School of Public Policy (PUBP)
School of Industrial and Systems Engineering (ISYE)

Energy Technology and Policy
ISYE 6701 and PUBP 6701

Energy Policy
Wednesday 12:20-3:05 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. 2011. *Climate Change and Global Energy Security: Technology and Policy Options* (MIT Press) (2014 edition).
  ISBN 978-0-262-51631-0 (paperback) ISBN 978-0-262-01625-4 (hardback)
- M. A. Brown and Y. Wang. 2015. *Green Saving: How Policies and Markets Drive Energy Efficiency* (Praeger Press).
  ISBN 978-1-4408-3121-8 (e-book) ISBN 978-1-4408-3120-1 (hardback)
- B. K. Sovacool, M. A. Brown, and S, Valentine. 2016. *Fact and Fiction in Global Energy Policy: 15 Contentious Questions* (Johns Hopkins Press).

ISBN 13: 978-1-4214-1898-8 (electronic) ISBN 13: 978-1-4214-1897-1 (paperback)
ISBN 13: 978-1-4214-1898-3 (electronic) ISBN 10: 1-4214-1897-5 (paperback)

Grades and Examinations:

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

Because of the interactive nature of the course, all students are expected to actively participate. Atlanta 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 30: 250-word Summary of Topic for Class Project
March 6: Quality Draft of Class Project Report
April 17: Final Project Report Due

Assignments for distance students will be on a one-week delay, following the Georgia Tech-ATL students. All final project reports are due on April 17.

There will be two exams: *20 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 Carbon Drawdown Program in Georgia 15%

Office hours:

Dr. Brown: Tuesdays 1 – 2 pm & Thursdays 11 am – noon most weeks, and by appointment
Dr. Thomas: Wednesdays 8:30 - 9:30 am most weeks, and by appointment

Schedule and Reading Assignments

Week 1. (January 9). MB and VT (Exercise 1a posted)
Energy Overview. Overview of Concepts in Energy Technology and Policy

Global Energy and Greenhouse Gas Trends

- International Energy Agency. 2018. *World Energy Outlook 2018*, Executive Summary, pp. 23-28.

U.S. Energy and Greenhouse Gas Trends

- Energy Information Administration. 2018. *Annual Energy Outlook 2018,* DOE/EIA-0383(2018). http://www.eia.gov/forecasts/aeo/executive_summary.cfm Overview: pp. 8-32.

Key Policy Ideas, Engineering and Science Factors, and Key Quantitative Skills.

- Thomas, Valerie. *Energy Sources*
- Thomas, Valerie. *Earth Systems* and *Significant Figures*.

Review of Syllabus

Week 2. (January 16). MB and VT (Introductory slide due for all students)
Rationale for Gov't Intervention

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.

Market failures and barriers to clean energy

- Brown and Sovacool. 2014. Chapter 5: "Barriers to Effective Climate and Energy Policies," pp. 147-177.

Rationale for government intervention in markets

- Sovacool, Brown, and Valentine. "Question 3: Should Governments Intervene in Energy Markets?" pp. 60-79.

Pollution standards and the U.S. Clean Air Act

Basic power relationships (Earth Sun People Food). Heat engines, electricity, and efficiency (Primary delivered energy, Energy-water nexus). Carbon dioxide emissions calculations.

Week 3. (January 23). MB (Exercise 2 posted).
Overview of Renewable Electricity and Key Supporting Technologies

Wind, Solar, Bio, and Hydro-power

- Sovacool, Brown, and Valentine. 2016. "Question 6: Can Renewable Electricity Ever be Mainstreamed?" pp. 120-140.

Renewable Electricity Policies

Stakeholder Analysis

- Brown and Sovacool. 2014. Section 4.2.4 "Political Feasibility and Critical Stakeholder Analysis," pp. 190-193.

The logic of policy design

- Brown and Wang. 2015. Section 3.4 "The Logic of Energy Efficiency Policy Design, pp. 62-63.

Video – The Levelized Cost of Electricity (LCOE) – Valerie Thomas

- Brown and Wang. 2015. "LCOE" and "Mitigation Supply Curves" Sections 2.5 and 2.6, pp. 37-44.
- Thomas, Valerie. *Cost-Benefit Analysis*

Week 4. (January 30). VT (Exercise 1a due for ATL students) (Exercise 1b posted)
(250-word summary of group project due for all students)
New Technology Development: Role of Research, Role of Deployment at Scale

Wind and Solar Energy, Biopower.

Non-heat engine electricity (solar, wind, hydro, electrochemical, piezo-, thermo-)

Video – The Tools of Government – Marilyn Brown

- Goulder, Lawrence and Ian Parry. 2008. "Instrument Choice in Environmental Policy," *Review of Environmental Economics and Policy*, Vol. 2: pp. 152-174.
- Overview of public policies and programs in Brown and Wang, Chapter 4, "Energy Efficiency Policies and Programs in a Maturing Marketplace," pp. 65-113.

Week 5. (February 6). VT and MB (Exercise 1a due for DL students)
Instrument Choice in Energy Policy

Energy-Efficient Buildings and Industry

- Brown and Wang, Sections 2.2 and 2.3 (Technologies and Practices for Energy-Efficient Buildings and Industry), pp. 23-33.

Instrument choice in energy policy

- Brown and Sovacool. 2014. Chapter 6: "Overcoming Barriers to Effective Climate and Energy Policies" pp. 179-214.
- Brown and Wang, 2015. Sections 3.1 & 3.2 (Market Failures, Public Interests and Barriers) pp. 45-58.

Appliance and equipment standards, energy benchmarking and labeling

Program evaluation, controlling for rival explanations, and alternative views of success

- Brown and Wang, 2015. Chapter 5 ("Program Evaluation and the Need for New Business Models"), Sections 5 – 5.5, pp. 115-129.

Week 6. (February 13) MB & VT (Exercise 1b due for ATL students)
Energy in Developing Countries. Climate Science.

Universal Energy Access

- International Energy Agency. 2018. *World Energy Outlook 2018*, Section 2.2 ("Universal Energy Access,") p. 86.
- 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

Fossil Fuel Consumption Subsidies: Justifications and Impacts

- International Energy Agency. 2018. *World Energy Outlook 2018*, Box 2.3 ("Recent Progress on Fossil Fuel Consumption Subsidies") pp. 111-112.

The Environmental Kuznets Curve

- Brown and Wang. 2015. Section 1.6 ("International Trends, Challenges, and Opportunities"), pp. 11-13.
- Sovacool, Brown, and Valentine. "Question 1: Is Industry the Chief Energy Villain?"

Climate Science: Presentation by Professor Kim Cobb, School of Earth and Atmospheric Sciences

- 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.

Week 7. (February 20). VT and MB
Climate Adaptation and Geoengineering
(Exercise 1b due for DL students)

Climate Adaptation

- Sovacool, Brown, and Valentine. "Question 9: Is Mitigation or Adaptation the Best Way to Address Climate Change?"

Sea Level Rise and Energy Infrastructure at Risk

Geo-engineering Technologies and Policies

- 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
- International Energy Agency. 2018. *World Energy Outlook 2018*, Carbon Capture, Utilization, and Storage, pp. 499-510

Life cycle assessment

- Thomas, Valerie. *Life Cycle Assessment*

Review of Key Concepts for Midterm

Week 8. (February 27). MB & VT Midterm Exam
Climate Policy
Carbon Pricing
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 6). VT & MB (Project Drafts Due)
Mitigation Options
Carbon Dioxide and Other Greenhouse Gases

- Thomas, Valerie. *Greenhouse Gas Emissions*.

Mitigation "Wedges" and Carbon "Drawdown"

- Socolow, R. and S. W. Pacala (2006) "A Plan to keep Carbon in Check", *Scientific American*, 195 (3), 50-57.

The Smart Grid: Technologies and Policies

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

Financing Climate Change Mitigation and Adaptation

Polycentric Governance

- Brown and Sovacool. 2014. Chapter 7: "The Case for Polycentric Implementation" pp. 215-240.
- Brown and Wang. 2015. Section 6.3 (on leading states: California and Massachusetts): pp. 152-163.

Week 10 (March 13) MB & VT (Exercise 2 Due for ATL students)
Clean Transportation Options

- Thomas, Valerie. *Transportation Energy*

Gasoline versus Electric Vehicles

- Brown and Sovacool. 2014. Section 2.2: "Transportation" pp. 25-33
- Sovacool, Brown, and Valentine. 2016. "Question 7: Is the car of the future electric?"

Automotive Efficiency Standards

Alternative Transportation Fuels

- Brown and Sovacool. 2014. Section 8.3: "Brazil's Biofuels Program"
- "In Battle over Biofuels, a Rare Setback for Oil" https://www.nytimes.com/2017/11/30/climate/trump-ethanol-biofuel.html

Spring Break (March 20) (Exercise 2 Due for DL students)

Week 11. VT & MB (March 27).
Geopolitics: Petroleum and Natural gas

Oil Economics and the U.S. oil export ban

- International Energy Agency. 2017. *World Energy Outlook 2017*. pp. 68-77.

Socio-technical approaches and competing frames of reference

- Sovacool, Brown, and Valentine. 2016. "Question 5: Is Shale Gas a Bridge to a Clean Energy Future?"
- Sovacool, Brown, and Valentine. 2016. "Conclusion: Values and Truth, Fact and Fiction"

Natural gas as a transition fuel

- International Energy Agency. 2018. *World Energy Outlook 2018.* Outlook for Natural Gas, pp. 171-213.

Week 12. (April 3). MB & VT
Geopolitics: Nuclear Power and Nuclear Waste

Nuclear Power and Nuclear Waste

- *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?"

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

Loan guarantees

Combined Heat and Power

- Brown and Sovacool. 2014. Section 8.1 on Denmark's Electricity Policy

Week 13. (April 10). MB & VT
Project Presentations

Week 14. (April 17). MB & VT
Project Presentations

Final Project Reports due April 17

Final Exam:

• **Atlanta section**: Friday April 26, 11:20-2:10

• **Distance section:** Monday April 29 – Friday May 3, arrange with proctor

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Grades Due
Atlanta: May 6, 2019 at 12 noon
DL: May 13, 2019 at 12 noon

Project Presentation Schedule
PUBP 6701 in Spring, 2019

Date	**Title**	**Team Members**	**Lead Professor for Review**
April 10 12:20 – 12:50			
April 10 1:00– 1:30			
April 10 1:40 – 2:10			
April 17 12:20 – 12:50			
April 17 1:00– 1:30			
April 17 1:40 – 2:10			