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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 especially 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

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Course Requirements

Midterm exam: 20%

Term-paper: 25%

Final exam: 30%

Attendance & participation (includes independent project & quizzes): 25%

Prerequisites

None

Student profile

Second-semester sophomore and above

Literature/Website

- Photocopied course reader; website

Course schedule

	Topics, Readings, etc.
Session 1	<p>Energy Facts & Data: EU & Germany v. USA</p> <p>What energy resources are available, produced and used for the EU, and Germany? What are prices, pollution and CO₂ 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).</p> <p>Reading:</p> <ol style="list-style-type: none"> 1. World Energy Outlook, WEO 2017, IEA (International Energy Agency) OECD, Paris, 14 Nov. 2017. (<i>WEO 2018 release date is Nov. 2018</i>) <ul style="list-style-type: none"> • Executive Summary (scroll down to summary with charts) 2. International Energy Outlook 2017, EIA (Energy Information Agency), US DoE, 14 Sep 2017 (<i>IEO 2018 release date is Sep 2018</i>). <ul style="list-style-type: none"> • Read: Executive Summary 3. Energy Policies of IEA Countries: Germany, IEA, Paris, 2013. <ul style="list-style-type: none"> • Read: Exec. Summary & Key Recommendations pp. 9-16.
Session 2	<p>Energiewende-1: Origins & goals</p> <p>Germany's <i>Energiewende</i> 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</p>

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	<p>and social convictions. What are the <i>Energiewende</i>'s roots, goals; its support and criticisms?</p> <p>Reading:</p> <ol style="list-style-type: none"> 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]
<p>Session 3</p>	<p><i>Energy System 1.0: Traditional, organic society</i></p> <p>Humans have made <i>systemic</i> energy transitions during industrial revolutions. This week we see how from ancient times, humans first depended on increasingly complex traditional “organic energy” systems.</p> <p>Reading:</p> <ol style="list-style-type: none"> 1. <i>Power to the People</i>, Chapter 3. Traditional Sources pp.37-80 [44 pp] (Note: Index of this book is at the end of Chapter 11) <p>Primer A: Electrical Systems (conventional): PPT & handout</p>
<p>Session 4</p>	<p><i>Energy System 2.0: The 1st Industrial Revolution</i></p> <p>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.</p> <p>Readings:</p> <ol style="list-style-type: none"> 1. Industrial Revolution. (2015, April 13). <i>New World Encyclopedia</i>, Retrieved 04:42, July 14, 2017/ [18 pp] 2. Marx, Karl. <i>Capital</i>. 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] <p>Primer B: Conventional Sources: PPT & handout</p>
<p>Session 5</p>	<p><i>Energy System 3.0: The 2nd Industrial Revolution</i></p>

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	<p>The 20th Century: Internal combustion engine (ICE) Development Bloc: oil and electricity. Microelectronics (ICT) Development Block. From analog to digital control; universal processors.</p> <p>Readings:</p> <ol style="list-style-type: none"> Smil, Vaclav, The Miraculous 1880's, July 2015 North American IEEE Spectrum, July 2015 <i>Power to the People</i>, Chapter 9: Major Development Blocks in the 20th Century and their Impacts on Energy pp. 287-318 [44 pp] <p>Primer C: Renewable Sources (solar, wind): PPT & handout</p>
Session 6	Midterm Exam
Session 7	<p><i>Energy System 4.0: The 3rd Industrial Revolution</i></p> <p>Reading:</p> <ol style="list-style-type: none"> <i>Power to the People</i>. Chapter 11: Summary & Implications for Future: Summing up the book; Thinking about the future; Some remarks about the future; pp. 366-86 [21 pp] <p>Primer D: Grids with Variable Renewables & Storage PPT & handout</p>
Session 8	<p><i>Energiewende-2: German & EU Renewable Transition Status</i></p> <p>Readings:</p> <ol style="list-style-type: none"> Cunningham, Thomas, Energiewende: From Germany's Past to Europe's Future?, Atlantic Council, Wash. D.C., Feb. 2017 [9 pp] Energy hit: German decision to slow expansion of green-energy production reasonable. Nature, Editorial, p 152, v. 534, 9 June 2016. [1 pp] Smil, Vaclav, How Green is Europe? <i>American</i>, Sept. 30, 2014. [3 pp] Smil, Vaclav, Germany's Energy Goals Backfire, <i>American</i>, Feb. 14, 2014 [2 pp] Sonal Patel, Germany's Energy Transition Experiment, <i>Power</i>, 05 January 2013. [10 pp] David Buchan, The Energiewende: Germany's Energy Gamble, Oxford (OIES), June 2012 [12 pp] <ol style="list-style-type: none"> Read only: Summary; Introduction; 'Energy Concept'; Nuclear exit-scenarios & Conclusion.
Session 9	<i>Energiewende-3: German & EU Transport - A "Transportwende?"</i>

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	<p>In Germany and the EU, 95% of all transport remains oil based, vehicles are increasing and traffic congestion is rising. A “<i>Transportwende</i>” transition from individual vehicles to electric-based mass transit (i.e., alternative modes, not alternative fuels or self-driving vehicles) is needed.</p> <p>Readings:</p> <ol style="list-style-type: none"> 1. Vehicle Ownership and Income Growth, Worldwide: 1960-2030, J Dargay, D Gatley 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]
<p>Session 10</p>	<p><i>Energiewende-4: Germany & Europe’s natural gas systems</i></p> <p>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.</p> <p>Readings:</p> <ol style="list-style-type: none"> 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]
<p>Session 11</p>	<p><i>Energiewende-5: A “Transport-wende?” Germany & Europe in the global oil system</i></p> <p>The origins of the present, global oil system, which arose in the wake of the 1973 OPEC oil embargo (the “First Energy Crisis”) and the subsequent nationalization of oil by OPEC countries (the “OPEC Revolution”). Note it is written from the perspective of the period of 1973 up to 2006 - when the Iraq war and EU-US relations were at a very intense point.</p>

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	<p>All OECD states, including Germany, are an integral part of the market-based, global oil system via the International Energy Agency of the OECD. Oil is the MAIN source of energy in many of these states, and still provides about 94% of all transport in Germany and all the others. The security of oil is collectively guaranteed in this system, with the USA playing the predominant role as “protector” or “hegemon” of the system, whether militarily or in “spot” and “futures” markets.. The decisions and policies of the USA in this role have at times created major frictions and disagreements with Germany and other OECD states (e.g., the Iraq wars, and confrontations with Iran, and Saudis relations..</p> <p><i>Read the beginning and end thoroughly and at least 2/3 of what i in between. It is not complicated, but if the history is mostly new, it is not necessarily easy to digest it all before our class discussion.</i></p> <p>Reading:</p> <ol style="list-style-type: none"> 1. O'Donnell, T.W., “Political-Economy of the Globalized Oil Order: How 'objective conditions' drove the OECD and OPEC from confrontation to collusion,” 2006/2011 [48 pp.]-
<p>Session 12</p>	<p><i>Energiewende-6: Nuclear energy</i></p> <p>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.</p> <p>Readings:</p> <ol style="list-style-type: none"> 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]
<p>Session 13</p>	<p>Final Exam</p>