ENERGY MARKETS AND POLICY

BEPP/OIDD 763 WEMBA (EAST)

Spring Semester 2020, Philadelphia, JMHH G50

Note: This syllabus may be updated during the semester. I will also update readings up to the first class session. 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, including an introduction to energy storage.

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 in all fairness to other students.

**Practice questions.** An extensive set of practice questions and solutions will be posted early in the semester. You can discuss them with the TA or with me if needed.

**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: [https://catalog.upenn.edu/pennbook/code-of-academic-integrity/](https://catalog.upenn.edu/pennbook/code-of-academic-integrity/).

**ELECTRICITY MARKETS**

Lecture 1 (Jan 17): **Course Introduction & Energy Overview**


Lecture 2 (Jan 17): **Market Efficiency and Scarcity Pricing**

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

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


(*) J. Mouawad, “Oil Refiners See Profits Sink as Consumption Falls”, *New York Times*, 5/14/08 ([link](https://www.nytimes.com/2008/05/14/business/energy-environment/14mouawad.html)).
(*) C. Krauss, “Oil Refining’s Fortunes Rise”, *New York Times*, 10/24/12 ([link](#)).


Lecture 3 (Jan 18): **Market Power in Electricity Markets (1)**

*Topics*: market power; deregulation.


Lecture 4 (Jan 18): **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 (Jan 31): **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 (Jan 31): **Oil and Natural Gas Extraction and Pricing (2)**

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


Lecture 7 (Feb 1): **Upstream Investment under Uncertainty**

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


**ENERGY AND ENVIRONMENTAL POLICY**

Lecture 8 (Feb 1): **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 14): Externalities and Policy Instruments

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”.

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


Lecture 10 (Feb 14): Cap-and-Trade

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

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


Lecture 11 (Feb 15): Designing Real-World Environmental Markets

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


Lecture 12 (Feb 15): U.S. and Global Policy Developments & Introduction to the Electricity Strategy Game

Topics: 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).


Lecture 13 (Feb 28): Electricity Strategy Game Auction & International Environmental Agreements

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


THE ECONOMICS AND FINANCE OF RENEWABLE ENERGY

Lecture 14 (Feb 28): The Economics of Renewable Energy

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


Lecture 15 (Mar 28): **Electricity Strategy Game Debriefing**

Lecture 16 (Mar 28): **Renewable Energy Finance**

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


(*) Lecture notes on renewable energy incentives (on Canvas).


J. Brady, “Solar Firms Plan to Return to Nevada after New Law Restores Incentives”, *NPR*, 6/7/17 ([link](#)).

Lecture 17 (Apr 10): **Renewable Energy Policy**

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

(*) J. Deign, “More 'Subsidy-Free' Offshore Wind Emerges in Europe”, *Greentech Media*, 4/5/18 ([link](#)).


(*) S. Mundy, “India’s Renewable Rush Puts Coal on the Back Burner”, *Financial Times*, 1/1/19 ([link](#)).

A. Swanson, “To Protect U.S. Solar Manufacturing, Trade Body Recommends Limits on Imports”, *New York Times*, 10/31/17 ([link](#)).

**TOPIC: TRANSPORTATION POLICY**

Lecture 18 (Apr 10): **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 19 (Apr 17): **Fuel-Economy Policy (2)**

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


Lecture 20 (Apr 17): **Unintended Consequences of Transport Policies & Course Wrap Up**

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


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

Lectures 21-22 (May 1): **Exam**
PRELIMINARY DUE DATES

Assignment dates

Assignment 1: posted on January 31, due by February 17
Assignment 2: posted on February 21, due by March 9
Assignment 3: posted on April 10, due by April 24

Electricity Strategy Game

February 15  Introduction to the Electricity Strategy Game in class
February 24  Bids due for the ESG test run by midnight EST
February 28  First ESG divestiture auction, in class
March 3     ESG strategies due by midnight EST for year 1, day 1
March 5     ESG strategies due by midnight EST for year 1, day 2
March 7     ESG strategies due by midnight EST for year 1, day 3
March 10    Sealed portfolio bids for year 2 due by midnight EST
March 12    ESG strategies due by midnight EST for year 2, day 1
March 14    ESG strategies due by midnight EST for year 2, day 2
March 17    ESG strategies due by midnight EST for year 2, day 3
March 28    ESG strategy memo due before class
March 28    ESG debriefing in class

Exam

The exam will be in class on May 1 from 9:30-11:30am in JMHH G50