E503 Natural Gas: Technical and Policy Challenges
Spring 2018

Class Meeting Time: Mondays and Wednesdays 5:30-6:45 PM
Class Location: SPEA 273

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Goal and Objectives:
The principle goal of this course is to convey to students the multiple factors that are associated with the formational processes, physical and chemical characteristics, exploration and development dynamics, compression and transportation technologies, energy conversion/product manufacturing, techniques and the environmental consequences associated with utilizing this unique energy resource; natural gas. This course is fundamentally a science and technology course but, will involve economic and policy components. An understanding of the complex interactivities of these factors are necessary for policymakers, analysts and scientists involved in making management decisions regarding this rapidly evolving resource.

I assume that most students, upon graduation from SPEA, will not be directly involved in working in the natural gas industry but, as global citizens and future public policy makers, environmental regulators and business members it is incumbent upon them to know about what controls the viability of this energy resource and how it can be used. The goal is to help students make more informed decisions when parts of the question may involve gas development and use, along with the associated consequences. To be an informed decision-maker allows one to contribute to the better management of this important energy resource and to make a higher quality of life for the planet.

The integration of gas usage within the total energy portfolio of the state, nation and globe will be explored. The environmental and climate consequences of gas combustion as well as the dynamics of the global supply of natural gas will be highlighted. Considering holistically the technical and policy aspects about natural gas and gas usage will be a key part of this course.

To accomplish this overall strategic goal, a set of tangible objectives will be used. The course will be taught at a graduate level with major emphasis placed on information compilation, investigation, and *critical analysis* being performed by the individual student. These analyses, whether as part of the student-led critics of papers, debates, or as a part of the final research paper must be based on substantiated information. Based on the number of students in the class and inclination of the group, some investigations and analyses will be performed by groups, but the performance of each individual student will still be assessed.

Prerequisites:
The subjects presented and the evaluation of topics in this course will use both concepts and content from numerous disciplines including: physics, chemistry, geology, biology, environmental science,

engineering/applied technologies, public policy and economics. Although there is no formal prerequisite courses for taking this course, students are expected to have the fundamental skills needed to: 1) read and comprehend technical issues on a fundamental level, 2) pursue individual research investigations, 3) write an analysis on a given topic and, 4) to present orally the findings of their own research as well as on the content from other published research papers.

Participation:
I am interested in investigating with the students many of the interrelated complexities associated with this unique energy source. In many cases, these lines of inquiry will be driven by the various interests of the individual students. I very much appreciate the interrogative and at times Socratic method of teaching and learning. Plan to engage fully in that process. I intend to learn from the students as well as they from me through this process. And please attend the class sessions. There will a variety of topics speakers and activities and all are important. The knowledge that will be gained is cumulative and toward the end of the class, when we discuss issues, many of the basic principles and considerations discussed earlier in the course will be used to frame and bound operational and policy concepts.

Grading and Assignments:
The assessment of performance in this course will be based on four principle elements:

1) Class participation: as this is a graduate class on a specific topic, I think that the most effective manner to teach and learn in this case is to talk about things. I very much appreciate and use the Socratic method of asking and answering questions to stimulate critical thinking and to illuminate ideas. We are going to have some interesting guest speakers and we will be in the field with practitioners; talk with them about your concerns and questions. We will also have a series of three debates in which the members of the class will be divided into teams that will discuss aspects of gas development before the balance of the class. Therefore, attendance to all class sessions and verbal engagement is highly valued. (15% of course grade)

2) Midterm examination: as the class will be roughly divided into two parts (investigation of topics and individual research), the content covered in the topical portion of the class will be need to be retained to be of value to the student in the research portion. The test will be comprised of short essays with possibly some short answer and perhaps multiple choice questions designed to assess your retention of the key concepts covered up to that time in the course. This material covered in the midterm will be from my lectures, guest speakers lectures and the review of technical papers by other students.(15% of course grade)

3) Technical papers review and discussion leadership: an important aspect having a substantial understanding of technical issues is to be able to access and understand the information that is available in the technical literature. There is a wide range of information that we will be accessing to cover various topics. To cover each, everyone in the class will be part of a group that **1)** chooses one of the topics to be covered in the first ¾ of the course, **2)** finds and distributes to the class (three days ahead of time) a paper(s) that they think illuminates the topic, **3)** along with a set of questions and then **4)** leads the class in discussion of the paper for all to better understand the topic. Part of this assignment will be to generate a succinct review and critique of the paper. This is to be prepared by the group and distributed to the rest of the class at the beginning of the class session. In addition to presentation, responses to the questions will be the basis of this part of the grade. (20% of course grade)

4) Research project and presentation: in addition to the three performance metrics listed above, each student will need to conduct a research investigation, using existing sources of information, on a natural gas-related topic of their choosing. As graduate students, you need to demonstrate your ability to find, analyze, discuss, and interpret information that has been put forth by others in the literature. These 12-15 page research papers will provide a critical review of a topic that is proposed in a one-page proposal and agreed upon before starting

the research for the paper. As these are to be critical assessments of a given topic, they will include a well-presented set of arguments that defend your position on the topic and a set of recommendations on alternative or additional actions that the world can undertake to accomplish your recommendations. (50% of course grade)

At the end of this syllabus there is a schedule that shows when each assignment is to be received by myself and the other students. Please honor your colleagues in the class and me as the instructor by turning in all assignments when required. Life is complex and unpredictable; when you have a challenge that will keep you from meeting an obligation, please let me know as soon as possible and let's work together toward a solution. In fairness to others, makeup and replacement assignments will come at a cost; generally a full grade penalty per day of lateness.

Collaboration is generally a good thing and I endorse it, BUT, don't cheat. I will need to evaluate each of you on your individual performance so do your own work. In preparing for all of the assignments and obligations of the class, work with your colleagues, discuss the papers, compare impressions and solutions, BUT on the written assignments do your own work. The expected academic performance and personal conduct of all students at Indiana University is defined by the IU Code of Student Ethics. Please be sure to abide by these policies. I don't have time or the inclination to issue additional chances if you violate the policy; you just will receive no credit for the assignment in question.

Resources:

There is no formal text for this course. There are series of readings that I will be drawn from a variety of text books and technical papers. As the semester progresses you will be asked to select readings for the class to read and then to discuss them. We will us Canvas as a locus for placing readings and distributing technical resources, as well as questions, responses to questions and critical reviews.

This is a complex subject and I am happy to talk with you should you have a question or a concern. Unlike many of your professors who teach classes in SPEA, I am not physically located in the SPEA building. My office is located two blocks to the west of SPEA on the corner of 10th Street and Walnut Grove. Enter the Geological Survey main entrance and my office is the second one on the right, ground floor.

Please contact me and set up a time when we can meet either one on one or with a group as part of a topic that you are interested in understanding. I also encourage you to polish your professional skills by contacting some of the guest speakers (in a professional manner befitting of their positions) to find out more information from their particular positions or disciplines.

Logistics:

This class is formally scheduled at 5:30-6:45 on Mondays and Wednesdays. With guest lecturers, tentatively I would like to plan to meet on Wednesdays at 4:00 in the afternoon. We will talk about this to confirm as the dates get closer.

Additionally, I would like to go into the field to visit a couple of operations where gas is being explored for and produced, gas being transported and stored and lastly a power generation facility where gas is being converted into electricity. These will be essentially all day fieldtrips that I would like to hold on a series of Fridays.

Activities:

Facts, opinions, legacies, and myths: On the first day of class I want establish some initial impressions and thoughts that you have about natural gas. Therefore I am going to have us record a set of statements that we will revisit occasionally through the course of the class to determine whether they are based on

substantiated facts and circumstances, opinions that are not based on facts and may be embellished, modified facts or fantasy.

Technical paper reviews and discussion: Using some readings (technical papers or book excerpts) that have been selected a small group of students (2-4) these resources will be distributed to the class ahead of the appropriate class session with an accompanying set of questions that all students will complete, prior to the session. The group will create (and post on Canvas at the beginning of class) a short and succinct review and critique of the paper that we will used to summarize the discussion. We will then use Canvas to review the responses to the questions and discuss the topic in a seminar format.

Debates: We will have three debates in this course. I will organize the students into opposing teams of debaters to present and defend ideas associated with three natural gas topics: Risks associated with the development of unconventional gas resources, land use uses associated with gas development and air emissions that accompany gas development and production. We will work up the questions jointly before the debates.

Schedule

Date, Day	Topic	Activity
January 8, M	Organizational discussions	Rupp
January 10, W	Introduction to Natural Gas	Rupp
January 15, M	Martin Luther King Day (no class session)	-
January 17, W	Geology of Gas Accumulations	Rupp
January 22, M	Gas Chemistry and Physics	Schimmelmann (GY-214)
January 24, W	Exploration and Development	Rupp
January 29, M	Gas Resources and Reserves	Rupp
January 31, W	Unconventional Gas	Rupp
February 5, M	Unconventional Gas	Rupp
February 7, W	Global Resources Distribution	Tarin
February 12, M	Production and Processing	Lydia
February 14, W	Transportation and Storage	Lydia
February 19, M	Gas Marketing and Contracts	Brad
February 21, W	Gas for Electricity	Tarin
February 26, M	Air Emissions (GHG, Carbon Capture and Storage)	Tarin
February 28, W	Water Impacts Associated with Gas Utilization	Lydia

March 5, M	Land Impacts Associated with Gas Utilization	Brad
March 7, W	**Midterm Exam** (completed and submitted remotely)	
March 19, M	Natural Gas Policies I	Rupp
March 21, W	Gas and Government Affairs	John Clark
March 26, M	Natural Gas Policies II	Brad
March 28, W	Risks of Unconventional gas development	Discussion
April 2, M	Gas and the Indiana Utility Regulatory Commission	David Ziegner
April 4, W	Governance of natural gas development	Debate 1
April 9, M	Risks and benefits of gas usage	Debate 2
April 11, W	Student Research Project Presentations	
April 16, M	Student Research Project Presentations	
April 18, W	no class	
April 23, M	Summary Discussions	
May 2, W	Final Paper due	

Fieldtrips (tentative dates)

April 6, Friday	9:00 - 3:00	Sugar Creek NGCC	NiSource	Generation