Energy and Environment

New York University, Stern School of Business
B30.2105, Spring 2017
Syllabus

Instructor: Vignesh Gowrishankar, Adjunct Associate Professor, NYU Stern School of Business; Associate Director, Energy & Transportation, Natural Resources Defense Council (NRDC); vgowrish@stern.nyu.edu or vgowrishankar@nrdc.org

Teaching Assistant: TBD

Lectures: Monday, 6:00 to 9:00 pm in first half of semester (on February 6, 13, 27, and March 6, 20, 27)

Credits: Economics elective, 1.5 credits

A. Course Overview
This course is designed to give students an overview of the economics and policy landscape of the inter-related fields of energy and the environment, as we find ourselves at an energy crossroads. It will draw on the instructor’s diverse experiences, readings and other media, hands-on project(s), and classroom discussions, to explore and debate the salient drivers that will shape our energy future. The course will cover six main themes: (1) implications of growing energy consumption on the environment; (2) basic and emerging concepts related to energy demand and supply (e.g., demand elasticity, demand response, shale boom, electricity markets); (3) value chains of different energy resources (e.g., market barriers, cost evolution, incumbents, VCs); (4) policies and how they drive energy economics and markets; (5) emerging market mechanisms (e.g., solar financing, EV charging) that are building on falling costs and advancing technology to establishe new energy products and services; and (6) security and global implications of energy.

B. Course Objectives
The course has the following objectives:

- Provide an overview of the energy needs, challenges and opportunities that lie ahead of us, especially in the context of climate change.
- Debate and critique the environmental implications of traditional and new/emerging energy solutions, via classroom discussions and student projects.
- Equip the students with an appreciation of today’s energy system and our future energy and environmental needs, as they take the next step in their careers.
C. Grading

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<tr>
<th>Type</th>
<th>Description</th>
<th>% of Final Grade</th>
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<tr>
<td>Participation, Discussion and Reflection</td>
<td>Come prepared to actively engage in the classroom conversation of the day’s topics, by discussing the background readings, asking probing questions, connecting to energy news etc. To encourage adequate preparation and stimulate your in-class participation, you may for example be called upon to summarize your reflections of background readings; alternatively, for certain topics, you may be asked to submit a short written reflection or a short survey.</td>
<td>40%</td>
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<tr>
<td>Group Project and Paper/Presentation</td>
<td>You can form groups of 3-5 to work together on a chosen topic. (Exceptions can be made for fewer or more students.) You will have broad latitude to select from roughly 10 topics as per the course outline below (second column). You will be able to define the scope of your project, although some ideas will be provided as well. You will be required to define a problem statement, analyze the challenges and potential solutions, connect related economics concepts to energy and environmental issues, and develop recommendations. You are also encouraged to use the models that will be introduced in the first class (or other similar ones) to help with your analyses. The group will be able to either submit a concise paper or make a presentation.</td>
<td>40%</td>
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<tr>
<td>Essay</td>
<td>Each student will be required to submit one essay that answers the intentionally provocative question: What are the five best policies and/or other actions that will address climate change, and what are your arguments in this regard? Again, using the models and their results is strongly encouraged. Feel free to be creative and have fun, without going overboard!</td>
<td>20%</td>
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D. Grading Policy
Assessments will be done on an individual basis as pertaining to class participation and the essay. The entire group will be assessed collectively for the group project; each student is expected to contribute equally and free-ridership is strongly discouraged and will be accounted for as appropriate. Each item will be scored on a scale of 1-10 and weighted accordingly. The group project and essay submissions will have deadlines that will be determined during class. Late submissions will incur a penalty, and after a final deadline will receive no score.

E. Course Materials
There is no textbook. For each class there will be a small and manageable number of required readings (which will be specified closer to the classes), and extra suggested readings for those interested in exploring further. Almost all readings will be available through the course website or online. These have been chosen to primarily provide you with sufficient background for the topics to be discussed in class. As such, please use your judgment in reading them: if very long or technical feel free to skim them and focus on the summaries/conclusions; if short or presented simply give them a good read. In any case, please try to get a sense of the basic issues and nuances in the readings, which will prepare you for the class discussions.
F. Course Outline

Given the rapidly changing nature of energy issues, the course outline, syllabus and course materials will inevitably evolve, even during the semester. Any changes will be announced with adequate notice. Nonetheless, the outline provided below should give you a good sense of both the topics that will be covered and likely readings. Guest speakers may also be invited.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic title (concepts in italics)</th>
<th>Main list of issues covered</th>
<th>Background Readings (few required readings + extra suggested readings)</th>
</tr>
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</table>
| Wk 1, Part a | Climate Change - carbon budget - tradeoffs | • The climate problem  
• Ocean acidification  
• Solution pathways and tradeoffs  
• Need for emissions reduction  
• Models: carbon accounting, DICE | o “The Stern Review: The Economics of Climate Change”, Nicholas Stern, 2006 – Executive Summary only  
  o “Climate Change 2014, Synthesis Report”, IPCC, 2014 – Summary for Policymakers only  
| Wk 1, Part b | Social Cost of Carbon and Externalities - externalities - cost-benefit - discount rate | • Climate externalities  
• Elements of social cost  
| Wk 2, Part a | Energy Demand Basics - demand elasticity - consumer behavior | • Overall energy market and trends  
• Demand elasticities  
• Energy efficiency  
• Demand response  
• Oil use, oil price  
| Wk 2, Part b | Energy Supply Basics - supply curves - price drivers - elasticity (substitution) | • Cost of different energy sources  
• Electricity markets  
• Natural gas prices  
  o “There Will Be Oil”, Daniel Yergin, Wall Street Journal, 17 September 2011  
  o “State of the Market Report for PJM”, Monitoring Analytics LLC, 10 March 2016 – pages 1 to 9 |
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| Wk 3, Part a | Transforming Our Energy Mix - technology lifecycle - market barriers - time horizons | • Lifecycle stage of major energy sources  
• Technology barriers: innovation, R&D, VCs  
• Market adoption barriers  
• Status of “new” energy sources  
• Utility sector landscape  
• Oil and gas sector landscape  
• Stock turnover  
• Short-term outlook vs. long-term needs | o “The Power of Change”, National Academies of Sciences, Engineering, and Medicine, 2016, at [http://www.nap.edu/21712](http://www.nap.edu/21712) – Chapter 2  
| Wk 3, Part b | Policies to Drive Markets 1 – Pricing Carbon - market efficiency - policy pros, cons | • Pricing carbon as foundational solution  
• Carbon tax: features  
• Cap & trade: features  
• Waxman Markey  
| Wk 4 | Policies to Drive Markets 2 – “Traditional” Policies - cost-benefit - mandates - market barriers - business models - incentives - supplier behavior | • Framework for policy intervention  
• Fossil-fuel subsidies  
• Renewable portfolio standards  
• Tax Credits (ITC, PTC)  
• Net metering vs. alternatives  
• Fuel efficiency standards  
• Energy efficiency programs, incentives  
• Cost tests  
• Loan guarantee | o “Cap 2.0: Policy Solutions for Curbing Global Warming and Building the Clean Energy Economy”, NRDC, 2009  
o Select case studies (suggested later) |
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| Wk 5 | Policies to Drive Markets 3 – Emerging Policies and Market Mechanisms - business models - aligning incentives - regulatory reform | • New utility rate structures  
• The “duck curve”  
• Value of solar  
• Community solar  
• New financing approaches, yieldcos  
• Electric vehicle pilots  
• Urban sustainability  
o “Teaching the “Duck” to Fly (Second Edition)”, Jim Lazar (Regulatory Assistance Project), February 2016  
o “The Economics of Battery Energy Storage”, Rocky Mountain Institute, October 2015  
o “The Economics of Demand Flexibility”, Rocky Mountain Institute, August 2015  
o Select case studies (suggested later) |
| Wk 6, Part a | Energy Security - system shocks - energy security - energy resiliency - market power - elasticity | • Macroeconomic energy security; energy crisis  
| Wk 6, Part b | Global Considerations - tradeoffs - tailored solutions | • UNFCCC  
• Paris Agreement  
• Global development vs. climate change  
• Energy poverty  
• China and its prospects  
• India and its prospects | o “The Paris Agreement on Climate Change”, NRDC, December 2015  

### G. Acknowledgments
Some of the readings and course ideas are based on the outline of the course offered last year by Gernot Wagner (formerly full-time with EDF), as well as a renewable energy course offered by Nathanael Greene (NRDC) at Columbia University. I would like to also thank a large number of authors and researchers for making many of their resources publicly available.