University of Michigan
Department of Economics
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ECON 437: ENERGY ECONOMICS AND POLICY

This course examines recent developments in energy markets and energy policy. It will use economic theory and empirical evidence to analyze the real-world operation of oil, natural gas, and electricity markets. Understanding the structure of supply and demand in these industries is essential for designing effective energy policy. Examples of policy areas that will be explored in this course include price regulation, efficiency standards, carbon taxes, cap-and-trade programs, and renewable energy incentives. At the end of the course you should be able to apply economic tools to critically analyze the design of policies in a variety of energy sectors.

LECTURES

These will be given on Mondays and Wednesdays, 4:10 p.m. to 5:30 p.m., in 296 DENN.

Lecture slides and handouts will be posted on CTools, but please note that these comprise only a portion of the material covered in each lecture. You do not need to let me know if you are unable to make it to a lecture, but you are responsible for catching up on any material that you missed.

READINGS

Readings for each lecture are shown on the attached class schedule. It is expected that you will complete the readings before class in order to understand and take part in the discussion. Many of the readings are from the following book, which provides background material on the policies and institutions we will be discussing throughout the course:

Yergin, Daniel, *The Quest: Energy, Security, and the Remaking of the Modern World*, 2011.

Additional readings include recent academic papers and excerpts from other books. These readings are posted on the CTools site. Note that the lectures will be more technical than many of the readings, so you should definitely see the readings as a complement rather than a substitute to attending the lectures. Please also note the suggestions at the top of the reading list to help you plan your reading.

OFFICE HOURS

My regular office hours will be after class on Wednesdays from 5:40 p.m.–7:00 p.m. in Lorch 212.

I am also happy to meet with you individually outside this time if you have any questions or concerns. There is a link on the CTools site to a sign-up calendar where you can select from the available times. If you cannot access the sign-up calendar (or if there are no available slots and you need to see me urgently) then please send me an email.

EMAIL POLICY

Please send me an email (sdmcrae@umich.edu) if you have any questions or comments on the lecture material, readings, or problem sets. I will try to respond the same day to all emails sent before 6:00 p.m., Monday to Friday. If you have questions on course administration, please check this syllabus and the class announcements on CTools first.

SHORT-ANSWER QUESTIONS AND HOMEWORK PROBLEMS

Before each lecture I will post a list of short-answer questions related to the readings, the lecture material, or recent news articles. You are encouraged to meet with other students to discuss your responses to these questions. Of course you are also welcome to share your ideas on these questions during lectures and to discuss your responses with me during office hours. Your answers to these questions are not expected to be turned in. However, the first section of the midterm and final exams will comprise a subset of the short-answer questions that have been provided during the course. Many of these questions have no single correct answer, so there will be no answer key provided.

In addition to the short-answer questions, there will be approximately 25 homework problems distributed during the semester. The numerical and analytical problems on the midterm and final exams will be similar to these exercises. Your final answers to these problems will be submitted electronically through a web form; you do not need to submit a paper version to show your working. I will post detailed answer keys to these problems. There will also be opportunities to work on shorter problems and exercises during lectures. A small part of the final grade will be based on these homework problems and in-class exercises. It will not be necessary to complete all problems or answer everything correctly in order to obtain full marks for this component of your course grade.

ENERGY MARKET GAMES

A major goal of the course is to understand the operation of real-world energy markets and the relevance of these markets for energy policy. Although the lectures and readings will provide theoretical and empirical perspectives on how energy markets operate, a greater appreciation for these markets can be gained by direct participation. During the course everyone will have the chance to compete in simulated oil and electricity markets as part of two interactive strategy games, developed at UC Berkeley by Severin Borenstein and James Bushnell.

The first game, starting in the fourth week of the course, will be a simulation of the world oil market. Students will be divided into teams of about three people, and each team will represent one member country of OPEC. For each round of the game, teams will make decisions on their country's production, which will determine the world oil price and country profits.

The second game, starting after the winter break, will be a simulation of a wholesale electricity market. Each team of students will represent a firm with a portfolio of electricity generation plants. For each round of the game, teams will make decisions on the prices and quantities at which they bid their generation plants in to the wholesale electricity market. The wholesale electricity price, as well as each firm's generation quantity and profits, will depend on the level of demand and the bids of all firms.

For each of the games, teams will prepare brief summaries of their strategy and how it evolved during the course of the game. The grade for each team will be determined by the team's performance relative to the

other groups (that is, how much money you make!) as well as my assessment of your strategy as observed throughout the game and as described in the memos. There will also be a question in the midterm and the final exams about your team's strategy during the energy market games. This means you will need to participate fully in discussions with your team members.

EXAMINATIONS

There will be two midterm exams. The first midterm will be on Wednesday, February 13, from 4:10 p.m. to 5:30 p.m. The second midterm will be on Wednesday, March 27, from 4:10 p.m. to 5:30 p.m. The final exam will be given as announced in the Time Schedule. My understanding is that this is Thursday, May 2, from 8:00 a.m. ***sharp*** to 10:00 a.m. If you are unable to take the exams at these times then you should not elect this course.

There will be no makeups available for the midterm exams.

A makeup for the final exam will be allowed only in the event of a medical emergency. This requires a record of hospital admission **or** certification in writing from a health professional that you would jeopardize your own health or the health of others in the exam room if you took the exam normally.

All exams will be cumulative and will be based on the material covered in lectures, readings, short-answer questions, and the longer problems, up to and including the lecture before each exam. The midterm and final exams in this course are relatively long in order to provide greater opportunities for you to demonstrate your understanding of the course material. It will not be necessary to give a perfect or complete answer to every exam question in order to get an excellent grade in the course.

DISABILITIES

If you need an accommodation for a disability, please let me know before January 23. (Of course, if a problem arises during the semester, please let me know as soon as possible). Some aspects of this course may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Services for Students with Disabilities office to help us determine appropriate accommodations. I will treat any information you provide as private and confidential.

COURSE GRADING

The numerical grade for the course will be calculated using the following weights:

Midterm exam 1 *(m_1)*	20%
Midterm exam 2 *(m_2)*	20%
Final exam *(f)*	40%
Homework and in-class problems *(hw)*	10%
Energy market games *(em)*	10%

If your final exam score is higher than your score for either of the midterm exams, I will drop one of the midterms and replace it with your final exam score. That is, your final course grade will be calculated as:

max { $0.2\ m_1 + 0.2\ m_2 + 0.4\ f + 0.1\ hw + 0.1\ em$;
$0.2\ m_2 + 0.6\ f + 0.1\ hw + 0.1\ em$;
$0.2\ m_1 + 0.6\ f + 0.1\ hw + 0.1\ em$ }

There is no fixed curve for assigning letter grades in this class. A letter grade of A will be given to everyone in the class who (i) provides insightful responses to the short-answer questions that go beyond repetition of material from the readings and lectures, and (ii) demonstrates a deep understanding of all of the analytical questions and applies an efficient approach to find their solution, even if not every question is answered perfectly. A letter grade of B will be given to everyone in the class who (i) provides careful responses to the short-answer questions that demonstrate knowledge and understanding of the material, and (ii) demonstrates a good understanding of most of the analytical questions and develops a reasonable approach to find their solution, even if not every question is answered completely.

For students on the borderline between two letter grades, participation during lectures will tip the balance.

CLASS SCHEDULE AND READING LIST

# indicates optional textbook readings that you may wish to consult for an alternative presentation of the material in this lecture.

^ indicates academic papers for which you should focus on the economic insights rather than the details of the theoretical or econometric models. This will mean spending more time on the introduction, results, discussion, and conclusion sections. You will not be expected to understand the theoretical or econometric details of these papers beyond the material that we cover in the lectures.

#	Date	Lecture	Reading
1	Jan 9	Introduction to course	
TOPIC 1: ENERGY DEMAND			
2	Jan 14	Short-run energy demand and the rebound effect	Fouquet and Pearson (2006), "Seven Centuries of Energy Services".
3	Jan 16	Long-run energy demand and the energy paradox	^ Davis (2008), "Durable Goods and Residential Demand for Energy and Water".
TOPIC 2: OIL AND GAS MARKETS			
4	Jan 23	Market power, oligopoly, and collusion	Yergin Ch. 4. # Viscusi, Harrington, and Vernon (2005), *Economics of Regulation and Antitrust*, Ch. 5, "Oligopoly, Collusion, and Antitrust" (pages 101-128).
5	Jan 28	Optimal extraction of non-renewable resources	Salant (1995), "The Economics of Natural Resource Extraction: A Primer for Development Economists". # Keohane and Olmstead (2007), *Markets and the Environment*. Ch. 6, "Managing Stocks: Natural Resources as Capital Assets".
6	Jan 30	Non-renewable resource extraction with market power ***Introduction to OPEC game***	
7	Feb 4	Peak oil? An introduction to the oil and natural gas industries ***Meeting of OPEC members***	Yergin Ch. 11, 12, 15, 16. ^ Holland (2011), "The Economics of Peak Oil".

8	Feb 6	Futures markets, speculators, and the world oil price	Yergin Ch. 8. ^ Hamilton (2009), "Causes and Consequences of the Oil Shock of 2007–08" (pp. 215–240).
9	Feb 11	Drill Baby Drill: Risk and regulation in oil and gas production	Krupnick, Campbell, Cohen & Parry (2011), "Understanding the Costs and Benefits of Deepwater Oil Drilling Regulation". # KO (2007). Ch. 3, "The Benefits and Costs of Environmental Protection".
	Feb 13	**MIDTERM EXAM 1**	

TOPIC 3: ELECTRICITY MARKETS

10	Feb 18	Regulation of natural monopolies	^ Davis and Muehlegger (2010), "Do Americans consume too little natural gas?" # VHV (2005), Ch. 11, "Theory of Natural Monopoly".
11	Feb 20	Introduction to electricity markets and industry restructuring	Yergin Ch. 17. # VHV (2005), Ch. 12, "Natural Monopoly Regulation and Electric Power".
12	Feb 25	Price formation in competitive wholesale electricity markets	
13	Feb 27	Market power in wholesale electricity markets	# McRae and Wolak (2009), "Merger Analysis in Restructured Electricity Supply Industries" (pages 38-59).
14	Mar 11	Understanding the California electricity crisis ***Introduction to Electricity Game***	Yergin Ch. 19.

TOPIC 4: ENVIRONMENTAL POLICY

15	Mar 13	Economic analysis of the impact of climate change	Yergin Ch. 21, 22, 23. ^ Nordhaus (2007), "A Review of the *Stern Review on the Economics of Climate Change*".
16	Mar 18	Environmental externalities and economic efficiency ***Electricity Portfolio Auction***	# KO (2007). Ch. 2, "Economic Efficiency and Environmental Protection" and Ch. 5 "Market Failures in the Environmental Realm".

17	Mar 20	Market-based instruments for controlling emissions	# KO (2007). Ch. 8, "Principles of Market-Based Environmental Policy".
18	Mar 25	Emissions markets in practice	Yergin Ch. 24. Schmalensee and Stavins (2012). "The SO_2 Allowance Trading System: The Ironic History of a Grand Policy Experiment". # KO (2007). Ch. 9, "The Case for Market-Based Instruments in the Real World" and Ch. 10, "Market-Based Instruments in Practice" (pp. 182-190).
	Mar 27	**MIDTERM EXAM 2**	

TOPIC 5: CURRENT ISSUES IN ENERGY POLICY

19	Apr 1	Economics of renewable electricity generation	Yergin Ch. 27, 29, 30.
20	Apr 3	Alternatives for the future of electricity generation	Yergin Ch. 18, 20, 31, 32.
21	Apr 8	Retail gasoline markets	^ Hastings (2004), "Vertical Relationships and Competition in Retail Gasoline Markets".
22	Apr 10	Biofuels and low-carbon fuel standards	Yergin Ch. 33.
23	Apr 15	Energy efficiency and fuel economy standards	Yergin Ch. 34, 35. ^ Anderson and Sallee (2011), "Using Loopholes to Reveal the Marginal Cost of Regulation".

TOPIC 6: ENERGY AND ECONOMIC DEVELOPMENT

24	Apr 17	Cookstoves and solar lamps: Climbing up the energy ladder	Friedman (2009), *Hot, Flat, and Crowded*. Ch. 9, "Energy Poverty". ^ Hanna, Duflo and Greenstone (2012), "Up in Smoke: The Influence of Household Behavior on the Long-Run Impact of Improved Cooking Stoves".
25	Apr 22	Energy supply and demand in middle-income countries	Yergin Ch. 9, 10.