-K students)
Overview of Nuclear Power and Loan Guarantees

a. Nuclear Power, Nuclear Waste and Nuclear Non-proliferation
   - *The Future of Nuclear Power, Executive Summary, Chapters 1-3 or more, and Update of the 2003 Report* (MIT).
   - Sovacool, Brown, and Valentine. "Question 12: Is Nuclear Energy Worth the Risk?"

b. Non-proliferation: Perspectives from Deterrence Theory, Regime Analysis and Organizational Behavior

c. Loan guarantees

Week 13. (April 11). MB & VT
Project Presentations

Week 14. (April 18). MB & VT
Project Presentations

Final Project Reports due April 18

Final Exam:

- **Atlanta section:** Monday April 30, 2:50-5:40, ESM 210
- **UTK section:** Monday April 30, 2:50-5:40, proctored by UT-K
- **Distance section:** Tuesday May 1 – Monday May 7, arrange with proctor

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Grades Due
Atlanta: May 7, 2018 at 12 noon
DL: May 14, 2018 at 12 noon
UT-K: May 15, 2018