Freie Universität Berlin

FU/BEST Program

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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: 5 **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 energy transformations, culminating in the late-20th-century European fossil-hydro-nuclear system with uncontrolled global warming. How WW II and four post-War energy crises shaped this system.
- Europe's 21st-century lower-carbon, renewables transition(s), especially Germany's *Energiewende* compared to the USA.

- The 21st-century trajectories of the EU's fossil and nuclear power sectors in response to economic, geopolitical and climate imperatives.
- And, students learn how to find reliable energy data and expert commentary

Course Requirements
Midterm exam: 20%
Term-paper: 25%
Final exam: 30%
Attendance & participation (incl. Independent Project report & quizzes): 25%

Student profile
Second-semester sophomore or above

Prerequisites
None

Literature/Website
All readings are in a photocopied course reader; and at the course website http://www.umich.edu/~twod/fu_f2017 A password will be given for student directories.

Course schedule

Sessions	Topics, Readings, etc.
Session 1	**Energy Facts & Data: EU & Germany v. USA** For the EU and Germany, what energy resources' are available, produced and used; what are their prices, their pollution and CO_2 emissions? What is used to fuel 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 learn where to find official energy data online (IEA, EIA, EU and Germany). **Reading:** 1. Energy Information Agency's International Energy Outlook (IEO), May 2016: Executive Summary, [6 pp]
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. Paul Hockenos, Blame California for the Energiewende, IP Journal, 18 Dec 2012. Also published as a Heinrich Boll Stiftung Report. [2 pp] 2. Energy Policies of IEA Countries: Germany, 2013, - Read: Exec. Summary & Key Recommendations pp. 9-16. [7 pp] 3. David Buchan, The *Energiewende*: Germany's Energy Gamble, Oxford (OIES), June 2012 [12 pp] - Read only: Summary; Introduction; 'Energy Concept' & nuclear exit–scenarios; Conclusion.
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] *(Note: Index of this book is at the end of Chapter 11)*
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. [16 pp]
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]
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]
Session 8	***Energiewende-2:*** **German & EU Renewable Transition Status** **Readings:** 1. Hockenos, Paul, The Lost Honor of Germany's Energiewende: An Analyst [Claudia Kemfert] Returns Fire in the War of Words. [4 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. Kirsten Verclas, The Reform of the German Renewable Energy Act in 2014, AICGS, 22 Augt 2014.[5 pp] 4. Smil, Vaclav, How Green is Europe? *American,* Sept. 30, 2014. [3 pp] 5. Smil, Vaclav, Germany's Energy Goals Backfire, *American,* Feb. 14, 2014 [2 pp] 6. Sonal Patel, Germany's Energy Transition Experiment, Power, 05 January 2013. [10 pp]
Session 9	***Energiewende-3:*** **German & EU Transport** 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, The 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 in the global oil system**

	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]
Session 11	***Energiewende-5:*** **Germany & Europe's natural gas systems** Part 2: German high gas prices, Fracking controversy, LNG as transport fuel; Why so much coal and so little gas for German electricity? **Readings:** 1. Arthur Neslen, "Germany moves to legalize fracking: Four-year moratorium … overturned", Guardian, 14 Feb 2015.[2 pp] 2. Craig Morris, "German government did not just approve fracking," Heinrich Boll Stiftung,17 Feb 2015 [2 pp] 3. O'Donnell, Thomas "Energiewende vs. Shale Gas: Can German Industry Compete? 30 Dec 2013 [3 pp] 4. "The right way to develop shale gas" By M Bloomberg and F Krupp, Apr 29, 2014: NYT Op-Ed [1 p] 5. "Missing Shale Miracle: Why Cheap Energy Won't Spark a U.S. Manufacturing Renaissance," N. Tsafos, Foreign Affairs, Mar 23, 2014.
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**