ENERGY MARKETS AND POLICY

BEPP/OIDD 763 WEMBA (EAST)

Spring Semester 2019, Philadelphia, location to be announced

Note: This syllabus is always subject to revisions. Please check Canvas for the latest version.

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Course overview. Over the last several decades, energy markets have become some of the most dynamic markets of the world economy. Traditional fossil fuel and electricity markets have seen a partial shift from heavy regulation to market-driven incentives, while rising environmental concerns have led to a wide array of new regulations and “environmental markets”. The growth of renewable energy is another source of rapid change, but brings with it a whole new set of technological and policy challenges. This changing energy landscape requires quick adaptation from energy companies, but also offers opportunities to turn regulations into new business. The objective of this course is to provide the economist’s perspective on a broad range of topics that professionals in the energy industry will encounter. Topics include the effect of competition, market power and scarcity on energy prices, extraction and pricing of oil and gas, geopolitical uncertainty and risk in hydrocarbon investments, the environmental policies related to the energy and transportation sectors and their effectiveness, cap-and-trade markets, and energy efficiency. There is special emphasis on the economics and finance of renewable energy.

Readings. A mix of newspaper articles, academic papers, reports, plus the following textbook: Nathaniel Keohane and Sheila Olmstead (KO), Markets and the Environment, Washington, D.C.: Island Press, second edition, 2016. Starred (*) readings are required. Many starred readings are short. Non-starred readings are optional but I will discuss them in class, and you are highly encouraged to read them if you want further background on a specific topic. The best way to use the readings is as a supplement to the lectures, which overlap partially (but certainly not perfectly!) with the readings. You will be responsible for required readings not covered in class.

Prerequisites. Managerial Economics (MGEC 611/612) or an equivalent intermediate microeconomics course approved by the instructor.

Strategy game. The Electricity Strategy Game is a simulation of an electricity market. Student teams manage a portfolio of generation units (coal, natural gas, nuclear and renewables) and bid
into an electricity market. This game requires an initial in-class auction, six online electricity wholesale market bid submissions plus one additional round of auction bids in between class meetings.

Assignments and grading. Three equally weighted assignments (30%), an exam (40%), the Electricity Strategy Game (20%) and class participation (10%). The three assignments are take-home. You may discuss assignments with other students but you need to formulate and submit answers in teams of at most three. The exam will be given in class on the last scheduled class date. You should plan to attend the exam in person. Contact me if you have a scheduling conflict with another class, a medical issue, or an emergency. No other exceptions. Please do not email me about alternative exam dates for other reasons as I have no flexibility to accommodate such requests out of fairness to other students.

Practice questions. An extensive set of practice questions and solutions will be posted early in the semester.

Cheating policy. It should not be necessary to say this – but for completeness: all students are expected to comply with the University of Pennsylvania’s Code of Academic Integrity. It is the policy of the Department, and this course, to immediately fail any student for the course who is in violation of the University’s Code of Academic Integrity. Cheating in any manner, on a graded assignment or exam, or violating the rules of the strategy games, will result in a failing grade for this course. Additional sanctions may be imposed of the Office of Student Conduct. The Code of Academic Integrity can be reviewed at: http://provost.upenn.edu/policies/pennbook/2013/02/13/code-of-academic-integrity.

ELECTRICITY MARKETS

Lecture 1 (Jan 11): Course Introduction & Energy Overview


Lecture 2 (Jan 11): Market Efficiency and Scarcity Pricing

Topics: market efficiency; scarcity pricing; electricity markets; refined products markets.

(*) KO Chapter 4: “The Efficiency of Markets”.


Lecture 3 (Jan 26): **Market Power in Electricity Markets (1)**

*Topics:* market power; deregulation.


Lecture 4 (Jan 26): **Market Power in Electricity Markets (2)**

*Topics:* the California electricity crisis; the rise and fall of Enron.


P. Healy and K. Palepu, 2003. “The Fall of Enron”, *Journal of Economic Perspectives* 17(2): pp. 3-12 (remainder is optional and less relevant for this course; link).


**OIL AND GAS MARKETS**

Lecture 5 (Feb 8): **Oil and Natural Gas Extraction and Pricing (1)**

*Topics:* trends in oil and gas reserves; optimal extraction; Hotelling model.

(*) KO Chapter 6: “Managing Stocks: Natural Resources as Capital Assets”.

(*) Lecture notes on the Hotelling model for optimal resource extraction (on Canvas).

Lecture 6 (Feb 8): **Oil and Natural Gas Extraction and Pricing (2)**

*Topics*: oil price volatility; oil price forecasting; oil futures.

(*) R. Rowling and J. Blas, “Oil Traders Empty Key Crude Storage Hub”, *Bloomberg*, 9/20/17 ([link](#)).

T. DiChristopher, “Citi Forecasts Oil Goes Nowhere in 2019 as OPEC Cuts and US Pumps More”, *CNBC*, 12/10/18 ([link](#)).

Lecture 7 (Feb 9): **Upstream Investment under Uncertainty**

*Topics*: NOCs vs. IOCs; upstream contracts; drilling investment under uncertainty; geopolitical risk; expropriations.

(*) A. Ulmer and C. Pons, “Venezuela Ordered to Pay Exxon $1.6 Billion for Nationalization”, *Reuters*, 10/9/14 ([link](#)).


**ENERGY AND ENVIRONMENTAL POLICY**

Lecture 8 (Feb 9): **Global Climate Change**

*Topics*: climate change impacts; the climate change debate; discounting; risk and uncertainty.

(*) Lecture notes on climate change mitigation and discount rates (on Canvas).


Intergovernmental Panel on Climate Change, Summary for Policymakers, 2018 ([link](#)).

Lecture 9 (Feb 9): **Externalities and Policy Instruments (1)**

*Topics*: environmental externalities; tragedy of the commons; Coase Theorem; property rights; taxes vs. subsidies vs. standards; effect of regulations on business; double dividend.

(*) KO Chapter 5: “Market Failures in the Environmental Realm”.
(*) A. Lustgarten, “Palm Oil Was Supposed to Help Save the Planet. Instead It Unleashed a Catastrophe”, *New York Times*, 11/20/18 (link).

Lecture 10 (Feb 22): **Externalities and Policy Instruments (2) & Cap-and-Trade**

*Tops*: basics of cap-and-trade; cost-effectiveness; introduction to market design issues.

(*) KO Chapter 8: “Principles of Market-Based Environmental Policy”, pp. 139-162.

(*) Lecture notes on the economics of cap-and-trade (on Canvas).


Lecture 11 (Feb 22): **Designing Real-World Environmental Markets**

*Tops*: market design issues in cap-and-trade markets; EU Emissions Trading Scheme; RECLAIM; acid rain trading program.


Lecture 12 (Mar 8): **U.S. and Global Policy Developments & Introduction to the Electricity Strategy Game**

*Tops*: U.S. climate change policy; recent environmental policy developments; regulatory rollbacks; global carbon trading developments; emissions leakage.

(*) Student instructions for the Electricity Strategy Game (on Canvas).


“California Shows How States Can Lead on Climate Change”, *New York Times*, 7/24/17 ([link](#)).

Lecture 13 (Mar 8): **International Environmental Agreements**

*Topics:* international climate agreements; Kyoto Protocol; Montreal Protocol; free-riding; carbon offsets.

(*) B. Plumer, “Climate Negotiators Reach an Overtime Deal to Keep Paris Pact Alive”, *New York Times*, 12/15/18 ([link](#)).


C. Davenport et al., “Inside the Paris Climate Deal”, *New York Times*, 12/12/15 ([link](#)).

**THE ECONOMICS AND FINANCE OF RENEWABLE ENERGY**

Lecture 14 (Mar 9): **The Economics of Renewable Energy**

*Topics:* trends in renewable energy; levelized cost of electricity; environmental benefits of renewables.


Lecture 15 (Mar 9): **Renewable Energy Finance**

*Topics:* tax credits; tax equity; solar leasing; securitization; renewable portfolio standards; (S)RECs.


(*) Lecture notes on renewable portfolio standards and RECs (on Canvas).


Lecture 16 (Mar 22): Electricity Strategy Game Auction

Lecture 17 (Mar 22): Renewable Energy Policy

Topics: PACE; net metering; feed-in tariffs and tenders; import tariffs; green subsidies vs. carbon tax.


TOPICS: ENERGY EFFICIENCY AND TRANSPORTATION

Lecture 18 (Apr 5): Energy Efficiency: Puzzle and Policies

Topics: the “energy efficiency puzzle”; informational barriers and market failures; rebound effect; energy efficiency policies; energy efficiency business models.


Lecture 19 (Apr 5): Energy Efficiency (Continued)


Lecture 20 (Apr 6): **Fuel-Economy Policy (1)**

*Topics:* policy developments in the car industry; fuel-economy standards; gasoline tax; electric vehicle policy.


(*) V. McConnell, 2013. “The New CAFE Standards: Are They Enough on Their Own?”, *RFF Discussion Paper 13-14*, pp. 1-14 (Sections I and II; remainder is optional and less relevant for this course; link).

Lecture 21 (Apr 6): **Fuel-Economy Policy (2)**

*Topics:* unintended consequences from fuel-economy standards; cost-benefit analysis.


Lecture 22 (Apr 19): **Electricity Strategy Game Debriefing**

Lecture 23 (Apr 19): **Unintended Consequences of Transportation Policies & Course Wrap Up**

*Topics:* congestion policies; enforcement; cheating; emissions leakage; course summary.


“Day without a Daft Idea”, *The Economist*, 7/16/14 (link).

Lecture 24 (May 2): **Exam**
PRELIMINARY DUE DATES

Assignment dates

Assignment 1: posted on February 8, due by February 25
Assignment 2: posted on February 22, due by March 11
Assignment 3: posted on April 6, due by April 26

Electricity Strategy Game

March 8  Introduction to the Electricity Strategy Game in class
March 18 Bids due for the ESG test run by midnight EST
March 22  First ESG divestiture auction, in class
March 25  ESG strategies due by midnight EST for year 1, day 1
March 27  ESG strategies due by midnight EST for year 1, day 2
March 29  ESG strategies due by midnight EST for year 1, day 3
April  3   Sealed portfolio bids for year 2 due by midnight EST
April  5   ESG strategies due by midnight EST for year 2, day 1
April  8   ESG strategies due by midnight EST for year 2, day 2
April 10  ESG strategies due by midnight EST for year 2, day 3
April 19  ESG strategy memo due before class
April 19  ESG debriefing in class

Exam

The exam will be in class on May 2nd from 9-11am, location to be announced