E.J. Bloustein School of Planning and Public Policy, Rutgers University

Energy Sustainability and Policy

SYLLABUS AND STUDY GUIDE

Instructor: Frank Felder, PhD

Thursdays 9:50 to 12:30
Spring 2016
Classroom: Civic Square Building (CSB), Room 113

I. Instructor Contact Information

Civic Square Building, Room 249
Telephone: 848 932 2750
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Instructor Background: http://bloustein.rutgers.edu/felder/
Center for Energy, Economic and Environmental Policy, http://www.policy.rutgers.edu/ceeep/

Office hours: Thurs 9-9:50 and 12:30-1:30 or by appointment

II. Course Objectives

Familiarize students with the major issues associated with sustainable energy policy, planning and markets, and develop their abilities to conduct energy related studies and assess their economic, environmental and social implications.

Students from all departments and programs are welcome. No formal perquisites required. Previous courses in microeconomics, environmental policy, and energy engineering are helpful but by no means necessary.

III. Course Description

Energy sustainability is a critical component of state, national and international public policy and planning. Issues surrounding the reliability and security of energy supplies directly affect domestic and foreign policy, as well as environmental, economic development and land use concerns. Moreover, the policies, strategies, and programs adopted by both the public and private sectors will directly impact upon our lives as professionals, members of a community, and our families. This graduate seminar will examine energy sustainability and policy through a timely, critical and practical approach designed to give students an insight into the factors that shape energy policy.

This class will be conducted as a mixture of lectures, classroom discussion, and individual meetings with the instructor. Major topic areas include energy technologies, the design and operation of
energy markets, environmental issues, energy planning, and the components of a holistic energy policy.

IV. Required and Recommended Readings

Required and recommended readings are either available on the internet or on the course’s Sakai website https://sakai.rutgers.edu/portal

The text for the seminar is Sustainable Energy – without the hot air by David JC MacKay (hereafter MacKay) and is available for free at: http://www.withouthotair.com/download.html

V. Academic Integrity

All members of our community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain advantage not given to all students is dishonest, regardless of whether the effort is successful. A violation of academic honesty is a breach of trust, and will result in penalties, including possible suspension or expulsion. When in doubt about plagiarism, paraphrasing, quoting, or collaboration, consult the course instructor. Please see: http://academicintegrity.rutgers.edu/academic-integrity-at-rutgers/ for further information.

VI. Students with Disabilities

Students with disabilities are encouraged to contact the instructor so that appropriate accommodations can be made. See also https://ods.rutgers.edu/ for more information.

VII. Grading

Energy Log (15%)

The draft and final energy log should be accompanied with a 1 to 2-page summary of your direct energy usage, supporting detailed calculations of energy costs, and carbon dioxide emissions over a one week (seven-day) period, description of your key assumptions, your methodology, presentation of high-level numerical results, and 3-5 bullets of key take-always. It should include transportation, heating, cooking, and electricity. Be very sensitive to the use of decimal points and significant figures (https://en.wikipedia.org/wiki/Significant_figures).

Your log should include some analysis of uncertainty. You need to include readable tables and charts to support your points. The log should be organized, easy to understand, contain appropriate units, and all calculations should be transparent and supported with references and key assumptions. Students will submit a draft energy log and then a final one. Comments will be provided on the draft log, but only the final log will be graded.

Draft Energy Log due February 9th in class, hard copy.
Final Energy Log due March 2nd, in class, hard copy.

Memos (2 memos, 15% each for a total of 30%)
Each memo should be in a professional format, carefully written without any grammatical errors, direct, to the point, and key points supported with data and solid reasoning. Late memos will not be accepted. Where appropriate, leverage readings, class lectures and discussions. Memos must be handed in at the start of class (no emails or electronic copies).

Memo #1 due February 23rd, in class, hard copy.  
Memo #2 due April 6th, in class, hard copy.

Case Study (20%)  
Team based case study requiring presentations, inter-team negotiation, and integration of policy content with process. See Section VIII Schedule of Classes and Assignments for April 13, 20 and 27th for specifics including specific assignments and due dates.

Final Exam (25%)  
Cumulative exam based upon the readings, lectures and class discussions. Questions listed in the syllabus (including discussion questions) are a good starting point for preparing for the exam. A sample exam will be distributed several weeks before the final exam.

Final Exam, May 4th, 9:50 to 12:30, in class, closed book and notes in our classroom, Room 113.

Discussion Group Note Taking (see below), Class Participation and Attendance (10%)  
Students will also be evaluated as part of the discussion groups (see below), class participation, and attendance. Students must schedule at least one 10-minute meeting with the instructor during office hours during the semesters.

Discussion Synopsis: Each student must submit one discussion summary over the course of the semester with in twenty-four hours of the completion of the relevant class.

VIII. Schedule of Classes and Assignments

The reminder of this syllabus and study guide is the class-by-class plan. For each class, there is a list of questions pertaining to that course. Students should answer these questions for each class meeting but do not submit them. Some of the answers will come from the assigned reading and some from the class lectures and discussions. In some cases, students may have to conduct some additional research to answer them.

Students should prepare for the class discussion topic identified for each class. Students will be divided into small discussion groups to explore their views and then the whole class will reconvene to compare the findings and reasoning of the discussion groups. Class lectures and readings should be incorporated into the discussions.

Each small discussion group will have a note taker that will summarize the discussion, its findings, policy recommendations, and different positions. The note takers will alternate through the semester. The synopsis should be submitted to the instructor within twenty-four hours from the end of the relevant class.
January 19: Class Overview, Introduction and Major Energy Trends

KEY WORD: OBJECTIVES

QUESTIONS

1. What are some different definitions of energy sustainability?
2. How is energy sustainability quantified and measured?
3. What are different objectives that energy policy and planning try to accomplish?
4. What are the different types of energy policies that are employed in the U.S.?
5. How are these various objectives measured and quantified?
6. What are the values underlying these objectives?
7. Can these different objectives be combined into a single objective? Why or why not?
8. What is the difference between a final objective and a means objective?
9. What is the difference between a substantive objective and process objective?
10. What is meant by the public policy and planning process in the context of energy?

CLASS DISCUSSION

For the purposes of energy policymaking and planning, what should be the definition of energy sustainability and why?

DUE

2. Reach Our Common Future (Brundtland Commission Report, 1983) Chapter 1, Section 3 (Sustainable Development, paragraphs 27-30) and Chapter 7 available on Sakai
3. From a web search, find three different definitions of energy sustainability.
January 26: Energy Trends, Technologies and Implications, Part 1

KEY WORD: SCALE

QUESTIONS

1. What are the major trends in oil and natural gas pricing and availability?
2. What is meant by scale?
3. Why is scale important in energy policy?
4. What does the term *economies of scale* mean? Why is it important in energy planning and policy?
5. What are the major units of energy production/consumption?
   a. What are the units for electricity?
   b. What are the units for oil?
   c. What are the units for natural gas?
   d. What units are used for national energy amounts across all fuels?
6. Which units measure a stock versus a flow?
7. Why is the distinction between stocks and flows important?
8. What are energy flow diagrams?
9. What is an energy balance sheet?
10. What is the difference between wholesale energy and retail energy markets?
11. What are the different technologies used to produce electricity?
12. What are the major uses of oil, natural gas, and electricity?
13. What are sunk costs, fixed costs, and variable costs related to energy infrastructure?
14. What are some examples of construction costs, operating costs, and decommissioning costs related to energy infrastructure?

CLASS DISCUSSION

What criteria would you propose that policymakers and planners use to conduct technological assessments of energy technologies related to transportation and why?

DUE

1. Read Chapters 1-9 of Part I of MacKay
February 2: Energy Trends, Technologies and Implications, Part 2

KEY WORD: UNITS

QUESTIONS

1. How do you convert from one unit to another?
2. How many barrels of oil does the world use a day? The U.S.?
3. What percentage of the U.S.’s electricity comes from coal, natural gas, nuclear, hydro, and renewables?
4. How much carbon dioxide does the world release a year? The U.S.? China?
5. What is concentration of greenhouse gases in the atmosphere in 2016?
6. What is the annual growth rate in energy demand for the U.S. and China?
7. What are the different types of air emissions associated with the use of fossil fuels and what are the units?

CLASS DISCUSSION

What should be included your energy log and why? What, if anything, should energy planners and policymakers take away from tracking your energy usage? What are ways to make your energy log transparent and easy to understand? How can your energy log also be used as a tracking and monitoring tool to evaluate the impacts of your energy usage?

DUE

1. Read Chapter 10-18 of Part I of MacKay
2. Begin working on your energy log. See the last page of this syllabus for more information.
February 9: Energy Trends, Technologies and Implications, Part 3

KEY WORD: TECHNOLOGIES

QUESTIONS

1. What are the major fuel sources that the world uses?
2. Which fuel sources are used for which energy uses and sectors (electricity, transportation, heating, residential, commercial, industrial)?
3. What is an energy flow diagram?
4. Which technologies can be used to make electricity?
5. What are the technological changes that are affecting the electric power system?
6. What are the pro’s and con’s of each of the technologies that make electricity?
7. What does the statement mean that electricity is an energy carrier not an energy source?
8. What is meant by the term “intermittency” and why is this important?
9. What is geoengineering and what are several examples?
10. What is meant by the hydrogen economy?

CLASS DISCUSSION

List ten different energy policies and develop a taxonomy to categorize them that will assist energy planners and policymakers? Make sure at least four involve an energy component of transportation.

DUE

1. Read Felder and Haut, Balancing Energy Alternatives on Sakai
2. Read U.S. Electricity Industry Primer, July 2015, US DOE, on Sakai
4. Energy Log: Submit DRAFT energy log of your direct use of energy. Your log should be legible, self-explanatory, define all abbreviations, provide key formulas and assumptions, and contain references/explanations for each assumption.
February 16: Energy Analysis, Part 1

KEY WORD: SYSTEMS

QUESTIONS

1. What is a definition of a system?
2. Why is the concept of systems important in energy policy and planning?
3. What are examples of energy systems?
4. What is feedback? What are positive and negative feedbacks?
5. What does time step or time scale mean?
6. Why is the definition of system boundary important for energy planning and policy? What is an example?
7. How do stocks and flow interact in a system? What is an example?
8. What is the Global Energy System?
9. How does the political process affect the Global Energy System?
10. How can the various political processes (legislative, executive, and legal; federal and state) interact in the context of energy policy and planning?

CLASS DISCUSSION

What are three possible energy system interactions that may result in unintended consequences and how should energy planners and policymakers anticipate them? Make sure at least one involves transportation.

DUE

1. Read Felder, Climate Change Mitigation and the Global Energy System, paper available at http://digitalcommons.law.villanova.edu/cgi/viewcontent.cgi?article=1346&context=elj&sei-redir=1&referer=https%3A%2F%2Fscholar.google.com%2Fscholar%3Fstart%3D10%26q%3Dfa%2BFelder%2Benergy%2Bsystems%26hl%3Den%26as_sdt%3D0%2C31#search=%22fa%20felder%20energy%20systems%22
February 23: Energy Analysis, Part 2

KEY WORD: UNCERTAINTIES

QUESTIONS
1. What are the major uncertainties associated with energy policy and planning?
2. How can each of the following analytical tools be used to address uncertainty in energy planning and policy?
   a. Technological assessments
   b. Forecasting
   c. Risk assessment
   d. Cost-benefit analysis
   e. Decisionmaking under uncertainty
   f. Game theory
   g. Economic impacts
3. What are ways an energy analyst can address uncertainty into its analysis?
4. What is sensitivity analysis? What is scenario analysis?
5. How can energy policies and plans address uncertainty?

CLASS DISCUSSION

Using the energy policy taxonomy developed on Feb 9, identify if and how each category of energy policies account for uncertainty. How can policymakers and planners improve on them? Focus on transportation policies and plans that have a major energy component.

DUE

1. MEMO #1: For a specific example of a transportation policy related to energy, write a 600-word memo discussing possible unintended and undesirable consequences of that policy and how policymakers can prevent or reduce that consequence.
2. Read Bridges et al, Uncertainty in energy planning: Estimating the health impacts of air pollution from fossil fuel electricity generation, available on Sakai
March 2: Climate Change I

KEY WORD: SCIENCE

QUESTIONS

1. What is greenhouse effect?
2. What are the categories of evidence that supports climate change? For each category, what are several examples of such evidence?
3. What evidence questions or contradicts climate change?
4. What is the role of models in analyzing climate change?

CLASS DISCUSSION: What are different strategies that can be used to persuade people who hold different views than you on climate change? What policies, if any, should be used to do so?

DUE

1. Read John Holdren, Meeting the Climate Change Challenge, available on Sakai
3. Submit final energy log
March 9: Climate Change II

KEY WORD: EQUITY

QUESTIONS

1. What does the term regressive mean? Why are energy costs and in many cases policies, regressive?
2. How can equity be measured in the context of energy policy and planning?
3. How is the quantification of greenhouse gases by country versus by person used to advance equity claims?
4. Which countries and regions of the world are most likely to be the most adversely affected by climate change and how does that affect discussions about equity?

CLASS DISCUSSION

What policies and plans should be implemented to address the inequities due to climate change and policies designed to mitigate and adapt to climate change? How does uncertainty affect these policies and plans?

DUE:

March 23: Energy Infrastructure

KEY WORDS: INFRASTRUCTURE, NUCLEAR POWER

QUESTIONS
1. What is the definition of critical infrastructure? Which parts of the energy infrastructure is considered critical?
2. What are the major categories of the energy supply chain? What are the specifics for electricity and oil?
3. What is meant by energy density?
4. How is energy infrastructure vulnerable to severe weather and other disruptive events?
5. How much electricity does the world generation from nuclear power?
6. How much electricity does the U.S. generation from nuclear power?
7. What are the major pro’s and con’s of nuclear power?
8. What are the implications of capital-intensive sources of electricity such as nuclear power?
9. How does a nuclear power plant work?
10. What is the different between fission and fusion?

CLASS DISCUSSION

Should states craft policies to support nuclear power plants that are at risk of closing due to low wholesale electricity prices? Does the possibility of the introduction of significant numbers of electric vehicles affect this assessment? Why or why not?

DUE
2. Read Felder, A critical assessment of energy accident studies, available on Sakai
March 30: Energy Security and Markets

KEY WORDS: SECURITY, RESILIENCY AND RELIABILITY

QUESTIONS
1. What are the energy security issues related to oil in the U.S.?
2. What are the energy security issues related to natural gas in Europe?
3. What is OPEC?
4. What role does Russia have regarding energy security?
5. What is the oil curse? Also, referred to as the resource curse.
6. What is the definition of reliability? What is the definition of resiliency?
7. See questions for April 6 Class regarding energy markets.

CLASS DISCUSSION

What is the definition of energy security? Does it differ by type of fuel? Which metrics are and are not useful in measuring energy security related to oil and transportation and why?

DUE:
2. Read Executive Summary of Nicolas Stern’s report on Sakai
4. Read Felder, Examining Electricity Price Suppression Due to Renewable Resources and Other Grid Investments, available on Sakai
April 6: Energy Economics and Markets

KEY WORDS: EFFICIENCY and EQUITY

QUESTIONS
1. How does engineering efficiency differ from economic efficiency?
2. What do supply and demand curves look like on a graph?
3. What is a negative externality? What are several examples in the context of energy policy and planning?
4. What is a positive externality and what is an example in the context of energy policy and planning?
5. What is the difference between private and social costs?
6. What is a market failure?
7. What is the difference between economic efficiency and equity?
8. How does cap and trade work? What are its major components?
9. How do renewable portfolio standards work? What are its major components?
10. Why do economists emphasize the importance of putting a price on greenhouse gases and what are the two major ways to do that?
11. What is Pareto efficiency?
12. What is Kaldor-Hicks efficiency?

CLASS DISCUSSION

Economists frequently invoke the Kaldor-Hicks concept that a policy’s efficiency gains can be used to address distributional impacts that it may cause. Identify 2 desirable transportation policies that have negative distributional impacts. How should policymakers and planners adjust these two policies to temper these negative distributional impacts?

For the final 10 minutes of class, the case study teams will be formed and meet to review the case study requirements and get organized.

DUE

1. Read FERC ENERGY Primer: A Handbook of Energy Market Basics, Nov. 2015, Chap. 4-6
2. MEMO #2: Submit 600-word memo on regarding whether NY should provide financial support to existing nuclear power plants.
April 13, 20, and 27: Case Study – New Jersey 2050 Transportation Master Plan (TMP)

The class will be divided into three groups, representing the NJ Dept. of Environmental Protection, the NJ Board of Public Utilities, and the NJ Dept. of Transportation.

Collectively, these three groups will form a NJ Transportation Task Force and work together to arrive at a NJ Transportation Plan that satisfies the NJ Global Warming Response Act, which requires that by 2050, greenhouse gas emissions be reduced by 80%.

The group must agree to a plan that satisfies the mandates of each of the three agencies. The plan will be in the format of a detailed presentation (not a full blown, written out plan).

The TMP should contain the following major elements:

1. A business as usual (BAU) case including underpinning assumptions. What would happen without the TMP? What would be the key parameters and metrics (vehicle miles travelled, emissions, costs, usage of the types of transportation modes, etc.). The BAU case should account for existing federal transportation policies.
2. The components (legislative, regulatory, etc.) of the TMP. What would happen if the TMP is implemented?
3. Uncertainty analysis.
4. Funding mechanisms.
5. Discussion of key issues that cannot be quantified.
6. Implementation schedule.
7. Evaluation and tracking plan to ensure that the plan is being implemented on schedule and that its impacts are being assessed and feedback into updates to the plan.

April 13: Group Meetings

Each group meets individually for an hour to identify what their organization’s scope and mandate are relative to this task, identify the key outcomes that they want to achieve as part of the Transportation Task Force, and conduct research related to their organization’s role and past efforts in preparation for the Task Force meetings.

The three groups meet collectively as the Transportation Task Force to develop and assign tasks to prepare the NJ Transportation Master Plan.

DUE

1. Each team will submit to the instructor by the close of business on April 13 a list of 4-6 outcomes that they want to see in the NJ Transportation Master Plan along with 2-3 sentences describing their negotiation strategy. The teams desired outcomes and negotiating strategies should be kept confidential and not shared with other teams.

April 20: Transportation Task Force Meeting
Transportation Task Force will meet to continue to work on the NJ Transportation Master Plan.

DUE

1. By close of business on April 20th, the Task Force will submit its draft plan in presentation style to the instructor.
2. During the period of April 20-27, the Task Force will continue to work on its final presentation.

April 27: Final Presentation, Negotiation Strategies, and Course Wrap-up

DUE

1. The Task Force will present for 1.5 hour its proposed NJ Transportation Master Plan. Each person will present some portion (roughly equal in time) of the plan. After a 10-minute break, there will be a period of 30 minutes of Q&A.

2. One hard copy of the presentation will be provided to the instructor at the start of the presentation.

May 4 (Finals Week – 9:50 to 12:30, Room 113)

Closed book, in class exam.