

**ECO 386E: MARKETS FOR ELECTRICITY, UNIQUE NOS. 33865 (BLENDED OR HYBRID)**

**ECO 395K: MARKETS FOR ELECTRICITY, UNIQUE NOS. 33900, 33995, 34000  
(BLENDED OR HYBRID)**

**ECO 395K: MARKETS FOR ELECTRICITY, UNIQUE NOS. 34002, 34003, 34004  
(WEB BASED)**

Note: This will be a “hybrid or blended course,” that a student may complete either in-person (at least for the meetings before Thanksgiving) or remotely. This course will be taught in a combination of synchronous (in real time) and asynchronous modes (my lectures will be videotaped to later viewing).

Instructor:	Dr. Jay Zarnikau
If you want to show up:	RLP 0.112; Monday evenings from 5:15 p.m. to 8:15 p.m.
Email:	<a href="mailto:jayz@utexas.edu">jayz@utexas.edu</a> (When I reply, my consulting firm’s email domain name will be on the email address, since I forward all UT emails to my consulting firm’s server.) I cannot directly reply to an email sent to me via Canvas; so it is best to just use this <a href="mailto:jayz@utexas.edu">jayz@utexas.edu</a> address rather than Canvas to communicate.
Office:	On Campus: In the Economics Department: BRB 2.138. But, I won’t be there much this semester.
Office Hours:	Office hours will be via Zoom meetings, usually on a weekend before a homework or exam is due.

**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?
- 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?
- How can the emissions of CO<sub>2</sub> from power plants be constrained in an economically-effective manner?

## **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 plan to 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. I will often stray from it. And, if you already have familiarity with electricity markets or want to rely on other materials, you may 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 book chapters will be posted on Canvas. These vary in length and technical complexity. Feel free to skim through the more-voluminous reports and book chapters. Moreover, 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.

## **Homework Problems**

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

## **Presentation to Review an Article**

I will ask you (or, perhaps a group of two) to provide the class with a short overview of a journal article on a topic covered in the course, and to lead a short discussion of the topic. Hmm. We'll need to figure out a way for this to be done via Zoom or a recording.

## **Term Paper and Presentation**

There is a term paper requirement.

If you plan to eventually apply for admission into a PhD program, I'd recommend that you work on the term paper on your own, so that if you use me (or someone else in the Econ Dept.) as a reference, they will have a document to that can be used to judge your research and writing skills.

If you have no plans to pursue a PhD program, you may opt to work on the term paper project in a small group.

In addition to writing the paper, you will need to present your findings to the class through a presentation in the second half of the semester.

Your research will most-likely expand upon my lecture notes, going deeper into the topic.

## **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 35% of your final grade. The mid-term counts for 30%. 5% of your grade is based on your short presentation reviewing 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 at least 7 points if/when they make up the incomplete.

I reserve the right to adjust anyone’s grade upward based on class participation.

## **If you attending in person, no Email or Facebook/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. I reserve the right to adjust anyone’s grade downward based on failure to pay attention during 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.

### ***Class 1 Augusts 31 Introduction and Preview***

- Preview of the course material
- Solicit feedback from the class on interests
- What is “energy”?
- 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?
- Constrained Optimization

### ***Class 2 Sept 14 A Review of Concepts in Microeconomics and a focus on the Demand Side of Energy Markets***

- Demand and Consumer Surplus

- Supply and Producer Surplus
- Microeconomic foundations and functional forms for demand models
- Functions: Generation, Transmission, and Distribution
- Establishment of groups for term paper projects

Readings to be discussed during Class 2:

- Portions of Biggar and Hesamzaden, Chapters 1.1 to 1.4.

***Class 3 Sept 21 Electricity Industry Functions and Traditional Market Structure***

- Power plant technology: How to boil water
- 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)
- Industry structure
- RTOs and ISOs: The need for coordination at the wholesale level

Readings to be discussed during Class 3:

- Biggar and Hesamzaden, Introduction to Chapter 2, 2.4, 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.

***Class 4 Sept 28 Dispatch of Generation***

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

Readings to be discussed during Class 4:

- Biggar and Hesamzaden, Chapter 4-5.

***Class 5 Oct 5 Electricity Market Reform***

- 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
- How well is it working in Texas?
- Zonal versus Nodal market structures

Readings to be discussed during Class 5:

- Biggar and Hesamzaden, Chapter 3.2 to 3.8, and 5.
- Zarnikau (2005). A review of efforts to restructure Texas' electricity market, *Energy Policy*.
- F.P. Sioshansi (2006). Electricity market reform: What have we learned? What have we gained? *The Electricity Journal*.
- Woo and Zarnikau (2009). Will electricity market reform likely reduce retail rates? *The Electricity Journal*.
- Su (2015). Have customers benefited from electricity retail competition? *Journal of Regulatory Economics*.
- Zarnikau, Woo, and Baldick (2014). Did the introduction of a nodal market structure impact wholesale electricity prices in the Texas (ERCOT) market? *Journal of Regulatory Economics*.
- Isser (2015). *Electricity restructuring in the U.S.: Markets and policy from the 1978 Energy Act to present*. Borrow from:  
<http://www.utxa.ebib.com.ezproxy.lib.utexas.edu/patron/FullRecord.aspx?p=1936710&echo=2&userid=xbZchMjvcG%2fJvSkY9AqBhg%3d%3d&tstamp=1471382002&id=1B0C99B44D510C109F0189025D2F1844AD42BDF1>
- Potomac Economics, *2016 State of the Market Report for the ERCOT Wholesale Market*.

**Class 6 Oct 12 Market Monitoring and Market Power**

- A special guest lecture from Dr. Parviz Adib

**Class 7 Oct 19 More on Wholesale Market Reform and Putting a Price on Electricity: Wholesale Pricing**

- Locational Marginal Prices (Short-Run Marginal Cost pricing)
- Pricing of Transmission and Distribution
- Pricing the use of the transmission system
- Pricing of ancillary services

Readings to be discussed during Class 6:

- 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*.

**Class 8 Oct 26 Putting a Price on Electricity: Retail Pricing**

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

- The theory of second best
- Performance-based regulation
- 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

Readings to be discussed during Class 8:

- Strauss and Oren (1993). Priority pricing of interruptible electric service with an early notification option. *The Energy Journal*.
- Joskow and Wolfram (2012). Dynamic pricing of electricity. *American Economic Review*.
- Faruqi and Sergici (2010). Household response to dynamic pricing of electricity: A survey of 15 experiments. *Journal of Regulatory Economics*.
- Biggar and Hesamzaden, Section 20.5.

### ***Class 9 Nov 2 The Demand Side of Electricity Markets***

- Price Elasticity of Demand
- Pricing and Marketing in Competitive Retail Markets
- Modeling energy demand (functional forms, price elasticity of demand estimates)
- Forecasting the demand for energy at various scales (time-series models, econometric modeling, end-use models)
- 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.

### ***Class 10 Nov 9 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

Readings to be discussed during Class 10:

- Portions of the US EPA, *National Action Plan for Energy Efficiency*, 2008.
- Zarnikau, Isser, and Martin (2015). Energy efficiency programs in a restructured market: The Texas framework. *The Electricity Journal*.

***Class 11 Nov 16 Investment***

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

***Class 12 Nov 23 Distributed Renewable Energy***

- Renewable energy potential and costs
- Trends in renewable energy
- Government policies to promote renewable energy

Readings to be discussed during Class 12:

- NREL *Renewable Energy Futures* report, or various reports from LBNL.

***Class 13 Nov 30 The Electrical Grid of the Future (By Internet or Recording – no In-Person Class Meeting)***

- How will advancing technologies change the production and use of energy?
- Enabling demand response and dynamic pricing through new communications and monitoring technologies
- Distributed generation and “soft energy paths”
- Will batteries become the “game changer”?
- Demand response policies, programs, and methods for estimating impacts

Readings to be discussed during Class 13:

- Zarnikau, Zhu, Russell, Holloway, and Dittmer (2015). How will tomorrow’s residential energy consumers respond to price signals? Insights from a Texas pricing experiment. *The Electricity Journal*.

***Class 14 Dec 7 Electricity Markets and Environmental Goals (By Internet or Recording – no In-Person Class Meeting)***

- Approaches to achieving environmental goals (e.g., cap and trade, pollution emissions taxes, best available control technology, environmental dispatch)

**How does Lecture Capture Work?**

Your class is using the Lectures Online recording system. This system records the audio and video material presented in class for you to review after class. Links for the recordings will appear in the Lectures Online tab on the Canvas page for this class. You will find this tab along the left side navigation in Canvas.

To review a recording, simply click on the Lectures Online navigation tab and follow the instructions presented to you on the page. You can learn more about how to use the Lectures Online system at <http://sites.la.utexas.edu/lecturesonline/>.

Please note that your professor decides when and for how long recordings will be available for you to review.

You can find additional information about the lecture capture system at:  
<http://sites.la.utexas.edu/lecturesonline/>.

**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/](http://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>

Campus Safety & Wellness Resources link: <https://www.utexas.edu/campus-life/safety-and-security>  
Harassment Reporting Requirements. Senate Bill 212 (SB 212), which took effect as of January 1, 2020, is a Texas State Law that requires all employees (both faculty and staff) at a public or private post-secondary institution to promptly report any knowledge of any incidents of sexual assault, sexual harassment, dating violence, or stalking "committed by or against a person who was a student enrolled at or an employee of the institution at the time of the incident". Please note that both the instructor for this class are mandatory reporters and MUST share with the Title IX office any information about sexual harassment/assault shared with us by a student whether in-person or as part of a journal or other class assignment. Note that a report to the Title IX office does not obligate a victim to take any action, but this type of information CANNOT be kept strictly confidential except when shared with designated confidential employees. A confidential employee is someone a student can go to and talk about a Title IX matter without triggering that employee to have to report the situation to have it automatically investigated. A list of confidential employees is available on the Title IX website.

Please note that this semester, students are required to wear a mask at all times on the UT Campus. Students who refuse to wear a mask may be asked to leave campus.

Please note that health conditions may change that require courses to meet fully online.