Econ 444 Syllabus | Burkhardt, Spring 2019
MWF 1:00-1:50 pm | Room BHSCI 105

Economics of Energy Resources

Instructor: Jesse Burkhardt
Email: jesse.burkhardt@colostate.edu
Office Hours (B-311): Mondays 2:00-3:00 and by appointment
Class Meeting Times: Mon, Wed, Fri 1:00-1:50
Class Location: BHSCI 105

Description:
This course uses microeconomic techniques to rigorously examine contemporary environmental, energy, and climate issues. The course consists of four main sections. First, we will discuss electricity markets including electricity supply and demand, producer competition, and regulation and deregulation. Students play a month long strategy game in which they own electricity producing firms and bid supply functions to an Independent Systems Operator. Through the game students will recreate the California energy crisis of 2000 and learn how economic competition was a contributing factor. Second, we will discuss oil and gas markets including optimal oil extraction rates, oil and energy security and externalities, peak oil, and oil price volatility. Students will play a second game in which they will act as oil producing countries supplying oil to a global oil market. Third, we will discuss energy externalities including carbon and climate change. We will work with a simplified Integrated Assessment Model to estimate the social cost of carbon and identify the key assumptions in the model that affect the social cost of carbon estimates. Finally, we will cover energy efficiency, behavioral interventions to encourage efficiency, and renewable energy policies.

This course is designed for economics majors, agriculture and resource economics majors, and upper level undergraduates interested in exploring energy markets and energy and climate policies from an economics perspective. As such, intermediate microeconomics is a prerequisite. Graduate students are also welcome to take the course and will be given additional reading.

Course Objectives:
- Use economic tools to describe the production and consumption of energy.
- Be able to apply economic models of competition to energy markets.
- Apply the tools of economics to assess contemporary issues in energy economics and policy.
- Be able to articulate how energy contributes to the climate change discussion and articulate an opinion on the determinants of climate change policy.
- Be able to articulate the methodology for estimating the Social Cost of Carbon.
- Demonstrate writing and research dissemination skills through work on group projects and class presentations.

Student Learning Outcomes
Professional Development: Graduates will embody a general awareness of issues in agricultural and natural resource management and their implications in a larger societal context. Students will

begin to develop a network of personal and professional connections which will foster an understanding of the culture surrounding professional expectations and conduct.

Communication Skills: Graduates will demonstrate proficiency in oral and written communication in terms of substance, organization, mechanics, documentation, and synthesis. Proficient students will have the ability to clearly communicate findings, critically and analytically, at a professional level within their chosen career.

Leadership: Graduates will have developed leadership qualities that they will use in their professional, personal and community interactions leveraging the other competencies acquired in the program. These leadership qualities include vision, initiative, personal responsibility, team building, and motivating collective action.

Problem-solving Skills: Graduates will demonstrate the ability to solve real-world problems beyond the context of the classroom. Students will be able to identify a problem and its scope, evaluate resources available to address the problem, formulate alternative solutions, and select the solution(s) most consistent with a stated objective.

Readings:

There is no required textbook for this course. The readings will come from content made available through Canvas. The readings that are required for a give class are indicated on the course schedule and will be announced in class. All documents, including the course schedule and problem sets, and exams will be posted on Canvas.

Helpful Texts:

Bhattacharyya, Subhes. 2011. *Energy Economics: Concepts, Issues, Markets and Governance*. Springer-Verlag. (hereafter Bha)

Keohane, Nathaniel and Sheila Olmstead. 2007. *Markets and the Environment*, Washington, DC: Island Press. (hereafter KO).

Grading:

- Participation and bids for strategy games (15%): I expect students to attend every class, have completed the assigned readings, and prepare to contribute. Your participation in class is highly valued!

- Problem Sets and Homeworks (20%): Through week 10 there will be a problem set or homework due approximately every other week. You are allowed to work on the assignments in groups but your work must be your own. If you work in groups, please turn in one assignment per student with your name printed on top. Assignments will be due at the beginning of class and late assignments will be assessed a 10 point reduction for each day late. Problem sets will be a mixture of traditional economic problems involving math and graphs combined with short answer questions about the readings or policy issues, for example.

- Midterm (15%): There will be one midterm. The exams will include short answer and essay questions related to the problem sets, readings and lectures. If you have a medical excuse or family emergency and cannot attend an exam, you must let me know at least 48 hours in advance and provide proper documentation.

- Final (10%): The final exam will be comprehensive and feature short answer and essay questions. The exam will take place during the exam period. There are no early or make up exams given with exceptions for University approved activities or documented illness or family emergencies. A student arriving late to an exam session will be allowed to take the exam in the remaining time, so long as the student does not arrive after other examinees have left. In case of documented illness, family emergency or university-excused absence, you may reschedule an exam within 5 days (+/-) of the exam date. Any student who wants to challenge the validity of a test answer, and who is not satisfied with the instructor's preliminary explanation, may submit in writing the reason(s) a disallowed answer might be considered correct within one week of receiving that exam back.

- Final Paper (20%): Each student will be responsible for writing a 5 page paper, Times New Roman font, size 12, double spaced. The topic of the paper is the Social Cost of Carbon (SCC). You can relate the content from the first half of the class to the SCC or discuss the estimation of the DICE model and key assumptions, for example. Most importantly, I want you to show your understanding of how the SCC is calculated using IAMs and why it is important for energy policy.

- Group Presentations and Simulations of the DICE model (20%): Second half of the semester (weeks 11-16): The remainder of the semester focuses on Integrated Assessment Models. Students will be given a simplified version of the DICE model. Students will be split into 4 groups that will explore the DICE model and its key assumptions. Each group will be assigned a key assumption in the DICE model: 1) discount rates, 2) climate sensitivity, 3) damage functions, and 4) catastrophic events. Each group will lead a group discussion around their topic. This will last approximately 4 class sessions. Finally each group will run the DICE model with adjustments based on the discussions in class. The groups will calculate the SCC for each run of the model and discuss the implications of their adjustments for the SCC estimates. Presentations will be marked on their clarity, depth of understanding shown, and quality. It is expected that each member of the group will speak during the presentation.

Academic Integrity: This course will adhere to the CSU Academic Integrity Policies and Guiding Principles as found in the General Catalog and the Student Conduct Code. At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services. If you have any questions about what is permissible, please ask or visit http://tilt.colostate.edu/integrity/

CSU Honor Pledge: Academic integrity lies at the core of our common goal: to create an intellectually honest and rigorous community. Because academic integrity, and the personal and social integrity of which academic integrity is an integral part, is so central to our mission as students, teachers, scholars, and citizens, I will ask that you affirm the CSU Honor Pledge as part of completing your work in this course.

Resources for Disabled Students

Students with disabilities may be eligible for accommodations in accordance with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act. It is the students responsibility to disclose any learning disabilities. Please contact the instructor if a special accommodation is required. To request accommodations, students should contact Resources for Disabled Students at (970) 491-6385 or go to http://rds.colostate.edu. Documentation of disability is required and the RDS office will assist in this process.

In-Class Learning Environment

As an educator, it is my professional responsibility, and as a faculty member, it is a Colorado State University requirement that I control the conduct of this class to provide an environment in which all students can learn to the best of their ability. Therefore, I will not tolerate any form of disruptive or obstructive in-classroom behavior during the class meeting time by any enrolled students or other persons attending any class meetings. Therefore, please refrain during class from carrying on conversation while the instructor or any student, or invited guest, is speaking to the entire class. Also, if you must occasionally arrive to class late or leave early, please enter and leave in as non-disrupting manner as possible. It would be an expected courtesy to inform the instructor before class that you must leave early.

If anyone enrolled in this class is bothered by any distracting behavior of the instructor or any student(s) to the extent that it is inhibiting your learning during scheduled class meetings, please let me know immediately. Also, if you are physically or otherwise learning disabled, please let me know how I may best accommodate you and help you achieve maximum possible learning in this course.

Attendance is an expectation for all students. A positive relationship exists between class attendance and performance in this course. All of your assignments rely heavily on material and discussion covered in class as well as assigned chapters. Coming regularly to class will have a positive effect on your overall grade. Questions, comments, and active discussion are always encouraged and will make class sessions more interesting and exciting for all. If you are having problems with the course, please talk with me about those problems. The sooner you come for help, the better. I want you to succeed as much as you do.

Principles of Community

The Principles of Community support the Colorado State University mission and vision of access, research, teaching, service and engagement. A collaborative, and vibrant community is a foundation for learning, critical inquiry, and discovery. Therefore, each member of the CSU

community has a responsibility to uphold these principles when engaging with one another and acting on behalf of the University.

- **Inclusion:** We create and nurture inclusive environments and welcome, value and affirm all members of our community, including their various identities, skills, ideas, talents, and contributions.
- **Integrity: W**e are accountable for our actions and will act ethically and honestly in all our interactions.
- **Respect**: We honor the inherent dignity of all people within an environment where we are committed to freedom of expression, critical discourse, and the advancement of knowledge.
- **Service**: We are responsible, individually and collectively, to give of our time, talents, and resources to promote the well-being of each other and the development of our local, regional, and global communities.
- **Social Justice:** We have the right to be treated and the responsibility to treat others with fairness and equity, the duty to challenge prejudice, and to uphold the laws, policies and procedures that promote justice in all respects.

Mental Health Statement: Need Help?
CSU is a community that cares for you. If you are struggling with drugs or alcohol and/or experiencing depression, anxiety, overwhelming stress or thoughts of hurting yourself or others please know there is help available. Counseling Services has trained professionals who can help. Contact 970.491.6053 or go to http://health.colostate.edu. If you are concerned about a friend or peer, tell someone at by calling 970.491.1350 to discuss your concerns with a professional who can discreetly connect the distressed individual with the proper resources (http://supportandsafety.colostate.edu/tellsomeone). Rams take care of Rams. Reach out and ask for help if you or someone you know is having a difficult time.

Sexual Assault and Violence Elimination
CSU's Student Sexual Harassment and Violence policy, following national guidance from the Office of Civil Rights, requires that professors follow CSU policy as a "mandatory reporter" of any personal disclosure of sexual harassment, abuse, and/or violence related experiences or incidents shared with the professor in person, via email, and/or in classroom papers or homework exercises. These disclosures include but are not limited to reports of personal relational abuse, relational/domestic violence, and stalking. While professors are often able to help students locate appropriate channels of assistance on campus (e.g., see the CSU Health Network link below), disclosure by the student to the professor requires that the professor inform appropriate CSU channels to help ensure that the student's safety and welfare is being addressed, even if the student requests that the disclosure not be shared.

For counseling support and assistance, please see The CSU HEALTH NETWORK, which includes a variety of counseling services that can be accessed at: http://www.health.colostate.edu/. And, The Sexual Assault Victim Assistance Team is a confidential resource for students that does not have a reporting requirement and that can be of

great help to students who have experienced sexual assault. The web address is http://www.wgac.colostate.edu/need-help-support .

Finally, if there is anything you would like me to know about you, please do not hesitate to tell me. If you are having trouble in the class, please come tell me as soon as possible so that we can work together to keep you on track.

COURSE SCHEDULE AND EXPECTED READINGS

Week	Topic	Readings
Part 1: Electricity markets and economic competition		
1	Introduction to Energy Economics and Electricity Markets.	
2	Production, distribution, and consumption of electricity. Electricity producer cost curves. What are the key issues in electricity markets? Begin electricity markets strategy game.	Griffin & Puller primer on electricity markets (Book chapter); United States Electricity Industry Primer (DOE);
3	Discuss market structure and deregulation. This section will introduce the idea of economic competition. I will outline the differences between perfect competition, monopoly, and oligopoly and use case studies of energy markets to explain why energy markets are not perfectly competitive. We will solve for the oligopolists optimal output and use.	Borenstein California Electricity Crisis; Borenstein Bushnell, Restructuring
4	We will look at the California Electricity Crisis of 2000. Case studies of market deregulation and how it has affected production and prices of energy. Learn how economists estimate market power. **Rawhide power plant tour.**	Puller 2007; Borenstein, Bushnell, Wolak 2002;
Part 2: Oil markets		
5	Introduction to oil markets. Pricing exhaustible resources, Hotelling rule, peak oil, and fracking. Begin OPEC strategy game. The "Green Paradox:" Can environmental policy lead to more pollution?	Keohane and Olmstead CH 6;
6	Oil externalities including energy independence and energy security; The oil price premium; Peak oil: does it exist and should we be worried?	Nordhaus Oil Market Speech; Dan Yergin Foreign Affairs on Energy Security. Brown and Huntington,
7	Oil price volatility: what drives oil price fluctuations and is it predictable? What countries have control over oil prices?	Baumesiter Kilian 2015. Kilian AER
8	Discuss OPEC game. Review for Midterm. In class midterm on Friday.	
9	Spring Break	
Part 3: Energy Externalities; Climate Change Economics; Energy Policy		
10	Energy externalities. Economically efficient policies and cost effective policies for addressing emissions. The Clean Air Act and local emissions regulation. Cost Benefit analysis.	Keohane and Olmstead CH on efficiency; Loomis Haefele BC of Fracking Ecol Econ 2017;

11	Climate Change 1: Introduction to the economics of climate change and integrated assessment models. What role does economics play in climate change policy? In class practice with DICE model.	Stern Lecture 2008; Nordhaus Climate Casino Ch ?; Nordhaus JAERE (2013) for an intro to DICE
12	Climate Change 2: The Social Cost of Carbon and its key assumptions such as the discount rate. Critiques and Arguments in favor of the Social Cost of Carbon. **Student presentations/discussions on discount rates.**	Greenstone et al. on Social Cost of Carbon; Nordhaus JAERE (2013) second half on critiques of SCC; Nordhaus Tail Events
13	Climate Change 3: Assumptions of IAMs. International strategies to address climate change including taxes, cap and trade, international agreements, and climate clubs. **Student presentations/discussions on damage functions.**	Nordhaus "To tax or not to tax: Alternative Policies to Slow Global Warming."; Nordhaus Climate Clubs
14	**Student presentations on climate sensitivity and catastrophic events.**	
Part 4: Energy Efficiency Policy; Renewable Energy Policy; Behavioral Economics		
15	International climate agreements and beyond; The Levelized Cost of Energy; Energy Efficiency Policy and Behavioral Economics; Incentivizing customers to reduce energy consumption via behavioral economics	Borenstein, Private and Public Economics of Renewable Energy; Gillingham and Palmer; Allcott, OPOWER
Part 5: Transportation Economics; Electric vehicles tying oil and electricity together		
16	Transportation Externalities, Electric Vehicles, and the Smart Grid. Cost effective transportation policies and linking oil and electricity markets via coordinated electric vehicle charging.	Parry et al. 2007 JEL; Austin and Dinan; Zivin, Kotchen and Mansur