

**AEM 4515 / AEM 5515 / ECON 3870 – Fall 2022**  
**Business and Economics of Energy**

---

**Class Meetings:** TR 9:40am - 10:55pm in Baker Laboratory 335

**Instructor:** Todd Gerarden

**Contact:** [gerarden@cornell.edu](mailto:gerarden@cornell.edu)

**Office Hours:** Tuesdays 4:00pm - 5:00 pm in Warren 466  
By appointment: [aem4515.youcanbook.me](https://aem4515.youcanbook.me)

**Teaching Assistant:** Tong Wu

**Contact:** [tw494@cornell.edu](mailto:tw494@cornell.edu)

**Office Hours:** Mondays 2:30pm - 4:00pm in Warren 330

**Course Summary:** This course will investigate energy issues from an economic and business perspective using a quantitative approach. In the first part of the course, students will learn how to think about energy through an economic and business lens. The second part of the course will focus on topical energy market issues such as imperfect competition, bidding in electricity markets, markets for oil and gas, and the economics of renewable energy.

**Course Outcomes:**

1. Use and evaluate scientific and economic information to reach defensible conclusions.
2. Describe the implications of using markets to supply and allocate energy.
3. Identify market failures that justify energy policy interventions.
4. Develop skills to evaluate the benefits and costs of different energy policies.

**Prerequisites:** MATH 1110, and AEM 2600 or ECON 3030 (or equivalent).

**Readings:** There is no textbook. Readings will be posted on canvas. The lectures, problem sets, and prelims will draw from these readings.

**Grading Scale:**

A: 92–100; A-: 90–91  
B+: 88–89; B: 82–87; B-: 80–81  
C+: 78–79; C: 72–77; C-: 70–71  
D+: 68–69; D: 62–67; D-: 60–61  
F: < 60

**Grading Weights:**

Prelims (2): 50%  
Problem Sets (4): 40%  
Electricity Strategy Game: 10%

**Prelims:** There will be 2 in-class prelims.

**Problem Sets:** There will be 4 problem sets with a mix of qualitative and quantitative questions.

**Games:** We will play the Electricity Strategy Game to gain hands on experience with economic concepts and an understanding of electricity markets. Each group will complete a short assignment in advance to prepare for the game.

**Lecture Notes:** Lecture notes will be posted on the course site.

**Power Plant Trip:** One class period will be a power plant trip. Attendance is required.

**Guest Lectures:** We may have 1-2 guest speakers. Attendance is required.

**Class Attendance:** Lecture attendance is highly recommended but not required.

**Grade Appeals:** If you wish to appeal your grade on an assignment you must bring it to our attention, in writing, within 24 hours of when the assignment is returned. I reserve the right to regrade the entire assignment and the new grade will be final.

**Dyson Grading Policy:** Dyson faculty policy mandates that grades reflect a range of outcomes distinguishing between failing, poor, good, and excellent performance. The latter category is awarded an A grade and is considered the top mark in this course. The grade of A+ is awarded only for extraordinary achievement far above the mean and will in no case make up more than 5% of total final grades.

**Academic Integrity:** For homework assignments, you may consult with other students and/or us (during office hours). However, each person must complete his or her own assignment. You must complete prelims without help. This class will follow Cornell University's Code of Academic Integrity: <https://cuinfo.cornell.edu/aic.cfm>.

**Accessibility:** Cornell is committed to ensuring access to learning opportunities for all students. If you have an access need, please contact me or Student Disability Services.

**Important Dates:**

Prelim 1: October 6

Prelim 2: December 1

Power plant trips: Oct. 27, Nov. 1, and Nov. 3 (randomly assigned)

***Tentative Assignment Dates:***

Homeworks: September 13, October 4, November 8, November 22

Electricity Strategy Game group memo: November 1

## Course Outline and Readings:

An **O** before a reading indicates that it is optional for undergraduate students. Underlined readings are more technical – just try to get the gist of what’s in the article, don’t read the whole thing or stress about understanding every last detail.

### Introduction

August 23: Introduction to Business and Economics of Energy

- Energy Information Administration, 2022. Annual Energy Outlook 2022.
- International Energy Agency, 2021. World Energy Outlook 2021.

August 25: Market Efficiency and Scarcity Pricing

- Simonetti, I. 2022. Exxon and Chevron Report Record Profits on High Oil and Gas Prices. *NYTimes*.
- ExxonMobil 2Q2022 Earnings Release

August 29: *Microeconomics Review from 4:30-5:30pm in Warren B50 (optional)*

- TA Tong Wu will review prerequisite micro concepts

August 30: Market Efficiency and Scarcity Pricing (continued)

- [Marketplace: U.S. oil refiners are doing well, even though gasoline prices are down](#)
- DiSavino, 2019. Explainer: Why Are U.S. Natural Gas Prices in Texas Below Zero? *Reuters*.

### Business and Economics of Oil and Gas

September 1: Oil and Gas Background

- [Investopedia: How the Oil and Gas Industry Works](#)
- [NPR: Breaking down the price of gasoline \(podcast\)](#)
- API, 2014. Understanding Crude Oil and Product Markets.

September 6: The Hotelling Model of Resource Extraction

- Eaton, C., 2020. Small Oil Drillers Are Turning Off Taps More Quickly Than Anticipated. *Wall Street Journal*.
- [WSJ Explains: The Forces Fueling 2020’s Oil Bust \(4 min. video\)](#)

September 8: Forecasting and Financial Markets for Oil and Gas

- [NPR: A Bet, Five Metals And The Future Of The Planet](#)

\* Longer version: [Planet Money #508: A Bet On The Future Of Humanity](#)

- Worstall, T., 2013. But Why Did Julian Simon Win The Paul Ehrlich Bet? *Forbes*.
- Bailey, J., 2007. Southwest Airlines Gains Advantage By Hedging On Long-Term Oil Contracts. *The New York Times*.
- Hamilton, J., 2009. Understanding Crude Oil Prices. *The Energy Journal* 30(2). Only pages 179-188 required.

#### September 13: Oil and Gas Midstream

- [NPR: Backwardation in the oil market](#)
- Levine, M., 2020. Money Stuff: There's Nowhere to Put the Oil. *Bloomberg*.
- Gilbert, A., 2020. Oil prices are negative: What does it mean and what comes next? *Fast Company*.

#### September 15: Oil and Gas Midstream (continued)

#### September 20: Supply-side Environmental Policy

- Heal, G. and W. Schlenker. 2019. Carbon Taxes and the Oil Market.
- Heal, G. and W. Schlenker. 2020. Coase, Hotelling and Pigou: The Incidence of a Carbon Tax and CO<sub>2</sub> Emissions. NBER Working Paper No. 26086.

#### September 22: Supply-side Environmental Policy II

- Clark, P. 2013. Norwegian's provocative plan to curb climate change wins EU prize. *The Financial Times*.
- Harstad, B. 2012. Buy Coal! A Case for Supply-Side Environmental Policy. *Journal of Political Economy*, 120(1). Only pages 77-80 required.
- Geman, B. 2021. Making Sense of Shell's Exit from the Permian Basin. *Axios*.
- Tabuchi, H. 2022. Oil Giants Sell Dirty Wells to Buyers With Looser Climate Goals, Study Finds. *NYTimes*.

#### September 27: Oil and Gas Downstream: Monopoly Regulation

- Davis, L.W. and Muehlegger, E., 2010. Do Americans consume too little natural gas? An empirical test of marginal cost pricing. *The RAND Journal of Economics*, 41(4), pp.791-810.
- S. Borenstein. ["Reinventing Fixed Charges,"](#) Energy Institute Blog, UC Berkeley, November 16, 2020.
- Borenstein, Fowlie, and Sallee. 2021. Designing Electricity Rates for An Equitable Energy Transition. Energy Institute Working Paper 314.

September 29: Oil and Gas Downstream: Rate-of-Return and Incentive Regulation

- Davis, L.W. and Kilian, L., 2011. The allocative cost of price ceilings in the US residential market for natural gas. *Journal of Political Economy*, 119(2), pp.212-241.

October 4: Oil and Gas Downstream: Gasoline Markets and Policies

- Larrick, R., and J. B. Soll, 2008. The MPG Illusion. *Science*.
- Anderson, S., et al., 2011. Automotive Fuel Economy Standards: Impacts, Efficiency, and Alternatives. *Review of Environmental Economics and Policy* 5(1).
- Tabuchi, H. and B. Plumer, 2021. How Green are Electric Vehicles? *NYTimes*.
- Holland, S., et al., 2016. Are There Environmental Benefits from Driving Electric Vehicles? The Importance of Local Factors. *American Economic Review* 106(12).
- Should We Ban Gas-Powered Cars? *The Economist*, 2020.

October 3: Prelim Review from 5:30-7:00pm in Warren 175 (optional)

October 6: **First Prelim**

### **Business and Economics of Electricity**

October 11: No Class (Fall Break)

October 13: Electricity Background

- [Burn: How the grid works \(4 min. video\)](#)
- S. Borenstein. “Pricing for the Short Run,” Energy Institute Blog, UC Berkeley, August 19, 2019.

October 18: Scarcity Pricing, Investment, 2021 Texas Power Crisis

- “What Went Wrong with Texas’s Main Electric Grid and Could It Have Been Prevented?” *Texas Monthly*, 2/17/21.

October 20: Market Power, Residual Demand and Market Manipulation

- M. Slezak, “Energy Companies Withholding Supply to Blame for July Price Spike, Report Finds,” *The Guardian*, 8/17/16.
- P. Healy and K. Palepu, 2003. “The Fall of Enron,” *Journal of Economic Perspectives* 17(2). [read up to p. 12]
- S. Borenstein, 2002. “The Trouble with Electricity Markets: Understanding California’s Restructuring Disaster,” *Journal of Economic Perspectives* 16(1): pp. 191-211.

October 25: Profit Maximization in Practice (Intro to the Electricity Strategy Game)

- [Energy game manual](#)
- Portfolio Evaluation Guide on canvas

October 27: Teams Prepare for the Electricity Strategy Game

- **No regular class meeting**
- 1/3 of the class will tour the Central Energy Plant (150 Maple Avenue, CEP 303 Conf Rm.)

November 1 and 3: Electricity Strategy Game

- 1/2 of class will play the Electricity Strategy Game (in class) each day
- 1/3 of the class will tour the Central Energy Plant (150 Maple Avenue, CEP 303 Conf Rm.)

### **Business and Economics of Renewable Energy**

November 8: Renewable Energy Background

- Bloomberg New Energy Finance. Renewable Energy Investment Tracker, 2H 2022. August 2022.
- Lazard. Levelized Cost of Energy Analysis – Version 15.0. October 2021.
- Lazard. Levelized Cost of Storage Analysis – Version 7.0. October 2021.
- S. Borenstein, 2012. “The Private and Public Economics of Renewable Electricity Generation,” *Journal of Economic Perspectives* 26(1): pp. 67-92.

November 10: Renewable Energy Policy

- J. Dizard. “Tricky Tax Equity Erodes US Infrastructure Boom,” *The Financial Times*, 1/6/2017.
- [Bipartisan Policy Center: IRA Summary - Energy and Climate Provisions](#)
- S. Borenstein. “Can Net Metering Reform Fix the Rooftop Solar Cost Shift?” Energy Institute Blog, UC Berkeley, January 25, 2021.
- J. Leslie. “Nevada’s Solar Bait-and-Switch,” *The New York Times*, 2/1/2016.
- J. Brady. “Solar Firms Plan To Return To Nevada After New Law Restores Incentives,” *NPR*, 6/7/2017.

November 15: Innovation Case Study: Solar

- [NPR’s Planet Money Episode 616: How Solar Got Cheap](#)
- K. Bullis. “The Solar Panels Are Free, as Long as You Pay for the Power,” *MIT Technology Review*, 1/5/2011.

- D. Cardwell. "Bonds Backed by Solar Power Payments Get Nod," *The New York Times*, 11/14/2013.
- C. Flammer, 2020. "Green Bonds: Effectiveness and Implications for Public Policy" *Environmental and Energy Policy and the Economy* 1(1): pp. 95-128.

November 17: Renewable Energy Procurement: Physical and Virtual Contracts

- ["Corporate Clean Energy Buying Grew 18% in 2020, Despite Mountain of Adversity"](#) *Bloomberg New Energy Finance*, 1/26/21.
- [Google: 24/7 by 2030: Realizing a Carbon-free Future](#)
- J. Bartlett, 2019. "Reducing Risk in Merchant Wind and Solar Projects through Financial Hedges" Resources for the Future Working Paper 19-06.

November 22: Renewable Energy Procurement (continued)

November 24: No Class (Thanksgiving Break)

*November 28: Prelim Review from 6:00-7:30pm in Warren 151 (optional)*

November 29: Decarbonization and The Energy Transition

- [Vox: How America can leave fossil fuels behind, in one chart \(7 min. video\)](#)
- [Blackrock Investment Institute: Managing the Net-Zero Transition](#)
- L. Davis. "Electrification? We Are Already On The Way," Energy Institute Blog, UC Berkeley, November 4, 2019.
- Jacobson, Delucchi, Cameron, and Frew. 2015. "Stabilizing grid with 100% renewables 2050." *PNAS*, 112 (49) 15060-15065.
- Clack *et al.* 2017. "Evaluation of 100% wind, water, and solar power." *PNAS*, 114 (26) 6722-6727.

December 1: **Second Prelim**