**PUBP 6352: Utility Regulation and Policy**

MW 3-4:15 (ESM Building on Cherry Street, Room 212)

Course Description

Electrification, digitalization, and decentralization are transforming utility systems worldwide. This course focuses on the governance and policies impacting this transformation. It covers the theory and implementation of utility regulation and policies, drawing from energy, water, and communication systems and addressing economic efficiency, security, resilience, environmental management and ethics.

Specific topics will span the spectrum from integrated resource planning, rate setting, technology transitions such as the 100% renewable energy movement, regulation of systems, the operation of monopoly vs competitive markets, and the integration of resources on the customer side of the meter (solar, electric vehicles, storage, etc.).

Learning Objectives

Students will learn how to use several analytical software tools and data sources to assess the cost-effectiveness of alternative electricity technologies, policies, and investments including:

* The levelized cost of electricity from alternative resources, based on data from Integrated Resource Plans and the S&P Global Market Intelligence energy database
* Impact of carbon taxes on power plant fuel portfolios, electric vehicles, and air quality based on EIA’s National Energy Modeling System (NEMS)
* Application of California’s standard utility cost tests to energy efficiency programs and investments
* How electric rates and tariffs affect solar economics, using NREL’s solar System Advisor Model (SAM)

Students will not only gain a mastery of at least one utility regulatory system in the U.S., but they will also gain an international perspective through case studies of several European and Asian countries.

Instructional Strategies

Each student will complete two exercises, present one of them in class, contribute to the discussion of readings, and write a research memo. Students will present one of their exercises and their research memo to their peers in class.

This is a discussion-based seminar course. Students are expected to have strong written and oral communication skills and experience with data analysis. Prior knowledge of utility regulation and policy is not necessary.

Course Texts

None

A selection of relevant articles and data resources will be available on Canvas. Please read the assigned readings on time (prior to class).

Course Grading

**Assessment and Grading**

Student performance and grades are based on the following scale:

|  |  |
| --- | --- |
| A | 90-100 |
| B | 80-89 |
| C | 70-79 |
| D | 60-69 |
| F | <60 |

**1) Class Participation: 10%**

Class participation includes an approximate equal weighting of attendance and participation. For attendance, I record students’ presence in each class and whether or not an absence is excused. Unexcused absences are emphasized in the grading. Canvas is used to record each student’s presence in class. Students can contact Elizabeth Nguyen to check that excused absences have been properly recorded. The quality of class participation reflects the degree that students come to class prepared to discuss the content of assigned readings and their active involvement in class discussions. Each student will be assigned to cover some readings and to lead the discussion of them in class.

**3) Exercise 1: 20%**

The first exercise will be assigned on September 4 and will be due October 11. It will be flexible to reflect the particular interests of students. Students will report the results of either Exercise 1 or Exercise 2 in class.

**4) Exercise 2: 20%**

The second exercise will be assigned on October 2 and will be due November 15. It will be flexible to reflect the particular interests of students. Students will report the results of either Exercise 1 or Exercise 2 in class.

**5) Presentation of Exercise 1 or 2: 10%**

**6) Research Memo: 20%**

Each student will prepare a 2,000-word independent research memo, investigating a topic of interest related to utility regulation. For example, you could examine:

* How electric rates and tariffs affect electric vehicle, using NREL’s solar System Advisor Model (SAM)
* How electric rates and tariffs solar economics, using NREL’s solar System Advisor Model (SAM)
* Net Metering Practices Across U.S. States
* Electricity Rate Design: Equity Issues Associated with Increasing Fixed Rates
* State Regulation of Hydraulic Fracturing
* The design and financing of low-income energy programs

**7) Presentation of Research Memo: 20%**

Each student will prepare a 20-minute presentation of the independent research they have conducted. The presentation will take place during the last several classes of the semester.

**Assignments and Due Dates**

1. Exercise 1 (to be assigned on 9/4/2019) 10/16/2019
2. Exercise 2 (to be assigned on 10/2/2019) 11/13/2019
3. Research Presentations 11/20, 25, 27
4. Research Memo (to be assigned on 10/16/2019) 12/11/2019

All written assignments are to be submitted on Canvas.

**Communications:**

T & Th at 11 am in my office, Room 312 in the D.M. Smith Building. You may also contact me to arrange to meet at other times. Please use a GA Tech email account for course communications and post all assignments on Canvas.

**Rights and Responsibilities**

Enrollment in this course indicates that you have read, acknowledge and agree to abide by the following:

* Policy on academic performance and incompletes - see Georgia Tech [Student Handbook](http://catalog.gatech.edu/rules/7/).
* Georgia Tech [Honor Code](http://osi.gatech.edu/content/honor-code) - including [Addendum for Graduate Students](http://osi.gatech.edu/content/honor-code#Graduate). You are informed that student papers may be reviewed by plagiarism detection software.

Enrollment for the course indicates that you agree to attend all scheduled classes. With instructor's permission, one or a few absences from class will be forgiven for good reason. Absences beyond this may result in a lower final grade.

**Absences**A student may miss class on occasion due to medical issues. Georgia Tech has a web page that describes the expectations, rights, and responsibilities of students, instructors, the Office of Student Life, and health care providers. The information is intended to give students better direction as to how they should proceed to notify instructors when they are ill and need to miss class and what kind of documentation they should provide and to whom. Students should refer to Georgia Tech policies at the "Student Absence from Class Due to Illness or Personal Emergencies" web page at
<http://www.catalog.gatech.edu/policies/student-absence-regulations/>

**Honor Code**The Academic Honor Code is a student initiative that became an official Institute policy in 1996. The objective of the Academic Honor Code is to increase academic integrity and strengthen trust in the Georgia Tech community. Students enrolled at Georgia Tech signed an agreement acknowledging their awareness of the Academic Honor Code. They are strongly encouraged to seek a full understanding of their instructors' expectations regarding academic honor.  You can find the Honor Code (with a listing of responsibilities in Sections 3 and 4) at
<http://www.policylibrary.gatech.edu/student-affairs/academic-honor-code>

**Disability Services:** Your experience in this class is important to me. If you have already established accommodations with the Offices of Disability Services, please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course. If you have not yet established services through Disability Services, but have a temporary health condition or permanent disability that requires accommodations (conditions include but are not limited to: mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact Disability Services at 404-894-2563 or dsinfo@gatech.edu or  [disabilityservices.gatech.edu.](http://depts.washington.edu/uwdrs/) Disability Services offers resources and coordinates (with students and their instructors) reasonable accommodations for students with disabilities and/or temporary health conditions.

**INCLUSIVE EXCELLENCE:** The Ivan Allen College of Liberal Arts supports the Georgia Institute of Technology’s commitment to creating a campus free of discrimination on the basis of race, color, religion, sex, national origin, age, disability, sexual orientation, gender identity, or veteran status. We further affirm the importance of cultivating an intellectual climate that allows us to better understand the similarities and differences of those who constitute the Georgia Tech community, as well as the necessity of working against inequalities that may also manifest here as they do in the broader society.

Course Schedule

**Introduction**

Week 1 |

August 19 – Review Syllabus – Electricity Sector Overview

* U.S. Department of Energy. 2017. *Quadrennial Energy Review: Transforming the Nation’s Electricity System,* Appendix A: Electricity Sector Overview, pp. A-1 to A-10: covering the Nation’s existing electricity system, including its physical structure and elements, the history of its development. <https://energy.gov/epsa/quadrennial-energy-review-second-installment>

August 21 – Electricity System History and Governance in the U.S.

* 1 hour Video of Utility Ratemaking Workshop #1-Background (Southface Energy Institute and Vote Solar) <https://www.youtube.com/watch?v=e9OdXZKKPxY&feature=youtu.be>
* U.S. Department of Energy. 2017. *Quadrennial Energy Review: Transforming the Nation’s Electricity System,* Appendix A: Electricity Sector Overview, pp. A-10 to A-24: covering the major laws and jurisdictions governing its operation, and the Federal role in the resilience and security of the electric grid, and the complex operations, business models, and market structures comprising the electricity system.
* Richard F. Hirsh, “Emergence of Electrical Utilities in America,” Smithsonian Institution, Powering a Generation of Change, last modified September 2002, <http://americanhistory.si.edu/powering/past/h1main.htm> (7 pages).

**Rate Setting and the Levelized Cost of Electricity**

Week 2 |

August 26 – Rate Setting

* 1 hour Video of Utility Ratemaking Workshop #2-Understanding the Utility Business Model and Rate Design (Southface Energy Institute and Vote Solar)

August 28 – Levelized Cost of Electricity

* 26-minute video on “Levelized Cost of Electricity”
* Skim: Energy Information Administration (EIA), *Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2016* (Washington, DC: EIA, 2016), http://www.eia.gov/outlooks/aeo/ pdf/electricity\_generation.pdf
* Brown, M.A., A. Favero, V.M. Thomas, and A. Banboukian. (2019) *“*The Economic and Environmental Performance of Biomass Power as an Intermediate Resource for Power Production,” *Utilities Policy,* 58: 52-62. <https://authors.elsevier.com/a/1YzH53Peo9VR76>
* Brown, Marilyn A. and Yu Wang. 2015. “Estimating the Levelized Cost of Electricity Generation and Savings” Section 2.5, pp. 37-42, in *Green Savings, How Policies and Markets Drive Energy Efficiency* (Praeger).

**Integrated Resource Planning**

Week 3 |

September 2 – Labor Day Holiday

September 5 – Introduction to the SNL Energy Data Subscription for “Market Intelligence”

* SNL Users’ Manual

Integrated Resource Planning

* Lazar, Jim. 2016. *Electricity Regulation in the US: A Guide*, Chapter 15: “Integrated Resource Planning” pp. 106-111 <http://www.raponline.org/wp-content/uploads/2016/07/rap-lazar-electricity-regulation-US-june-2016.pdf>

***Choose*** *a section of one of these three Integrated Resource Plans (IRPs) to read and review for class discussion*. Focus on a section of particular interest to you:

* 2017 Dominion IRP
* 2016 Tennessee Valley Authority IRP
* Georgia Power IRP

**Market Failures and the Utility Business Model**

Week 4 |

September 9 – Market Failures and Barriers

* 22-minute video on “Market Failures and Barriers”
* Skim: U.S. Department of Energy. 2016. *Quadrennial Energy Review: Transforming the Nation’s Electricity System,* Appendix A: Electricity Sector Overview, pp. A-29 to A-38: covering the major laws and jurisdictions governing its operation, the Federal role in the resilience and security of the electric grid, and the complex operations, business models, and market structures comprising the electricity system.
* Skim: Brown, Marilyn A. 2001. “Market Failures and Barriers as a Basis for Clean Energy Policies,” *Energy Policy*, 29 (14): 1197-1207.

September 11 – Net Metering of Solar Power: Impacts on Rates and Equity Issues

*Choose one of these for class discussion*:

* Johnson, Erik, Ross Beppler, Christopher Blackburn, Benjamin Staver, Marilyn Brown, and Daniel Matisoff. (2017) “Peak Shifting and Cross-Class Subsidization: The Impacts of Solar PV on Changes in Electricity Costs” *Energy Policy* 106: 436-444, <http://doi.org/10.1016/j.jclepro.2016.12.031>.
* Comello, S., & Reichelstein, S. (2016). Cost competitiveness of residential solar PV: The impact of net metering restrictions. *Renewable and Sustainable Energy Reviews*.
* Chukwuka G. Monyei, et al., Forthcoming. “Emerging Paradoxes of Electricity Decarbonization”

**Policy Diffusion Mechanisms and The 100 RE Movement**

Week 5 |

September 16 – The 100 RE (100% Renewable Energy) Movement

*Choose one of these for class discussion*:

* Clack, C. T., Qvist, S. A., Apt, J., Bazilian, M., Brandt, A. R., Caldeira, K., ... & Jaramillo, P. (2017). Evaluation of a proposal for reliable low-cost grid power with 100% wind, water, and solar. Proceedings of the National Academy of Sciences, 201610381.
* Jacobson, M. Z., Delucchi, M. A., Cameron, M. A., & Frew, B. A. (2015). Low-cost solution to the grid reliability problem with 100% penetration of intermittent wind, water, and solar for all purposes. Proceedings of the National Academy of Sciences, 112(49), 15060-15065.
* Hibbard, P., Tierney, S., & Franklin, K. (2017). *Electricity Markets, Reliability and the Evolving U.S. Power System.* Analysis Group

September 18 – Policy Diffusion Mechanisms

* Carley, S., Nicholson-Crotty, S., & Miller, C. J. (2016). Adoption, reinvention and amendment of renewable portfolio standards in the American states. *Journal of public policy*, 1-28.
* Matisoff, D. C., & Edwards, J. (2014). Kindred spirits or intergovernmental competition? The innovation and diffusion of energy policies in the American states (1990–2008). *Environmental Politics*, 23 (5) 795-817.
* Model Solar Ordinances

Week 6 |

September 23 – International Perspective

* Zou, Hongyang, Huibin Du, Marilyn A. Brown, and Guozhu Mao. 2017. “Large-scale PV power generation in China: A grid parity and techno-economic analysis,” *Energy.* 134: 256-268, <https://doi.org/10.1016/j.energy.2017.05.192>
* Stadelmann, M., & Castro, P. (2014). Climate policy innovation in the South–Domestic and international determinants of renewable energy policies in developing and emerging countries. *Global Environmental Change*, 29, 413-423.

**Standard Utility Cost Tests for Energy-Efficiency Programs**

September 25 – Standard Utility Cost Tests

* Brown, Marilyn A., Benjamin Staver, Alexander M. Smith, and John Sibley. 2015. Alternative Business Models for Energy Efficiency: Emerging Trends in the Southeast, *The Electricity Journal,* 2015,28 (4): 103-117.
* Brown, Marilyn A. and Yu Wang. 2015. Sections 5.6, in *Green Savings, How Policies and Markets Drive Energy Efficiency* (Praeger).

Week 7 |

September 30 – Introduction to the GT-National Energy Modeling System (NEMS)

* Users’ Manual for NEMS 2019 at Georgia Tech

 October 2 – NEMS Papers Applied to Demand Response and Energy Efficiency

*Choose one to read for class discussion*:

* Cullenward, D., J. Wilkerson, M. Wara and J. Weyant (2016). Dynamically estimating the distributional impacts of U.S. climate policy with NEMS: A case study of the Climate Protection Act of 2013. *Energy Economics,* 55, 303– 318.
* Smith, Alexander and Marilyn A. Brown. 2015. “Demand Response: A Carbon Neutral Resource?” *Energy* 85 (2015) 10**-**22.
* Brown, M. A., & Li, Y. (2019). Carbon pricing and energy efficiency: pathways to deep decarbonization of the US electric sector. *Energy Efficiency*, 1-19.

**Smart Meters and the Smart Grid**

Week 8 |

 October 11 – Smart Meters and the Smart Grid

*Choose one to read for class discussion*:

* Zhou, S. and Brown, M. 2017. Smart Meter Deployment in Europe: A Comparative Case Study on the Impacts of National Policy Schemes. *Journal of Cleaner Production*. 144:22-32. <http://www.sciencedirect.com/science/article/pii/S0959652616320868>
* Felder, F. A., & Athawale, R. (2016). Optimizing New York's Reforming the Energy Vision. Utilities Policy, 41, 160-162.
* Oliver, Jeannie and Benjamin Sovacool. 2017. “The Energy Trilemma and the Smart Grid: Implications Beyond the United States,” *Asia # the Pacific Policy Studies* 4(1): 70-84.
* Brown, M. A., Zhou, S., & Ahmadi, M. Smart grid governance: An international review of evolving policy issues and innovations. *Wiley Interdisciplinary Reviews: Energy and Environment*.

October 9

* 35-minute video on “Fossil-Fired Electricity Generation and Pollution Standards”
* Skim: Emanuele Massetti, Marilyn Brown, Melissa Lapsa, Isha Sharma, James Bradbury, Colin Cunliff, and Yufei Li. [*Environmental Quality and the U.S. Power Sector: Air Quality, Water Quality, Land Use and Environmental Justice*](https://energy.gov/sites/prod/files/2017/01/f34/Environment%20Baseline%20Vol.%202--Environmental%20Quality%20and%20the%20U.S.%20Power%20Sector--Air%20Quality%2C%20Water%20Quality%2C%20Land%20Use%2C%20and%20Environmental%20Justice.pdf)*,* Oak Ridge National Laboratory, ORNL/SPR-2016/772 (2017), <http://info.ornl.gov/sites/publications/files/Pub60561.pdf>

Read Chapter 2 on Air Quality.

* Yi, H. (2015). Clean-energy policies and electricity sector carbon emissions in the US states. *Utilities Policy,* 34, 19-29.

**Environmental Regulations and Climate Policy**

Week 9 |

October 14 – Fall Recess – No Class

October 16 – Carbon Cap and Trade vs Carbon Taxes

*Choose one to read for class discussion*:

* Tomain, J. P. (2016). A perspective on clean power and the future of US energy politics and policy. Utilities Policy, 39, 5-12.
* Marilyn A. Brown, Gyungwon Kim, Alexander M. Smith, and Katie Southworth. 2017. “Exploring the Impact of Energy Efficiency as a Carbon Mitigation Strategy in the U.S.” *Energy Policy,* 109: 249-259.
* Narassimhan, Easwaran, Kelly S. Gallagher, Stefan Koester, and Julio Rivera Alejo. 2017. Carbon Pricing in Practice: A Review of the Evidence, The Fletcher School, Tufts University, Report 2017.
* Hibbard, et al. 2019. “An expanding carbon cap-and-trade regime? A decade of experience with RGGI charts a path forward” *The Electricity Journal*, 1-8.

**Rate Structures, Nuclear Power, Mega Projects and Niche-Regime Conflicts**

Week 10 |

October 21 – Utility Rate Setting and Rate Structures

* 1 hour Video of Utility Ratemaking Workshop #3- Utility Rate Setting and Rate Structures (Southface Energy Institute and Vote Solar). I divided the Utility Ratemaking Video #3 into 3 parts and clipped some of the Q&A. They are posted in “My Media.”
* Sneak Preview of Rate Design:
* Customer Classes and Cost Recovery:
* Allocation of Costs:

Concept of Baseload, Integration of VRE, and Nuclear Power

* DOE. 2017. *Staff Report to the Secretary on Electricity Markets and Reliability,* Chapter 3.

October 23 ­ Projects and the Politics of Niche-Regime Conflicts

*Choose one to read for class discussion*:

* Brookes, N. J., & Locatelli, G. (2015). Power plants as megaprojects: Using empirics to shape policy, planning, and construction management. Utilities Policy, 36, 57-66.
* Hess, D. J. (2016). The politics of niche-regime conflicts: distributed solar energy in the United States. *Environmental Innovation and Societal Transitions*, *19*, 42-50.
* Geels, F. W. (2014). Regime resistance against low-carbon transitions: Introducing politics and power into the multi-level perspective. *Theory, Culture & Society*, *31*(5), 21-40.

**Energy Efficiency & Electric Vehicles**

Week 11 |

October 28 –Intro to Electric Transportation by Dr. Frank Southworth

 October 30 – Smart Charging, EV Rates, other EV Policies and Vehicles to Grid (V2G)

*Choose one to read for class discussion*:

* [Sovacool, BKand J Axsen. “Functional, symbolic and societal frames for automobility: Implications for sustainability transitions,” *Transportation Research Part A*118 (December, 2019), pp. 730-746.](https://www.sciencedirect.com/science/article/pii/S0965856416311247)
* Kempton, W., & Tomić, J. (2015). Vehicle-to-grid power fundamentals: Calculating capacity and net revenue. Journal of power sources, 144(1), 268-279.
* Shinzaki, S., Sadano, H., Maruyama, Y., & Kempton, W. (2015). Deployment of vehicle-to-grid technology and related issues (No. 2015-01-0306). SAE Technical Paper.
* Electricity Advisory Committee 2019. *Enhancing Grid Resilience with integrated Storage from Electricity Vehicles* U.S. Department of Energy, June 28*,* <https://www.energy.gov/oe/services/electricity-advisory-committee-eac/electricity-advisory-committee-reports-and-memos>

**Grid Reliability and Resilience**

Week 12 |

 November 4 – Energy Efficiency and the California Cost Tests

* Brown, Marilyn A., Benjamin Staver, Alexander M. Smith, and John Sibley. 2015. Alternative Business Models for Energy Efficiency: Emerging Trends in the Southeast, *The Electricity Journal,* 2015,28 (4): 103-117.
* Brown, Marilyn A. and Yu Wang. 2015. Sections 5.6, in *Green Savings, How Policies and Markets Drive Energy Efficiency* (Praeger).

Reliability and Resilience

* DOE. 2017. *Staff Report to the Secretary on Electricity Markets and Reliability,* *Chapter 4: Reliability and Resilience* (pp. 61-101).https://www.eenews.net/assets/2017/08/24/document\_gw\_06.pdf
* National Academy of Sciences, 2017. *Enhancing the Resilience of the Nation’s Electricity System* <https://www.nap.edu/catalog/24836/enhancing-the-resilience-of-the-nations-electricity-system>

November 6 – Terrorism and Cyber Security

* National Academy of Sciences report. 2012. Terrorism and the Electric Power Delivery System, National Research Council.
* Lloyds (2015) Business Blackout, 2-page executive summary
* Buchmann, M. (2017). Governance of data and information management in smart distribution grids: Increase efficiency by balancing coordination and competition. *Utilities Policy,* 44, 63-72.

**Energy Transitions**

Week 13 |

November 11 –

* Stadelmann, M., & Castro, P. (2014). Climate policy innovation in the South–Domestic and international determinants of renewable energy policies in developing and emerging countries. *Global Environmental Change*, 29, 413-423.
* Frank W. Geels, Benjamin K. Sovacool, Tim Schwanen, and Steve Sorrell. 2017. Sociotechnical transitions for deep decarbonization*. Science.* 357 (6357): 1242-1244.

November 13 – No Class: Students work on research memo

November 18 – No Class: Students work on research memo

November 20 – No Class: Students work on research memo

November 27 – Thanksgiving Break – No Class

**Student Paper Presentations: November 25, Dec. 2, and 4**