

# Energy Markets

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

**Classroom: Online**

**Time: Tuesdays 5:30 – 6:45 pm**

**Instructors:** Prof. Linquan Bai

Prof. Peter M. Schwarz

**Phone:** (704) 687-5918 **Fax:** (704) 687- 0968

**Phone:** (704) 687-7614 **Fax:** 7-1384

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

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

**Office:** Cameron 220

**Office:** Online

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

**Hours: T R 2:30-4 pm**

(<https://uncc.webex.com/meet/lbai4>)

(<https://meet.google.com/>

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. Bai 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, 2<sup>nd</sup> Edition*, Daniel S. Kirschen and Goran Strbac (K-S), John Wiley & Sons, Ltd., 2019, Hoboken, NJ. ISBN 9781119309888 (pdf) ISBN 9781119213253 (epub) | ISBN 9781119213246 (cloth)

Atkins Library has online copy of 1<sup>st</sup> edition only. You will need the 2<sup>nd</sup> edition for this course.

Seth Blumsack (B). (2019) Energy Markets, Policy, and Regulation (online, free)

<https://www.e-education.psu.edu/eme801/> Last retrieved January 13, 2021

**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. *Electricity Markets: Theories and Applications (IEEE Series on Power Engineering)*, Jeremy Lin and Fernando Magnano, Wiley, 2018, ISBN-13: 978-1119179351
15. *Energy Economics*, Peter M. Schwarz, Routledge, 2018, ISBN-13: 978-0415676786, free online at Atkins Library **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. Highly recommended: Regular, on-time attendance, including arriving on time, staying until the end of class.

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 by 5:15 pm before the class begins. Students will submit on Canvas. Late submissions are not accepted.
3. 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.
4. 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. These will be team presentations of up to four students. You are also required to produce a one-page executive summary of your findings. You are asked to discuss the presentation topic (either during office hours 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 four graduate students will be required to submit a written version of the project and also do a Zoom presentation on the last class day. Detailed instructions will be distributed separately. You are asked to discuss the research topic (either during office hours or via email) with the instructors before making the final decision. This discussion will comprise 10% of the project grade.
5. 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:**

Midterm	30%
Final Exam	30%
Homework	20%
Presentation/Project	20%

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 A = 90 – 100 B = 80 - 89.99 C = 70 - 79.99 U = < 70

UNC Charlotte will allow undergraduate students to elect Pass/No Credit (P/N) for up to three undergraduate courses for the entire academic year, no more than two per term.

Spring 2021 Term: Students must elect Pass/No Credit (P/N) by the date identified in the [Academic Calendar](#) (currently January 27, 2021)

Students will be allowed to have the grade of H recorded on transcripts for prerequisite courses in which they earned a C or better. The H grade will signify that they have satisfied progression (prerequisite) requirements. Students in a progression (prerequisite) course should be advised to complete the course for a letter grade.

*Graduate Students: Unlike the previous semester, there are no planned grading exceptions due to COVID-19.*

**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/146386/modules/items/3036351>

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.

**Make-up Policy:** If you are unable to take a midterm or the final due to an excused absence, let us know before the exam if at all possible. The exam will be rescheduled as close as possible to the original date.

**Course Incomplete:** At the discretion of the instructors for a student who is otherwise passing.

**Netiquette:** For Asynchronous Discussion Forums/Boards

1. In an online environment, your writing should represent you as a professional, educated person.
2. Be thorough and carefully proofread your work.
3. Be respectful—"remember the human."
4. Take your posts seriously.

For Synchronous Video Conference Discussions: In addition to respectful behavior and clear, concise discussions, video conferencing requires another level of intentionality, so that other attendees can see and hear you.

1. Wear headphones or earbuds, mute your audio when you are not speaking.
2. Attend your meetings in as quiet a space as possible.
3. For your video, make sure you have light in front of you, and avoid bright light behind you. Remove any clutter behind you, so your colleagues are not distracted.

**Course Outline, Reading, Quiz and Exam Schedule**

Week	Date	Topic	Instructors
<b>A. Introduction to Energy Markets</b>			
<b>1</b>	January 21, 2021	Course Overview: Syllabus and Energy and Electricity Markets	L. Bai and P. Schwarz
	Readings: Syllabus		
<b>2</b>	January 26, 28	Review of Microeconomics	P. Schwarz
	Readings: K-S Chapter 2		
<b>B. Overview of Electricity Markets</b>			
<b>3</b>	February 2, 4	Markets for Electrical Energy	L. Bai

	Readings: 1. Kirschen & Strbac Ch 1, 3 2. Possible supplementary reading material from US electricity markets		
<b>Week of Feb. 8-12 Spring Recess</b>			
<b>4</b>	February 16, 18	Markets for Electrical Energy (cont.)	L. Bai
	Readings: 1. Kirschen Ch 4 2. Selected reading material from US electricity markets		
<b>5</b>	February 23, 25	Overview of Energy Markets	P. Schwarz
	Readings: To be determined		
<b>6</b>	March 2, 4	Oil Markets	P. Schwarz
	Reading: S. Blumsack, Lesson 1: Global Markets for Crude and Lesson 2: Markets for Refined Petroleum Products		
<b>7</b>	March 9, 11	Natural Gas	P. Schwarz
	Readings: S. Blumsack, Lesson 3(Markets for Natural Gas) and Lesson 4 (Unconventional Natural Gas Development).		
<b>C. Additional Topics in Electricity Markets</b>			
<b>8</b>	March 16, 18	Electricity Regulation and Restructuring	P. Schwarz
	Readings: 1. S. Blumsack, Lesson 5 (Introduction to the Electricity Industry) and Lesson 6 (Restructuring and Deregulation in the Electric Power Industry)		
<b>9</b>	<b>March 23, 25 Mid-term exam; Part 1 (Dr. Schwarz) 3/23, Part 2 (Dr. Bai) 3/25</b>		
	Covers: Weeks 1-7: Course Overview (Energy and Electricity), Oil, Natural Gas (March 23), and Kirschen and Strbac Text Ch. 1-4, Possible supplementary reading material from US electricity markets (March 25)		
<b>10</b>	March 30, April 1	Transmission Networks and Electricity Markets	L. Bai
	Readings: 1. Kirschen & Strbac Ch. 5 2. Possible supplementary material from US electricity markets		

	April 6, 8	Power System Operations	L. Bai
<b>11</b>	Readings: 1. Kirschen & Strbac Ch. 6 2. Possible supplementary material from US electricity markets		
	April 13, 15	Power System Operations (cont.)	L. Bai
<b>12</b>	Readings: Possible supplementary material from US electricity markets		
<b>D. Investment in Energy and Electricity Markets</b>			
	April 20, 22	Levelized Cost and Renewable Energy	P. Schwarz
<b>13</b>	Readings: 1. Blumsack 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		
	April 27, 29	Investing in Generation and Transmission	L. Bai
<b>14</b>	Readings: Kirschen & Strbac Ch. 7, 8		
<b>15</b>	May 4	Undergraduate and graduate student presentations	
	May 11, 5-7:30 pm	<b>Final exam</b>	
<b>16</b>	Covers: Weeks 8-14: Blumsack Lessons 5, 6, 7, 9, possibly 12, Kirschen and Strbac Text Chapters 5-8, 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. You may discuss homework assignments, but you must write up your solutions on your own. Use of Chegg Tutors is strongly discouraged, and could result in an academic integrity violation. 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.