ECO 395K 4: MARKETS FOR ELECTRICITY
UNIQUE NO. 34205

Instructor:	Dr. Jay Zarnikau
Class Meeting:	BRB 2.136; M-W 1:00 to 2:30 pm
Email:	jayz@utexas.edu (When I reply, I might use jayzarnikau@gmail.com.)
	I cannot directly reply to an email sent to me via Canvas. So, it is best to just use this jayz@utexas.edu address rather than Canvas to communicate.
Office:	On Campus: In the Economics Department: BRB 3.134H
Office Hours:	Office hours will vary each week. Some might be via Zoom, particularly early in the semester.

Description

In this course, we will explore the design and performance of electricity markets and the challenges confronting these markets. We will explore the following key questions:

- Have efforts to introduce competition into segments of the electric power industry been successful?
- How are markets for energy constructed and how can they be improved?
- What went wrong in Texas' energy markets in February 2021, and how can the problems be resolved?
- How will new emerging technologies (e.g., inexpensive distributed solar generation, lower-cost battery storage, and home automation systems) disrupt the electric utility industry?
- What are the implications of an energy transformation away from fossil fuels?
- What are the benefits, costs, and impediments to achieving greater price elasticity of demand in energy markets through dynamic pricing, demand response programs, and other means?
- Is there a "missing money problem" in the electricity industry? That is, does pricing based on short-run marginal cost (SRMC) provide insufficient incentives to encourage the construction of new power plants?
- What are the consequences of market power in various sectors in this industry?

Objectives

Upon completing this course, you will have an understanding of key issues surrounding the provision of electricity and how standard economic research methods (e.g., regression analysis, optimization methods and simple microeconomic analysis) can be used to analyze such issues.

Textbooks and References

I very loosely follow:

> *The Economics of Electricity Markets* by Darryl Biggar and Mohammad Reza Hesamzaden, Wiley, IEEE Press, 2014.

This textbook covers nearly all of the topics that I wish to cover. However, I will often stray from it.

If you already have familiarity with electricity markets or want to rely on other materials, you do not need to buy this book. Also, an electronic version may be borrowed from UT Libraries.

My lecture notes will be posted on Canvas. In addition, numerous articles and reports will be posted on Canvas. These vary in length and technical complexity. It is fine to "skim-through" the more-voluminous reports and reports.

Some articles will use a lot of math and econometrics jargon. If you can't follow all of it, that is alright. Skip over the tedious math. But it is important to understand concepts and findings.

Additionally, I will ask you to review some videos on the Internet prior to some of the class meetings.

Homework Problems

There will be two homework assignments in the first half of the semester.

Presentation to Review an Article

I will ask you to provide the class with a short overview and critique of a journal article or policy report on a topic covered in the course, and to lead a brief discussion of the topic.

Term Paper and Presentation

There is an individual term paper requirement.

In the past, many students have used this as a writing example when applying for PhD programs or employment opportunities.

In addition to writing the paper, you will need to present your findings to the class through a presentation during one of the last two days of the semester.

I'll provide you with term paper ideas near the beginning of the semester, and I'll ask you to confirm your topic, provide a term paper outline, and confirm that you have access to the data necessary to complete it around the middle of the semester.

MidTerm

This will be "take home." You will have about 10 days to complete it after it is released toward the end of the semester (sometime in November).

Grading Policies

Each of the two homework sets count for 15% of your grade. The term paper (and associated presentation) counts for 40% of your final grade. The mid-term counts for 25%. 5% of your grade is based on your short presentation which will review and critique a journal article or a topic in the press.

I consider a 93.3% or higher to be an A, 90.0% to 93.3% to be an A-, 86.7% to 90.0% to be a B+, 83.3% to 86.7% to be a B, etc.

Students who take an incomplete in this course will receive a reduction in their grade of 7 points if/when they make up the incomplete, unless this failure to complete the assignments is due to the pandemic.

I reserve the right to adjust anyone's grade upward based on class participation. Note that class participation is not a course requirement (i.e., I don't take attendance).

No Email or Social Media while in Class, Please!!!

Feel free to bring a laptop or tablet to class. But please keep your attention on the class lectures and discussion while you are in class.

Agenda

The content described below may change. In particular, we may explore some current issues in newspapers, journals, or policy reports in lieu of some of the topics identified here. Also, I may make some changes depending upon the interests of the class.

August 26. Class 1: Introduction and Preview

- Preview of the course material
- Solicit feedback from the class on interests
- What is "energy"? Basic definitions.
- The importance of this topic
- The trends we are seeing in the generation and provision of electricity
- In what respects do energy markets differ from markets that we study in economic theory courses?
- The trend toward electrification
- What makes electricity special?

August 28. Class 2: Review of Optimization

- Constrained Optimization using Excel
- Discuss a couple "policy level" introductions to this subject of the course.

No class on Labor Day

September 4. Class 3: A Review of Concepts in Microeconomics

- Demand and Consumer Surplus
- Derived demand
- The role of prices
- Supply and Producer Surplus
- Maximizing welfare

Readings to be discussed during Class 3:

- Portions of Biggar and Hesamzaden, Chapters 1.1 to 1.5.

September 9. Class 4: Estimating Demand Models

- Microeconomic foundations and functional forms for demand models
- Econometrics reminders
- Estimating a simple demand model using Excel

September 11. Class 5: Electrical Engineering Basics

- Segments of the electricity industry: generation, transmission, distribution, retail
- Power plant technology: How to boil water
- Renewable energy
- Operating an electricity grid
- AC vs DC

Readings to be discussed during Classes 5 and 6:

- Biggar and Hesamzaden, Introduction to Chapter 2, 2.4, the beginning of 2.5, and Chapter 3.1.
- PNNL, A Primer on Electric Utilities, Deregulation and Restructuring of U.S. Electricity Markets, May 2002; Chapters 2 through 3.3, and 4.

September 16. Class 6: Traditional Regulation of Utilities and the Start of Wholesale Markets

- Natural monopoly characteristics in some segments of the industry
- Economic regulation of electricity system functions with natural monopoly characteristics (non-discriminatory open access to transmission, price regulation of transmission and distribution providers, regulatory principles)
- RTOs and ISOs: The need for coordination at the wholesale level
- The emergence of formal markets for electricity trading
- Discussion of short class presentations

September 18. Class 7: Dispatch of Generation

- System dispatch concepts (economic dispatch, economic merit order, unit commitment, identification)
- An Independent System Operator (ISO)
- Environmental dispatch

September 23. Class 8: Operations

- Operational considerations in the design of a competitive market
- Discussion of term paper topics

Readings to be discussed during Class 4:

- Biggar and Hesamzaden, Chapters 4 and 5.

The first HW will include the Class 8 material

September 25. Class 9: Electricity Market Reform: Introduction

- Why reform energy markets?
- California, Enron . . . . What went wrong?
- The history of market reform
- Unbundling of services
- Wholesale competition; markets for energy and ancillary services
- The design of wholesale electricity markets (real-time markets for energy; day-ahead markets for energy and ancillary services)
- Electricity market restructuring activities around the world
- Retail competition

September 30. Class 10: Electricity Market Reform: Focus on Texas

- How well is it working in Texas? What happened in February 2021?
- Zonal versus Nodal market structures

October 2. Class 11: More on Wholesale Market Reform and Putting a Price on Electricity: Wholesale Pricing

- Locational Marginal Prices (Short-Run Marginal Cost pricing)
- Setting prices in competitive electricity markets

Some of the material covered in Classes 11-12 will be from:

- Portions of Biggar and Hesamzaden, Chapter 6-7.
- Bohn, Caramanis, and Schweppe (1984). Optimal pricing in electrical networks over space and time. *RAND Journal of Economics*.
- Potomac Economics, *2023 State of the Market Report for the ERCOT Wholesale Market*.

October 7. Class 12: More on Putting a Price on Electricity

- Real-Time and Day-Ahead Markets
- Pricing of Transmission and Distribution
- Pricing the use of the transmission system
- Pricing of ancillary services

October 9. Class 13: Putting a Price on Electricity: Retail Pricing

- Traditional cost of service rate design
- The concept of return on equity

October 14. Class 14: Improving Price Signals at the Retail Level

- Getting the price closer to MC: Time of use rates, real-time pricing, and other forms of dynamic pricing
- Interruptible and curtailable rates
- Critical peak pricing
- Declining block and inverted block structures
- Priority pricing

October 16. Class 15: Market Power

October 21. Class 16: Topics in Antitrust

October 23. Class 17: Demand Response in Electricity Markets

- Price Elasticity of Demand
- Pricing and Marketing in Competitive Retail Markets
- Efforts to make the demand side more responsive to changes in wholesale prices

Readings to be discussed during Class 8:

- FERC, *Assessment of Demand Response and Advanced Metering*, latest annual report.

October 28 and 30. Class 18 and 19: Energy Efficiency

- Potential for energy efficiency
- Is there an "efficiency gap" suggesting that consumers are irrational? Or are other forms of market failure in play?
- Programs and government policies: How well do they work?
- Load shape objectives

- Cost effectiveness tests and the concept of avoided cost
- Decoupling and shareholder incentives
- Evaluation, measurement, and verification
- Jevon's paradox, rebound effects, and Net-to-gross ratios
- Integrated resource planning
- Energy efficiency and rate design
- Codes and standards
- Quantifying the benefits and costs of energy efficiency initiatives
- Regulatory mechanisms to encourage energy efficiency

Readings to be discussed during Class 10:

- Portions of the US EPA, *National Action Plan for Energy Efficiency*, 2008.

November 4. Class 20: Investment and Resource Adequacy: Part 1

- Placing a value on service reliability
- Resource planning and resource adequacy mechanisms
- Is there a "Missing Money" problem?

November 6. Class 21: Investment and Resource Adequacy: Part 2

- Installed Capacity Markets
- Ensuring adequacy of supply in a competitive market for electricity (the challenges face by power plant owners in the recovery of large fixed costs when markets price electricity based on short-run marginal cost; Hotelling's analysis)
- Operating Reserve Demand Curves

Readings to be discussed during Class 11:

- Portions of Biggar and Hesamzaden, Chapter 9-10.

November 11. Class 22: To be determined

November 13. Class 23: Storage, and Grid of the Future

- Finish discussion of resource adequacy. How is Texas addressing the challenge?
- Will batteries become the "game changer"?
- Demand response policies, programs, and methods for estimating impacts
- The smart grid and pricing in distribution networks
- Some student presentations (for those of you who don't want to wait until the final day of the course)
- Approaches to achieving environmental goals (e.g., cap and trade, pollution emissions taxes, best available control technology, environmental dispatch)

November 18. Class 24: *Distributed Renewable Energy*

- Distributed generation and "soft energy paths"
- Renewable energy potential and costs
- Trends in renewable energy
- Government policies to promote renewable energy

November 20: Class 25: Grid of the future. Mystery topics

No classes during Thanksgiving Week

December 2. Class 26: Term Paper Presentations
November 4. Class 27: Term Paper Presentations
December 9. Class 28: Term Paper Presentations

Notices from the University

Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. For further information, please visit the Student Judicial Services web site at: www.utexas.edu/depts/dos/sjs/. Students are expected to respect standards regarding academic dishonesty. You owe it to yourself, your fellow students, and the institution to maintain the highest standards of integrity and ethical behavior. A discussion of academic integrity, including definitions of plagiarism and unauthorized collaboration, as well as helpful information on citations, note taking, and paraphrasing, can be found at the Office of the Dean of Students web page. (http://deanofstudents.utexas.edu/conduct/) and the Office of Graduate Studies (http://www.utexas.edu/ogs/ethics/transcripts/academic.html). The University has also established disciplinary procedures and penalty guidelines for academic dishonesty, especially Sec. 11.504 in Appendix C of the Institutional Rules on Student Services and Activities section in UT's General Information Catalog.

At the beginning of the semester, students with disabilities who need special accommodations should notify the instructor by presenting a letter prepared by the Service for Students with Disabilities Office to ensure that appropriate accommodations can be provided. See: http://ddce.utexas.edu/disability/

The following recommendations regarding emergency evacuation from the Office of Campus Safety and Security, 512-471-5767, http://operations.utexas.edu/units/csas/terms.php:
Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside.

- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class. In the event of an evacuation, follow the instruction of faculty or class instructors.
- Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.
- Behavior Concerns Advice Line (BCAL): 512-232-5050

- Link to information regarding emergency evacuation routes and emergency procedures can be found at: https://preparedness.utexas.edu/emergency-plans

By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

More information on how to sign up for emergency text alerts, contact information for various UT offices, wellness resources, and campus initiatives relating to safety and/or wellness can be found at https://www.utexas.edu/campus-life/safety-and-security

Beginning January 1, 2020, Texas Senate Bill 212 requires all employees of Texas universities, including faculty, report any information to the Title IX Office regarding sexual harassment, sexual assault, dating violence and stalking that is disclosed to them. Texas law requires that all employees who witness or receive any information of this type (including, but not limited to, writing assignments, class discussions, or one-on-one conversations) must be reported. If you would like to speak with someone who can provide support or remedies without making an official report to the university, please email advocate@austin.utexas.edu. For more information about reporting options and resources, visit http://www.titleix.utexas.edu/,contact the Title IX Office via email at titleix@austin.utexas.edu, or call 512-471-0419. Although graduate teaching and research assistants are not subject to Texas Senate Bill 212, they are still mandatory reporters under Federal Title IX laws and are required to report a wide range of behaviors we refer to as sexual misconduct, including the types of sexual misconduct covered under Texas Senate Bill 212.The Title IX office has developed supportive ways to respond to a survivor and compiled campus resources to support survivors.

If you are a student with a disability, or think you may have a disability, and need accommodations please contact Services for Students with Disabilities (SSD). You may refer to SSD's website for contact and more information: http://diversity.utexas.edu/disability/. If you are already registered with SSD, please deliver your Accommodation Letter to me as early as possible in the semester so we can discuss your approved accommodations.

We are asking that students take a COVID-19 test to help keep themselves and their fellow Longhorns and the community safe, to enable us to learn and be together as we did before COVID-19. Failure to test may contribute to the further spread of COVID-19 and overload our already strained healthcare system, and could usher in a semester with sick students, some of whom could require hospitalization. Additionally, all students complying will help minimize the introduction of new cases to our campus community, reducing the likelihood of disruption from missing class due to illness or exposure or the implementation of further restrictions.

If you miss a class or assignment due to the pandemic, please let me know and we'll work out a solution. Note that the lectures will be videotaped.

Sorry. This classroom does not have a video capture system.