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Course title: Energizing Europe: 21st-Century Renewable & Fossil Transformations

Course number: FU-BEST 30

Language of instruction: English

Contact hours: 45 **ECTS-Credits:** 6 **U.S. semester credits:** 3

Course description:

Today, the EU is seen as a world leader in alternative energy efforts, notably Germany's *Energiewende* to replace coal and nuclear with wind and solar for electricity. The EU is also unifying member-state gas, electrical and transport systems, liberalizing energy markets, and requiring more renewables. This is aided by the new European Energy Union (EEU), formed in response to the Ukraine crisis and Europe's dependence on Russian gas. In *Energizing Europe,* we critically examine the difficulties facing these energy transitions.

We begin by looking at Europe's previous energy transitions, each the product of larger, industrial revolutions. Informed by this history, we then critically examine Germany's *Energiewende (EW)* and EU energy policy. This includes the EW's: (i) roots in German society, (ii) goals, (iii) technical, and economic challenges of building and paying for its massive wind and solar, and to reengineer the grid. In addition: (iv) German and the EU's continued dependence on oil to fuel cars and trucks; (iii) German and EU natural gas policies – including their heavy dependence on Russian imports; (iv) Germany\s continued high use of coal; (v) and its rejection of nuclear power, albeit a zero-carbon energy source.

Throughout, we compare the German and EU energy reality to US policy. The course should be of interest to students of either social or natural sciences.

Course Objectives:

Energizing Europe introduces students to:

- Europe's available energy resources, technology and infrastructure.
- Europe's previous, historical energy transformations, from medieval agricultural (organic-energy-based) society to 20th-century fossil-fuel-based systems and global warming.
- Europe's 21st-century lower-carbon renewables and/or nuclear transition(s), focusing on *Energiewende* compared to the USA.

Learning Objectives

- Competence in finding, using and recognizing official, scientific energy data and expert analysis, as distinguished from popular/populist data and commentary, whether it be pro- or anti-climate-change mitigation
- Ability to begin approaching environmental issues from an historical perspective of previous energy transitions and of the objective technical, infrastructural, economic

realities and constraints which must be addressed to achieve a lower-carbon and lower-pollution environment as opposed to basing judgements and policy on purely "moral" and/or ideologically motivated "solutions" and policies

Course Requirements
Midterm exam: 20%
Term paper: 25%
Final exam: 30%
Attendance & participation (includes independent project & quizzes): 25%

Literature/Website
All readings are in a photocopied course reader; and at the course website
A password will be given for student directories.

Course schedule

	Topics, Readings, etc.
Session 1	**Energy Facts & Data: EU & Germany v. USA** What energy resources are available, produced and used for the EU, and Germany? What are prices, pollution and CO_2 emissions? What fuels electricity, transport, heat, industry? How long can fossil fuels and nuclear last? How much renewables are possible, used and planned? We compare all this to the USA, and we learn where to find official energy data online (IEA, EIA, EU and Germany). **Reading:** 1. World Energy Outlook, WEO 2017, IEA (International Energy Agency) OECD, Paris, 14 Nov. 2017. *(WEO 2018 release date is Nov. 2018)* • Read: Executive Summary (scroll down to text with charts) 2. International Energy Outlook 2017, EIA (Energy Information Agency), US DoE, 14 Sep 2017 *(IEO 2018 release date is Sep 2018)*. • Optional: Executive Summary 3. Energy Policies of IEA Countries: Germany, IEA, Paris, 2013. • Read: Exec. Summary & Key Recommendations pp. 9-16.
Session 2	***Energiewende-1:*** **Origins & goals** Germany's *Energiewende* aims to replace coal and nuclear energy with wind and solar electricity. The program is rooted in German moral and environmental consciousness, in its political-economic and social convictions. What are the *Energiewende's* roots, goals; its support and criticisms? **Reading:** 1. Bajczuk, Rafal, The unfinished reform. An assessment of the energy transformation in Germany, OSW Studies, Warsaw, 21 Nov 2017. [18 pp] 2. Paul Hockenos, Blame California for the Energiewende, IP Journal, 18 Dec 2012. Also published as a Heinrich Boll Stiftung Report. [2 pp]

	3. Hockenos, Paul, The Lost Honor of Germany's Energiewende: An Analyst [Claudia Kemfert] Returns Fire in the War of Words. [4 pp]
Session 3	***Energy System 1.0:*** **Traditional, organic society** Humans have made *systemic* energy transitions during industrial revolutions. This week we see how from ancient times, humans first depended on increasingly complex traditional "organic energy" systems. **Reading:** 1. *Power to the People,* Chapter 3. Traditional Sources pp.37-80 [44 pp] *(Index of this book is in the reader here; online it's at end of Chapter 11)* ***Primer A:*** **Electrical Systems (conventional): PPT & handout**
Session 4	***Energy System 2.0:*** **The 1st Industrial Revolution** From the late-18th-to-mid-19th centuries, The First Industrial Revolution in England brought about an energy transition (or, vice-versa, according to most experts today) to a mineral-based, i.e., coal-fueled system, and put an end to the traditional organic system. **Readings:** 1. Industrial Revolution. (2015, April 13). *New World Encyclopedia,* Retrieved 04:42, July 14, 2017/ [18 pp] 2. Marx, Karl. *Capital*. Volume I, Part IV, Chapter 15. "Machinery and Modern Industry" Section 1. The Development of Machinery, London, 1865. Read at least excerpts marked in reader [6-of-16 pp] ***Primer B:*** **Conventional Sources:** PPT & handout
Session 5	***Energy System 3.0:*** **The 2nd Industrial Revolution** The 20th Century: Internal combustion engine (ICE) Development Bloc: oil and electricity. Microelectronics (ICT) Development Block. From analog to digital control; universal processors. **Readings:** 1. Smil, Vaclav, The Miraculous 1880's, July 2015 North American IEEE Spectrum, July 2015 2. *Power to the People,* Chapter 9: Major Development Blocks in the 20th Century and their Impacts on Energy pp. 287-318 [44 pp] ***Primer C:*** **Renewable Sources (solar, wind):** PPT & handout
Session 6	**Midterm Exam**
Session 7	***Energy System 4.0:*** **The 3rd Industrial Revolution** **Reading:**

	1. *Power to the People.* Chapter 11: Summary & Implications for Future: Summing up the book; Thinking about the future; Some remarks about the future; pp. 366-86 [21 pp] ***Primer D:*** **Grids with Variable Renewables & Storage** PPT & handout
Session 8	***Energiewende-2:*** **German & EU Renewable Transition Status** **Readings:** 1. Cunningham, Thomas, Energiewende: From Germany's Past to Europe's Future?, Atlantic Council, Wash. D.C., Feb. 2017 [9 pp] 2. Energy hit: German decision to slow expansion of green-energy production reasonable. Nature, Editorial, p 152, v. 534, 9 June 2016. [1 pp] 3. Smil, Vaclav, How Green is Europe? *American,* Sept. 30, 2014. [3 pp] 4. Smil, Vaclav, Germany's Energy Goals Backfire, *American,* Feb. 14, 2014 [2 pp] 5. Patel,Sonal, Germany's Energy Transition Experiment, Power, 05 January 2013. [10 pp]
Session 9	***Energiewende-3:*** **German & EU Transport -** ***A "Transport-wende?"*** In Germany and the EU, 95% of all transport remains oil based, vehicles are increasing and traffic congestion is rising. A "*Transportwende*" transition from individual vehicles to electric-based mass transit (i.e., alternative modes, not alternative fuels or self-driving vehicles) is needed. **Readings:** 1. Vehicle Ownership and Income Growth, Worldwide: 1960-2030, J Dargay, D Gately and M Sommer, Energy Journal, IAEE, vol. 0(No. 4), Jan 2007. Read: pp. 143-49 & 159-70, [17 pp] 2. "The Slow Lane, Can anyone solve the problem of traffic?" John Seabrook, New Yorker, 2 Sept. 2002. [15 pp]
Session 10	***Energiewende-4:*** **Germany & Europe's natural gas systems** Part 1: EU pipeline & market integration; Security; The Energy Union requires natural gas for electrical generation, heat, chemicals and industry; and to back up highly variable wind and solar. Gas is superior to coal and oil on carbon emissions and pollution, but the Germany's Russian gas supplier has seized Crimea and intervened in Ukraine. **Readings:** 1. Westphal, K., Russian Energy Supplies to Europe, Crimea Crisis…, SWP Comments 2014/C 17, Mar 2014. [4 pp] 2. Geden, O., Effective Provisions for Emergency Prevention and Response in the Gas Sector, SWP Comments, Aug 2009. [4 pp] 3. O'Donnell, T. W., *Neue Neue Ostpolitik, Berlin Policy Journal,* July/Aug 2017. [5 pp] 4. O'Donnell, T.W, Containing Gazprom, Berlin Policy J., 10 Aug'15 5. O'Donnell, T.W., Bypass Operation, Berlin Policy J., 20 Oct 2015 6. O'Donnell, T.W., Addressing Europe's Energy Dependence on Russia: IP Journal, DGAP, 06 May 2014.[3 pp]

	7. O'Donnell, Thomas "Energiewende vs. Shale Gas: Can German Industry Compete? 30 Dec 2013 [3 pp]
Session 11	***Energiewende-5:*** German high gas prices, Rejection of fracking. Opposition to LNG as a transport fuel. Why so much coal v. gas for German electricity? **Readings:** 1. O'Donnell, Thomas, "Germany's Real LNG Strategy," Berlin Policy Journal, 28 June 2018. [5 pp] 2. O'Donnell, Thomas "Energiewende vs. Shale Gas: Can German Industry Compete? 30 Dec 2013 [3 pp] 3. Tsafos, Nikos "Missing Shale Miracle: Why Cheap Energy Won't Spark a U.S. Manufacturing Renaissance," Foreign Affairs, Mar 23, 2014. [2 pp] 4. Arthur Neslen, "Germany moves to legalize fracking: Four-year moratorium … overturned" Guardian, 14 Feb 2015.[2 pp] 5. Craig Morris, "German government did not just approve fracking," Heinrich Boll Stiftung,17 Feb 2015 [2 pp] 6. Bloomberg, Michael and Krupp, Fred, "The right way to develop shale gas," 29 Apr 2014: NYT Op-Ed [1 p]
Session 12	***Energiewende-6:*** **Nuclear energy** Germany rejects nuclear. Plants being shut early were designed in the 1950-to-70's, as was Fukushima (1950's). However, Next-Generation reactors differ greatly in safety, waste, and efficiency. With nuclear's zero-carbon footprint, is 100% rejection of nuclear wise? France achieved the industrial world's first and only transition to zero-carbon electricity, in 26 years, using nuclear plants. **Readings**: 1. "Technology Roadmap: Nuclear Energy 2015," IEA and NEA. Read pp. 1-8 & 25-33, [16 pp] 2. "Next Generation Nuclear Power:" New, safer and more economical reactors could not only satisfy many future energy but combat global warming; James A. Lake, Ralph G. Bennett and John F. Kotek, Scientific American, January 2003. [14 pp] 3. '2009 Update of the MIT 2003 Future of Nuclear Power Study", MIT Energy Initiative, 2009. Read pp 3-10 & 17-20. [12 pp]
Session 13	**Final Exam**