PubAff 809: Introduction to Energy Analysis and Policy

Fall, 2018
University of Wisconsin
EnvSt-809, PubAff-809, URPL-809

3 credits
Room: 175 Science Hall
Tue., Thu. 9:30–10:45am

Instructor

Professor Greg Nemet

La Follette School of Public Affairs
209 Observatory Hill Office Bldg. email: nemet@wisc.edu

Office hours, Fall 2018: Tuesday 11–noon, Thursday 11–noon, Room 209 La Follette. *Expect some changes over the semester, announced at least 1 week in advance.*

Teaching Assistant: Ian Ryan, email: iryan@wisc.edu
Office hours: Mon. 11–12p, Wed. 4–5p, in Room 175A Science Hall

Grader: Jiaqi Lu, email: jlu42@wisc.edu

Course Description

Heightened concern about both the availability of energy resources and their environmental impacts has increased demand for leaders and analysts who can navigate the political, economic, scientific, and technological dimensions of these issues to inform critical policy decisions. Few are able to do so; and those who can provide valuable insight. In this course, you will develop an understanding of the dynamics of the global energy system, focusing on ways that public policy can affect these changes in societally beneficial directions. The perspective taken is that of a policy maker confronting decisions about the design and implementation of energy policy.

Learning Objectives

The goal of this course is for students to master a set of simple tools that will enable them to independently analyze problems, and be able to critically assess the work of others.

Students will become familiar with the breadth of energy-related problems at stake through development of methods, tools, and perspectives to analyze them. Topics covered span the full life cycle of energy production and use, including: material extraction, energy conversion, power generation, energy transportation, end use, and environmental impacts. The class surveys the types of energy used historically—from traditional biomass, to coal, to natural gas, to nuclear and renewables, as well as the increasingly diverse possibilities for future use discussed in current policy debates. Coverage also includes a historical review of regulation and policy in the energy industry. The geographic scope is international.

version: September 6, 2018

The field of energy analysis and policy is inherently interdisciplinary. As such the class draws on a set of tools and perspectives derived from multiple disciplines, and includes students from diverse backgrounds. While students are welcome to take this course alone, this course is the introductory seminar for the *Energy Analysis and Policy* certificate program and as such provides preparation for subsequent courses in the program. It emphasizes the learning objectives of *Knolwedge*, *Applied Research*, and *Professional Skills* within the LaFollette School of Public Affairs MPA and MIPA programs.

Requirements

The reading load for this class is typical for a graduate-level class; students are expected to read the required texts before class and participate actively in class discussions. Five problem sets will help develop analytical tools and methods. There will be a midterm exam and a final exam, both of which will include qualitative and quantitative questions. The course credit count of 3 is based on 45 Hours per Credit criterion, which equates to 9 hours of work per week for this class.

Please note that I do not distribute problem sets or solutions electronically—although I do accept completed problem sets electronically if necessary. Keep this in mind for your planning of research travel etc. during the semester.

Also note that I will work with students to accommodate absences for Eid-al-Adha, Rosh Hashana, Yom Kippur, and other religious holidays.

People with disabilities will be fully included in this course. Please inform me if you need any special accommodations in the curriculum, instruction, or assessments of this course to enable you to participate fully. Confidentiality of the shared information will be strictly maintained. Certain accommodations may require the assistance of the UW-Madison McBurney Disability Office - http://www.mcburney.wisc.edu/.

Evaluation

5% Class participation.
30% Five problem sets.
30% Midterm exam.
35% Final exam.

Readings

There are two required books for this course, which are available at the UW Bookstore:

- Rubin, E. S. (2001). Introduction to Engineering and the Environment. Boston, McGraw-Hill.
- Yergin, D. (2011). The Quest: Energy, Security, and the Remaking of the Modern World, Penguin.

All other readings are available on the Learn@UW website.

Academic Integrity

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the

integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

A Safe and Welcoming Classroom

Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. Safe and welcoming classrooms encourage that continual and fearless sifting and winnowing by which alone the truth can be found by fostering an environment of free speech consistent with US law and safe from threats or violence. The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background people who as students, faculty, and staff serve Wisconsin and the world.

Mental Health Resources

School is a context where mental health struggles can be exacerbated. If you ever find yourself struggling, please do not hesitate to ask for help. The University and larger Madison community offer mental health resources to support a range of psychological issues in a confidential and safe environment: Confidential Counseling Services: -University Health Service (UHS) - For 24/7 confidential consultation: 608-265-5600 (option 9)

Instructor Bios

Gregory Nemet is Professor at the University of Wisconsin in the La Follette School of Public Affairs and the Nelson Institute Center for Sustainability and the Global Environment (SAGE). His research and teaching focus on improving analysis of the environmental, social, economic, and technical dynamics of the global energy system. This work is motivated by a general interest in understanding how to expand access to energy services while reducing environmental impacts. He teaches courses in energy systems analysis, governance of global energy problems, and international environmental policy. His research analyzes the process of technological change in energy and its interactions with public policy. He received a Romnes Faculty Fellowship in 2015 and an Andrew Carnegie Fellowship in 2017. He has been an author for the Intergovernmental Panel on Climate Change (IPCC) and the Global Energy Assessment (GEA). He received his doctorate in energy and resources from the University of California, Berkeley. His A.B. is in geography and economics from Dartmouth College.

TA and grader: **Ian Ryan** is a joint Masters student in Public Affairs and Population Health. **Jiaqi Lu** is a PhD student in Environment and Resources working on decarvonization.

Class Schedule and Reading List

1) September 6:

Cheap, clean, and reliable: three energy policy challenges

- Energy Primer (section 1) GEA (2014). Global Energy Assessment - Toward a Sustainable Future. Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria.
- Yergin: Introduction
- Nixon, R. M. (1974). State of the Union Address. Washington, D.C.

optional:

- Carter, J. (1979). The "Crisis of Confidence" Speech.
- Holdren, J. P. (2001). "Meeting the energy challenge." Science 291(5506): 945-945.
- Gore, A. (2008). Energy Speech: "A Generational Challenge to Repower America".
- Obama, B. (2009). Remarks by the President on Energy (6/29/09).

2) September 11*:

Historical development of the production and use of energy
*** *Optional math review session 3-4p.***

- Yergin: Prologue.
- GEA, Energy Primer (section 2–3)

optional:

- Smil, V. (2000). "Energy in the twentieth century: resources, conversions, costs, uses, and consequences." Annual Review of Energy and Environment 25: 21-51.
- Hamilton, J. (2011). Historical Oil Shocks. Berkeley, CA, UC Center for Energy and Environmental Economics.
- Fouquet, R. and P. J. G. Pearson (1998)."A thousand years of energy use in the United Kingdom." The Energy Journal 19(4): 1-41.
- Interview with Daniel Yergin

3) September 13:

EAP Tools 1: Units, magnitudes, and rates of change

- GEA, Energy Primer (section 4–5)
- Rubin 524–529, section 12.9.1 on IPAT.
- Rubin 681–683
- Koomey, J. G. (2001). Turning Numbers into Knowledge. Oakland, CA, Analytics Press, pp 125–141.
- Norgaard (1996) "About calculations and unit conversions."
- Holdren, Harte, and Koomey, "Constants and conversions."

optional:

- Waggoner, P. E. and J. H. Ausubel (2002). "A framework for sustainability science: A renovated IPAT identity." Proceedings of the National Academy of Sciences of the United States of America 99(12): 7860-7865.
- Lovins, A. B. (1976). "Energy Strategy: The Road Not Taken?" Foreign Affairs 55(1): 65-96.

Problem set #1 handed out

4) September 18:

EAP Tools 2 : Combustion

- GEA, Energy Primer (section 6–7)
- Rubin: Ch 1
- Rubin: Ch 2

recommended:

- Swartz, C. E. (1993). Used Math for the First Two Years of College Science, American Association of Physics Teachers. [Ch 1 and 2]
- Masters, G. (1991). Introduction to Environmental Engineering and Science. New Jersey, Prentice Hall: 39–47.

5) September 20:

Energy and development, Part I

- GEA, Energy Primer (section 8)
- (ExecSumm + Sec. 2.1–2.4) Karekezi, S., et al. (2012). Chapter 2 - Energy, Poverty and Development. Global Energy Assessment. Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria: 151-190.
- Bose, S. (1993). Chapter 5. Women, Work, and Household Electrification in Rural India. Bombay, Oxford University Press: 143–181.

optional:

- Rubin 15.4, 15.5
- (See especially Exec. Summary and Introduction) IEA (2014). Africa Energy Outlook. Paris, International Energy Agency (IEA).
- Oparaocha, S. and S. Dutta (2011). "Gender and energy for sustainable development." Current Opinion in Environmental Sustainability 3(4): 265-271.
- Barnes, D. F. (2011). "Effective solutions for rural electrification in developing countries: Lessons" Current Opinion in Env. Sustainability 3(4): 260-264.

Problem set #1 due

6) September 25:

Energy and development, Part II

- Yergin: 9. China's Rise
- Yergin: 10. China in the Fast Lane
- (Sec. 2.5–2.12) Karekezi, S., S. McDade, et al. (2012). GEA Chapter 2 - Energy, Poverty and Development.

optional:

- Xiaohua, W. and F. Zhenmin (2001). "Rural household energy consumption with the economic development in China: stages and characteristic indices." Energy Policy 29(15): 1391-1397.
- WCD (2000). Executive Summary. Dams and Development: A New Framework for Decision-Making. South Africa, World Commission on Dams.

7) September 27:

EAP Tools 3: Power plant operation and efficiency

- Rubin: 5.1–5.4
- Yergin: 20. Fuel Choice
- Randolph, J. and G. M. Masters (2008). Energy for sustainability: technology, planning, policy. Washington, Island Press. [pp 364–374]
- Wu, X., J. Shen, Y. Li and K. Y. Lee (2015). "Steam power plant configuration, design, and control." Wiley Interdisciplinary Reviews: Energy and Environment.

optional:

- Friedmann, J. (2011). "Carbon Capture and Green Technology: Environmentalism's Step Forward–and Two Steps Back " Foreign Affairs.

Problem set #2 handed out

8) October 2:

Fossil fuels: coal and gas

- Yergin: 16. The Natural Gas Revolution
- MIT (2007). The Future of Coal: options for a carbon constrained world. Cambridge, MA, Massachusetts Institute of Technology. *read pp ix–xv, 1–41, 95–105.*

optional:

- Yergin: 15. Gas on Water
- Tussing, A. R. and B. Tippee (1995). The Natural Gas Industry: Evolution, Structure, and Economics, PennWell Books, pp1–23.

- Victor, D., A. M. Jaffe, et al. (2006). Natural Gas and Geopolitics: From 1970 to 2040, Cambridge University Press, [Ch 1 and Ch 14]
- Bohannon, J. (2008). "Weighing the Climate Risks of an Untapped Fossil Fuel." Science 319(5871): 1753.
- MIT (2010). The Future of Natural Gas: An Interdisciplinary MIT Study, Massachusetts Institute of Technology (MIT).

9) October 4:

EAP Tools 4: Life cycle analysis

- Rubin: Ch. 7
- Fthenakis, V. M. and H. C. Kim (2007). "Greenhouse-gas emissions from solar electric- and nuclear power: A life-cycle study." Energy Policy.
- Hall, C. A., J. G. Lambert and S. B. Balogh (2014). "EROI of different fuels and the implications for society." Energy Policy 64: 141-152.
- The Economic Input-Output Life Cycle Assessment tool `http://www.eiolca.net/`

optional:

- Renssen (2011). "What's in a name?" Nature Clim. Change 1(5): 241-242.
- Hendrickson, C., A. Horvath, et al. (1998). "Economic input-output models for environmental life-cycle assessment." Environmental Science & Technology 32(7): 184A-191A.
- Bergerson, J. and L. Lave (2007). "The long-term life cycle private and external costs of high coal usage in the US." Energy Policy 35(12): 6225-6234.

Problem set #2 due

10) October 9:

EAP Tools 5: Engineering economics for policy analysis

- GEA, Energy Primer (section 9, A.6)
- Rubin: Ch. 13
- Borenstein, S. (2013). "The Private and Public Economics of Renewable Electricity Generation." Journal of Economic Perspectives 26(1): 67-92.

optional:

- Lazard (2014). Lazard's Levelized Cost of Energy Analysis, Version 8.0.
- Anderson, D. (2006). Costs and Finance of Abating Carbon Emissions in the Energy Sector. Cambridge, UK, A report prepared for the HM Treasury Stern Review on The economics of climate change.

11) October 11:

Transmission and distribution

- Yergin: 17. Alternating Currents
- Meier, S. v. (2006). Electric Power Systems: A Conceptual Introduction, Wiley: IEEE Press. [Ch 6]
- Fairley, P. (2001). "A Smarter Power Grid." Technology Review: 41–49.
- Maris, E. (2008). "Energy: Upgrading the grid." Nature 454: 570-573.

optional:

- DOE (2006). National electric transmission congestion study, Washington, DC: US Department of Energy, Office of Electricity Delivery & Energy Reliability. August.

Problem set #3 handed out

12) October 16:

The electricity industry, markets, and restructuring

- Yergin: 19. Breaking the Bargain
- Hirsch, R. F. (1999). Creation of the Utility Consensus. Power Loss: The Origins of Deregulation and Restructuring in the American Electric Utility System. Cambridge, MA, The MIT Press.
- Borenstein, S. and J. Bushnell (2015). "The U.S. Electricity Industry After 20 Years of Restructuring." National Bureau of Economic Research Working Paper Series No. 21113.

optional:

- Joskow, P. (2000). Deregulation and Regulatory Reform in the US Electric Power Sector. Cambridge, MA, Massachusetts Institute of Technology, Center for Energy and Environmental Policy Research, pp 1–17.
- Borenstein, S. (2002). "The trouble with electricity markets: Understanding California's restructuring disaster." Journal of Economic Perspectives 16(1): 191-211.
- Dahl, C. (2004). International Energy Markets: Understanding Pricing, Policies and Profits, Pennwell Books. [Ch 4]

13) October 18:

Nuclear power (*Guest lecture Prof. Paul Wilson*)

- Yergin: 18. The Nuclear Cycle
- Rubin 2.6, 5.6.1,
- Deutch, J., E. Moniz, et al. (2003). The Future of Nuclear Power: An Interdisciplinary MIT Study. Cambridge, MA, Massachusetts Institute for Technology. *Read summary*

- Deutch, J. M. and E. J. Moniz (2006). "The nuclear options." Scientific American 295(3): 76-83.
- Goldemberg, J. (2007). "The limited appeal of nuclear energy." Scientific American 297(1): 38-40.

optional:

- Hannum, W. H. (2014). "Modern and future nuclear fuel cycles and the relationship with nuclear waste management." Wiley Interdisciplinary Reviews: Energy and Environment 3(4): 323-329.
- MIT Study, full report
- Ongena, J. and Y. Ogawa (2016). "Nuclear fusion: Status report and future prospects." Energy Policy 96: 770-778.

Problem set #3 due

14) October 23:

Wind power

- Yergin: 27. Rebirth of Renewables
- Yergin: 30. Mystery of Wind
- Rubin 5.6.5
- Wiser, R. H. and M. Bolinger (2017). 2016 Wind Technologies Market Report.

optional:

- Nemet, G. F. (2009). "Demand-pull, technology-push, and government-led incentives for non-incremental technical change." Research Policy 38(5): 700-709.
- Lu, X., M. B. McElroy, et al. (2010). "Global potential for wind-generated electricity." Proceedings of the National Academy of Sciences 106(27): 10933-10938.
- Lewis, J. I. and R. H. Wiser (2007). "Fostering a renewable energy technology industry: An international comparison of wind industry policy support mechanisms." Energy Policy 35(3): 1844-1857.

15) October 25:

MIDTERM EXAM

16) October 30:

Solar power

- Yergin: 29. Alchemy of Shining Light
- Rubin 5.6.7
- Barbose, G. L. and N. R. Darghouth (2016). Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States.
- Nemet, G. F. (2006). "Beyond the learning curve: factors influencing cost reductions in photovoltaics." Energy Policy 34(17): 3218-3232.

optional:

- Baker, E., M. Fowlie, et al. (2013). "The economics of solar electricity." Annual Review of Resource Economics 5(1).
- Lewis, N. S. (2007). "Toward Cost-Effective Solar Energy Use." Science 315(5813): 798-801.
- Zweibel, K., J. Mason, et al. (2008). "A Solar Grand Plan." Scientific American(January): 64–73.
- Butler, D. (2008). "Thin films: ready for their close-up?" Nature 454: 558-559.

17) November 1:

Mobility and transportation energy

- Yergin: 34. Internal Fire
- Rubin: Ch 3
- Schafer, A. and D. G. Victor (2000). "The future mobility of the world population." Transportation Research Part A: Policy and Practice 34(3): 171-205.
- Davis, S., S. Diegel, et al. (2008). Transportation Energy Data Book. Oak Ridge, TN, U.S. Department of Energy. *(browse)*

optional:

- Greene, D. L. (1998). "Why CAFE worked." Energy Policy 26(8): 595-613.
- Simmons, M. R. (2007). Another Nail in the Coffin of the Case Against Peak Oil.
- Schaeffer, A. (2007). "Long-Term Trends in Global Passenger Mobility." The Bridge 36(4).

18) November 6:

Energy and Air Pollution (*Guest lecture Ian Ryan*)

- Millstein, D., Wiser, R., Bolinger, M., & Barbose, G. (2017). The climate and air-quality benefits of wind and solar power in the United States. Nature Energy, 6, nenergy2017134. https://doi.org/10.1038/nenergy.2017.134

- Nemet, G. F., Holloway, T., & Meier, P. (2010). Implications of incorporating air-quality co-benefits into climate change policymaking. Environmental Research Letters, 5(1), 014007. https://doi.org/10.1088/1748-9326/5/1/014007
- `https://gispub.epa.gov/air/trendsreport/2017/#home` (Browse, this is a very good resource)

optional:

- Jacobson, M. Z. (2009). Review of solutions to global warming, air pollution, and energy security. Energy & Environmental Science, 2(2), 148–173. `https://doi.org/10.1039/B809990C`
- American Lung Association. (2017). The State of the Air 2017. `http://www.lung.org/assets/documents/healthy-air/state-of-the-air/state-of-the-air-2017.pdf`

19) November 8:

Storage: Batteries, PHEVs, H_2, and fuel cells *(possible power plant tour instead)*

- Yergin: 35. The Great Electric Car Experiment
- Bakker, S., H. van Lente, et al. (2012). "Competition in a technological niche: the cars of the future." Technology Analysis & Strategic Management 24(5): 421-434.
- Tran, M., D. Banister, et al. (2012). "Realizing the electric-vehicle revolution." Nature Climate Change 2(5): 328-333.
- Sperling, D. and J. Ogden (2004). "The Hope for Hydrogen." Issues in Science and Technology.

optional:

- IEA (2013). Global EV Outlook: Understanding the Electric Vehicle Landscape to 2020.
- Lemoine, D. M., D. M. Kammen, et al. (2008). "An innovation and policy agenda for commercially competitive plug-in hybrid electric vehicles." Environmental Research Letters(1): 014003.
- Sperling, D. and D. Gordon (2008). "Advanced Passenger Transport Technologies." Annual Review of Environment and Resources 33(1): 63.

Problem set #4 handed out

20) November 13:

EAP Tools 6: Resource depletion, Hubbert and Hotelling

- Yergin: 11. Is the World Running Out of Oil?
- Yergin: 12. Unconventional
- Hubbert, M. K. (1949). "Energy from Fossil Fuels." Science 109(2823): 103-109.

- Farrell, A. E. and A. R. Brandt (2006). "Risks of the oil transition." Environmental Research Letters 1(1): 014004.

optional:

- Devarajan, S. and A. C. Fisher (1981). "Hotelling's 'Economics of Exhaustible Resources': Fifty Years Later." Journal of Economic Literature 19(1): 65-73.
- Ahlbrandt, T. (2002). "Future Petroleum Energy Resources of the World." International Geology Review 44(12): 1092 - 1104.
- Kerr, R. A. (2010). "How Much Coal Remains?" Science 323(5920): 1420-1421.

21) November 15:

EAP Tools 7: Modeling technological change

- Yergin: 28. Science Experiment
- Rubin ch 15, (read 15.6 particularly closely)
- Nemet, G. F. (2013). "Technological change and climate-change policy." Encyclopedia of Energy, Natural Resource and Environmental Economics. Ed: J. Shogren.
- Grubler, A. (2012). "Energy transitions research: Insights and cautionary tales." Energy Policy 50: 8–16.

optional:

- McDonald, A. and L. Schrattenholzer (2001). "Learning Rates for Energy Technologies." Energy Policy 29: 255-261.
- Fouquet, R. (2010). "The slow search for solutions: Lessons from historical energy transitions by sector and service." Energy Policy 38(11): 6586-6596.
- Ridley, M. (2014). "The World's Resources Aren't Running Out." The Wall Street Journal.

Problem set #4 due

22) November 20:

Energy efficiency

- Yergin: 31. The Fifth Fuel—Efficiency
- Yergin: 32. Closing the Conservation Gap
- Rubin Ch 6.6–6.8, pp 262–275
- Fowlie, M., M. Greenstone and C. D. Wolfram (2015). "Are the Non-Monetary Costs of Energy Efficiency Investments Large? Understanding Low Take-up of a Free Energy Efficiency Program." American Economic Review.
- Charles, D. (2010). "Leaping the Efficiency Gap." Science 325(5942): 804-811.

optional:

- Gillingham, K., R. Newell, et al. (2006). "Energy Efficiency Policies: A Retrospective Examination." Annual Review of Environment and Resources 31(1): 161-192.
- Jenkins, J., T. Nordhaus, et al. (2011). Energy Emergence: Rebound And Backfire As Emergent Phenomena. Oakland, CA, The Breakthrough Institute.
- Lovins, A. (2007). Energy Myth Nine—Energy Efficiency Improvements Have Already Maximized Their Potential. Energy and American Society Thirteen Myths, Springer.
- Tietenberg, T. (2010). "Reflections–Energy Efficiency Policy: Pipe Dream or Pipeline to the Future?" Rev Environ Econ Policy: rep004.

November 22:

No class: Thanksgiving

23) November 27:

EAP Tools 8: Climate change and the energy system

- Yergin: 21. Glacial Change
- Yergin: 22. The Age of Discovery
- Rubin Ch 12
- IPCC (2007). Climate change 2007: Mitigation. Contribution of Working group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA, Cambridge University Press.

optional:

- Yergin: 23. The Road to Rio
- Krey, V. (2014). "Global energy-climate scenarios and models: a review." Wiley Interdisciplinary Reviews: Energy and Environment 3(4): 363-383.
- Wigley, T. M. L. and B. D. Santer (2013). "A probabilistic quantification of the anthropogenic component of twentieth century global warming." Climate Dynamics: 1-16.
- IEA (2008). Energy Technology Perspectives: Scenarios and Strategies to 2050. Paris, International Energy Agency.

Problem set #5 out

24) November 29

Climate policy and low-carbon energy technologies *possible guest lecture*

- Yergin: 24. Making a Market
- Yergin: 25. On the Global Agenda
- Hoffert, M. I., K. Caldeira, et al. (2002). "Advanced technology paths to global climate stability: Energy for a greenhouse planet." Science 298(5595): 981-987.
- Letters in response to Hoffert et al.
- Pacala, S. and R. Socolow (2004). "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies." Science 305: 968-972.

optional:

- Rogelj, J., M. Schaeffer, P. Friedlingstein, N. P. Gillett, D. P. van Vuuren, K. Riahi, M. Allen and R. Knutti (2016). "Differences between carbon budget estimates unravelled." Nature Clim. Change 6(3): 245-252.
- Prins, G., I. Galiana, et al. (2010). The Hartwell Paper: a new direction for climate policy after the crash of 2009. London, London School of Economics.

25) December 4:

U.S. energy policy 1973–2018

- Yergin: 26. In Search of Consensus
- Yergin: Conclusion: "A Great Revolution"
- Nixon, R. M. (1974). State of the Union speech.
- Carter, J. (1979). The "Crisis of Confidence" Speech.
- White House (2014). "The All-Of-The-Above Energy Strategy as a Path to Sustainable Economic Growth", Executive Office of the President.

optional:

- Cheney, R. (2001). National Energy Policy. Washington, DC, National Energy Policy Development Group, Office of the Vice President.
- Randolph, J. and G. M. Masters (2008). A brief chronology of U.S. Federal Energy Policy. Energy for sustainability: technology, planning, policy. Washington, Island Press: 681.
- Obama, B. (2013) Speech at Georgetown University (6/24/2013).

Problem set #5 due

26) December 6:

International energy governance

- Florini, A. and B. K. Sovacool (2009). "Who governs energy? The challenges facing global energy governance." Energy Policy 37(12): 52395248.
- Van de Graaf, T. and D. Lesage (2010). "The International Energy Agency after 35years: Reform needs and institutional adaptability." The Review of International Organizations.

optional:

- Witte, J.-M. (2010). Governing Global Oil in the 21st Century: Trends, Challenges and Policy Implications for the Transatlantic Alliance. Berlin, Global Public Policy Institute.
- Wood, G. (2010). "Re-Engineering the Earth." The Atlantic.
- Suding, P. H. and P. Lempp (2010). "The Multifaceted Institutional Landscape and Processes of International Renewable Energy Policy." International Association of Energy Economics: 4–9.

27) December 11:

Discussion and Review

28) December 13:

FINAL EXAM
9:30-11:30am, 175 Science Hall.

ADDITIONAL RESOURCES:

Energy Journals

- Annual Review of Energy and the Environment
- Climatic Change
- Energy Economics
- Energy Policy
- Energy
- Energy Research & Social Science
- The Energy Journal
- Environmental Research Letters
- Environmental Science and Technology
- Issues in Science and Technology
- Nature Climate Change
- Renewable and Sustainable Energy Reviews
- Science
- Wiley Interdisciplinary Reviews: Energy and Environment

Energy Data

International Energy Agency `http://www.iea.org/`
U.S. Energy Information Administration `http://www.eia.doe.gov/`
E.IA. mapping `http://www.eia.gov/state/maps.cfm`
BP Statistical Review of World Energy `http://www.bp.com/`
U.S. Bureau of Economic Analysis `http://www.bea.gov/`
U.S. D.o.E. Energy Citations Database `http://www.osti.gov/energycitations/`
CIA Factbook `https://www.cia.gov/library/publications/the-world-factbook/`
Wisconsin Energy Statistics `http://www.stateenergyoffice.wi.gov`

Other Help

– Scientific notation `http://www.nyu.edu/pages/mathmol/textbook/scinot.html`
– Swartz, C. E. (1993). Used Math for the First Two Years of College Science, American Association of Physics Teachers.

EnvSt/PubAff/URPL 809 : Introduction to Energy Analysis and Policy

Fall 2018

Prof. G. Nemet

SCHEDULE OF CLASSES: INTRO. EAP, FALL 2018

W	Date	Lecture #	Topic	Problem sets Handed-out, due	Coverage
1	6-Sep	1	Cheap, clean, and reliable: three energy challenges		1
2	11-Sep	2	Trends in production and use of energy		1
	13-Sep	3	EAP Tools 1: Units, magnitudes, rates of change	PS 1 out	1
3	18-Sep	4	EAP Tools 2 : Combustion		2
	20-Sep	5	Energy poverty, and development 1	PS 1 due	2
4	25-Sep	6	Energy poverty, and development 2		2
	27-Sep	7	EAP Tools 3: Power plants	PS 2 out	2
5	2-Oct	8	Fossil fuels: coal, and gas		3
	4-Oct	9	EAP Tools 4: Life cycle analysis	PS 2 due	3
6	9-Oct	10	EAP Tools 5: Cost assessment of energy technologies		3
	11-Oct	11	The grid: transmission and distribution	PS 3 out	3
7	16-Oct	12	The electricity industry: markets, and restructuring		MT
	18-Oct	13	*Nuclear power (Paul Wilson)*	PS 3 due	MT
8	23-Oct	14	Wind power		MT/4
	25-Oct	15	**MIDTERM EXAM**		
9	30-Oct	16	Solar power		4
	1-Nov	17	Mobility and transportation energy		4
10	6-Nov	18	Energy and air pollution (Ian Ryan)		4
	8-Nov	19	H2, FCVs, batt, storage **or WCCF**	PS 4 out	4
11	13-Nov	20	EAP Tools 6: Resource depletion: hubbert, hotelling		5
	15-Nov	21	EAP Tools 7: Modeling technical change	PS 4 due	5
12	20-Nov	22	Energy efficiency		5
	22-Nov		*No class: thanksgiving*		5
13	27-Nov	23	EAP Tools 8: Climate change and the energy system	PS 5 out	5
	29-Nov	24	Climate policy and low carbon energy technologies		5
14	4-Dec	25	U.S. energy policy 1973 - 2018	PS 5 due	F
	6-Dec	26	International Energy Governance		F
15	11-Dec	27	Discussion and Review		F
	13-Dec	28	**FINAL EXAM**		