

# Energy Markets

**EMGT 5962/MBAD 6962 (also cross-listed as SEGR 4962, ECGR 4172, ECGR 5172)**

**Classroom: Fretwell 126**

**Time: Tuesdays 5:30 – 8:15 pm**

**Instructors:** Prof. Badrul H Chowdhury  
**Phone:** (704) 687-1960 **Fax:** (704) 687-5588

Prof. Peter M. Schwarz  
**Phone:** (704) 687-7614 **Fax:** 7-1384

**E-mail:** [b.chowdhury@uncc.edu](mailto:b.chowdhury@uncc.edu)

**E-mail:** [pschwarz@uncc.edu](mailto:pschwarz@uncc.edu)

**Office:** EPIC 1162

**Office:** FRI 223A

**Hours: M: 12 – 1 pm; W: 11 am – 1 pm**

**Hours: T R 10-11:30 am**

and by appointment

**ALL PARTS OF THIS SYLLABUS ARE SUBJECT TO REVISION  
ANY REVISIONS WILL BE ANNOUNCED IN CLASS OR VIA CANVAS**

**Course Description:** Energy and power systems in regulated and competitive environments and implications on business decisions for firms in these industries. Topics include: mechanism of energy markets; comparative market systems; determination of prices under different market structures; gas, oil, coal, and electricity market architecture; electricity market design; dispatch and new build decisions; smart grid and renewable energy in electricity markets; risk and risk management in energy including demand and price volatility and use of financial derivatives; and the impact of financial market trends and current and proposed policies on the energy industry.

**Special Reminder:** *This is a cross-disciplinary course that spans two colleges at UNC Charlotte: The Belk College of Business and the Lee College of Engineering. Prof. Schwarz represents the Belk College and Prof. Chowdhury represents the Lee College. As obvious from the course title and the cross-listings, this course will include concepts from both Economics and Engineering. The course was designed for a specific type of student – one who values both economics and engineering. It is not meant for a student only interested in economics, nor for a student only interested in engineering principles of energy markets.*

**Prerequisite:** Basic math (including elementary Calculus), and economics (including Principles of Microeconomics) or consent of instructor(s). SEGR 4961/EMGT 5961 Introduction to Energy Systems or ECON 5181 Energy and Environmental Economics.

**Corequisite:** If students have not completed ECGR 4171/SEGR 4961/EMGT 5961 Introduction to Energy Systems or ECON 4181/5181 Energy and Environmental Economics, they should enroll in one of these courses concurrently with this one; or with permission of instructor(s).

**Required Textbook:** *Fundamentals of Power System Economics*, Daniel S. Kirschen and Goran Strbac (K-S), 2<sup>nd</sup> Edition, John Wiley & Sons, Ltd., 2019, Hoboken, NJ.

ISBN 9781119309888 (pdf) | ISBN 9781119213253 (epub) | ISBN 9781119213246 (cloth)

Seth Blumsack (B). (2019) Energy Markets, Policy, and Regulation (online, free)  
<https://www.e-education.psu.edu/eme801/> Last retrieved December 18, 2019

**Reference Textbooks:**

1. *Power System Economics: Designing Markets for Electricity*, Steven Stoft, May 2002, Wiley-IEEE Press, ISBN: 978-0-471-15040-4
2. *Energy Markets: Price Risk Management and Trading* (Wiley Finance), Tom James, December, 2007, Wiley; ISBN-13: 978-0-470-82225-8
3. *Power Markets and Economics: Energy Costs, Trading, Emissions*, Barrie Murray, March 2009, ISBN: 978-0-470-77966-8
4. *Operation of Restructured Power Systems*, Bhattacharya, Bollen, Daalder. Kluwer Academic Press, 2001
5. *Electricity Economics: Regulation and Deregulation*, Geoffrey Rothwell and Tomas Gomez, 2003, ISBN 0-471-23437-0 (printed on demand)
6. *International Energy Markets: Understanding Pricing, Policies and Profits, 2e*, Carol A. Dahl, Pennwell Corp , 2015, ISBN: 978-1593702915
7. *Understanding Today's Electricity Business*, John Ferrare and Bob Shively, Enerdynamics, San Francisco, 2008
8. *Investing in Energy*, Gianna Bern, Bloomberg Press, 2011
9. *Power System Operations and Electricity Markets*, Fred Denny and David Dismukes, CEC, 2002, ISBN: 9780849308130
10. *Electricity Markets and Power System Economics*, Deqiang Gan, Donghan Feng, and Jun Xie, CEC, 2013, ISBN: 9781466501690
11. *Evolution of Global Electricity Markets*, Fereidoon Sioshansi, Elsevier, 2013, ISBN: 9780123978912
12. *The Economics of Electricity Markets*, Darryl Biggar and Mohammad Reza Hesamzadeh, IEEE Press/Wiley, 2014, ISBN: 9781118775752
13. *Electricity Restructuring in the United States: Markets and Policy from the 1978 Energy Act to the Present*, Steve Isser, Cambridge, 2015, ISBN9781107100787
14. *Energy Economics*, Peter M. Schwarz, Routledge, 2018, ISBN-13: 978-0415676786
15. *Electricity Markets: Theories and Applications (IEEE Series on Power Engineering)*, Jeremy Lin and Fernando Magnano, Wiley, 2018, ISBN-13: 978-1119179351

**Supplementary Materials:** Lecture notes and non-textbook readings will be provided through the course website on Canvas.

**Learning Objectives:**

After completing the course, the students will be able to

1. Have a working knowledge of the mechanisms of energy markets
2. Understand supply and demand dynamics
3. Understand marginal cost
4. Understand regulated and restructured electricity markets
5. Understand electricity market economics and the constitution of locational marginal price
6. Understand the impact of transmission congestion on pricing
7. Understand risk management policies.
8. Communicate effectively in an area related to energy markets

**Course Requirements:**

1. Regular, on-time attendance, including arriving on time, staying until the end of class, and not leaving class except during breaks, is a requirement for on-campus students.

A student whose religion requires that (s)he miss class for a religious observance must fill out a “Request for Religious Observances” form <https://legal.uncc.edu/sites/legal.uncc.edu/files/media/UP409-ReligiousAccommodationForStudents.pdf> and submit it prior to the census date for that semester (typically the tenth day of instruction) to receive an excused absence for that event.

2. Homework should be submitted in class before the class begins. *Distance education* students will submit on Canvas. Late submissions are not accepted.

3. We will follow the flipped classroom model where appropriate. This means that students will be asked to read ahead of time from a reading assignment list. Students will then be tested during class with a short quiz on the reading material. Each quiz will count for 2% of grade. There will be 5 quizzes in the semester. The quiz will be followed by a discussion and lecture.

*Distance education* students will not be taking these quizzes. As a result, their exam weights will be increased.

4. There will be an in-class mid-term exam and an in-class final exam. Further details on each exam will be distributed in due time. You are allowed to use the following items for the exams:

- One single-sided 8.5 in x 11 in. sheet of notes in student’s own handwriting to be attached when the exam is turned in.
- Calculator (mobile phone, laptop, tablet and other forms of PDA are not allowed).
- Writing utensils.

5. For *distance education students*, there will be a midterm and a final exam. There will be no quizzes. The exams will either have to be taken in class with the rest of the students, or separately at their work places under the supervision of a suitable proctor as close to the scheduled exam time as possible.

7. During the last class of the semester, all students will be required to present a short team presentation.

(a) For undergraduate students, the presentation should include both economic and engineering aspects of an energy-related business practice of your employer. If you are not currently working, you may choose to focus on any organization with operations in NC or SC, or with permission of the instructors, a company outside the Carolinas. The goal of your presentation should be to educate us about a practice that needs improvement and possible solutions or an energy markets practice at your organization or another organization about which you think others would benefit from learning. Depending on class size, these may be team presentations of up to three students. You are also required to produce a one-page executive summary of your findings. You are asked to discuss the presentation topic (either face-to-face or via email) with the instructors before making the final decision. This discussion will comprise 10% of the project grade.

(b) Graduate students will be presenting on their team project. Teams of up to three graduate students will be required to submit a written version of the project and also do a presentation on the last class day. Detailed instructions will be distributed separately. You are asked to discuss the research topic (either face-to-face or via email) with the instructors before making the final decision. This discussion will comprise 10% of the project grade.

- (c) *Distance education* students should record a video of their project presentation and upload to Canvas in addition to submitting their reports.
4. Graduate and undergraduate sections will be taught jointly, but obtaining graduate credit will require the inclusion of more advanced assignments on the homework, project, and exams.

**Grading (for on-campus students):**

Pre-announced quizzes	10%
Midterm	25%
Final Exam	35%
Homework	15%
Presentation/Project	15%

**Grading (for *distance education* students):**

Midterm	30%
Final Exam	40%
Homework	15%
Presentation/Project	15%

The grading scale is as follows:

A = 90 - 100	B = 80 - 89.99	C = 70 - 79.99	D = 60 - 69.99
F = < 60	Graduate students	U = < 70	

**Canvas Environment:**

This course includes a significant and required use of the Canvas online environment. You must be able to access course materials and announcements on-line. You can login to Canvas here: <https://uncc.instructure.com/courses/46923> (update once we have created combined course)

We determine your grade according to the syllabus. Use Canvas for information on individual grades, but not for totals or averages. Canvas uses a single formula to calculate averages and totals, which we are unable to alter to reflect different point totals for undergraduate and graduate homeworks and exams.

**Email:**

You *must* be reachable via your UNC Charlotte email account. All course communication will be directed to you at your UNC Charlotte email address via Canvas. If you primarily use a different email account, then you should forward your email to your primary account.

## Course Outline, Reading, Quiz and Exam Schedule

Week	Date	Topic	Instructors
<b>A. Introduction to Energy Markets</b>			
<b>1</b>	January 14, 2020	Course Overview: Syllabus and Energy and Electricity Markets	B. Chowdhury and P. Schwarz
	Readings: J. Harris and B. Roach, Energy: The Great Transition <a href="http://www.bu.edu/eci/files/2019/06/Ch11_Energy_4E.pdf">http://www.bu.edu/eci/files/2019/06/Ch11_Energy_4E.pdf</a> Last retrieved December 28, 2019		
<b>2</b>	January 21, 2020	Review of Microeconomics	P. Schwarz
	Readings: K-S Chapter 2		
<b>3</b>	January 28, 2020	Oil Markets	P. Schwarz
	Reading: B, Lesson 1: Global Markets for Crude and Lesson 2: Markets for Refined Petroleum Products		
	<b>Quiz 1</b>		
<b>4</b>	February 4, 2020	Natural Gas	P. Schwarz and Frank Yoho (guest speaker)
	Readings: B, Lesson 3: Markets for Natural Gas and Lesson 4: Unconventional Natural Gas Development.		
	<b>Quiz 2</b>		
<b>B. Overview of Electricity Markets</b>			
<b>5</b>	February 11, 2020	Markets for Electrical Energy	B. Chowdhury
	Readings: 1. K-S Ch 1, 3 2. Selected reading material from US electricity markets		
<b>6</b>	February 18, 2020	Markets for Electrical Energy (cont.)	B. Chowdhury and P. Schwarz
	Readings: 1. K-S Ch 4 2. Selected reading material from US electricity markets		
<b>7</b>	February 25, 2020	<b>Mid-term exam</b>	

	Covers: Weeks 1-5: Course Overview (Energy and Electricity), Oil, Natural Gas, and Kirschen and Strbak Text Chaps. 1-3 2. Selected reading material from US electricity markets		
<b>Spring recess: March 2-7</b>			
<b>C. Additional Topic in Electricity Markets</b>			
<b>8</b>	March 10, 2020	Electricity Regulation and Restructuring	P. Schwarz
	Readings: 1. Blumsack, Lesson 5: Introduction to the Electricity Industry and Lesson 6: Restructuring and Deregulation in the Electric Power Industry		
	<b>Quiz 3</b>		
<b>9</b>	March 17, 2020	Transmission Networks and Electricity Markets	B. Chowdhury
	Readings: 1. Kirschen & Strbac Ch. 5 2. Selected reading material from US electricity markets		
<b>10</b>	March 24, 2020	Power System Operations	B. Chowdhury
	Readings: 1. K-S Ch. 6 2. Selected reading material from US electricity markets		
	<b>Quiz 4</b>		
<b>11</b>	March 31, 2020	Power System Operations (cont.)	B. Chowdhury
	Readings: Selected reading material from US electricity markets		
<b>D. Investment in Energy and Electricity Markets</b>			
<b>12</b>	April 7, 2020	Levelized Cost and Renewable Energy	P. Schwarz
	Readings: 1. B: Lesson 7: Economic Challenges in the Integration of Renewable Resources, Lesson 9: Discounted Cash Flow Models and Metrics for Evaluating Energy Projects, and possibly Lesson 12: Taxes, Subsidies, and Incentives for Renewable Energy Resources		
	<b>Quiz 5</b>		

<b>13</b>	April 14, 2020	Investing in Generation and Transmission	B. Chowdhury
	Readings: K-S Ch. 7		
<b>14</b>	April 21, 2020	Investing in Generation and Transmission (cont.)	B. Chowdhury
	Readings: K-S Ch. 8		
<b>15</b>	April 28, 2020	Undergraduate and graduate student presentations	
<b>16</b>	May 5, 2020	<b>Final exam</b>	
	Covers: Weeks 6-14: Blumsack Lessons 5, 6, 7, 9, possibly 12, Kirschen and Strbac Text Chapters 4-8, any additional readings.		

### Academic Integrity:

You are required to complete 100% of your own work in this class including making a full contribution to the team project and not communicating with other students on exams or homework assignments. It is our utmost desire that students will read and adhere to every aspect of the UNC Charlotte Honor Code and that there will be no incidents. We have zero tolerance for academic integrity violations. Violations represent cheating and will be pursued through the Academic Integrity Code. Regretfully, we have had to pursue violations in past semesters, so if you have any questions about what is allowed, ask if you have any doubts. It is in all of our best interests to not have any violations.

Cheating violates the UNC Charlotte Code of Academic Integrity and may result in a 0 on a homework assignment or an exam, course failure, suspension, and/or expulsion. For more information see the following: <http://www.legal.uncc.edu/policies/ps-105.html>.

### Disability Accommodations

UNC Charlotte is committed to access to education. If you have a disability and need academic accommodations, please provide a letter of accommodation from Disability Services early in the semester. For more information about accommodations, contact the Office of Disability Services at 704-687-0040 or visit their office in Fretwell 230.

### Diversity Statement:

The Belk College of Business and the William States Lee College of Engineering strive to create an inclusive academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socio-economic status.

### Safety and Security Information

Posted in each classroom