Freie Universität Berlin

FU/BEST Program

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Course title: Energizing Europe: 21st-Century Renewable and 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 a world leader in alternative energy efforts, most notably Germany's *Energiewende*, which aims to replace coal and nuclear with wind and solar electricity. However, the EU is also interconnecting member-state gas, electrical and transport systems and unifying its energy markets aided by its new European Energy Union (EEU) — whose formation was spurred by the Ukraine crisis and Europe's heavy dependence on Russian gas. In *Energizing Europe,* we investigate how these transitions impact EU carbon emissions, resources, economy, society, and geopolitical security. We begin by surveying the EU's energy resources and infrastructure as compared to the USA's. We then study Europe´s energy transitions from medieval times through its 20th-century energy crises and wars. With this preparation, we begin a study of Europe's intended 21st-century energy transitions. Topics include: (i.) Germany's *Energiewende*, its technical, economic, and social challenges and its impact on EU neighbors; (ii.) problems of oil dependence and traffic congestion in the German and EU transport sectors; (iii.) EU natural gas policy – external issues including dependence on Russia and pipelines through Ukraine, attempts to diversify with Norwegian, North African and Caspian gas and with US liquefied natural gas (LNG); and internal issues such as market unification, interconnection of pipelines, anti-monopoly efforts, fracking, and competition from cheap carbon-intensive coal; (iv.) finally, we examine German rejection of nuclear energy in light of risks and promises of next-generation reactors. Throughout, students follow current German, EU and related global energy affairs. This course should be of interest to students of both social and natural sciences.

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Course Objectives:

Energizing Europe introduces students to:
- Europe's available energy resources, technology and infrastructure.
- Europe's previous energy transformations, through centuries of development and industrial revolutions, 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 and are still felt today.
- Europe's 21st-century lower-carbon, renewables transition(s), especially Germany's *Energiewende* in historical/theoretical context and compared to projects of other EU member states and the US.
- The 21st-century trajectories of the EU's fossil and nuclear power sectors in response to economic, geopolitical and climate imperatives.

Emphasis is placed on examining policy and environmental arguments in light of available data and scientific research with leeway for students of both social and natural sciences to apply their particular approaches.

Course Requirements

Midterm exam: 20%
Term-Paper: 25%
Final exam: 30%
Attendance and participation (includes one Independent Project report): 25%

Literature/Website

All readings are in a photocopied course reader and from online links below where possible.

Course schedule

Sessions	Topics, Readings, etc.
Session 1	**Topic: European Energy Transitions: Overview & Introduction** Europe's current renewable energy transformations are only the latest steps in a centuries-long evolution of its energy system from "organic" to "mineral" and to today's push for renewables. From especially the 11th Century in the Middle Ages to the mid-20th century, Europe experienced a series of industrial revolutions, each of which drove major energy-system transformations.

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	Recently collected historical economic data inform a theoretical framework for evaluating today's European energy transformations. These are being attempted, as we shall see, at a rate of change far exceeding that in any past industrial revolution. Yet, today's transitions lack the social-economic drivers of those revolutions. The unique historical challenge presented by a massive transition to non-carbon sources – especially without nuclear energy – such as Germany's *Energiewende* aims to accomplish then becomes strikingly evident. (First five class sessions) **Reading:** 1. Astrid Kander, Paolo Malanima, Paul Warde. *Power to the People*: *Energy in Europe Over the Last Five Centuries.* Princeton & Oxford: Princeton University Press, 2013. [Hereafter: *Power to the People*] a. *Contents.* pp. iv-iix b. *Preface.* pp. ix-x [2 pp] c. Chapter 1. Introduction pp.1-16 [17 pp] i. What needs to be Explained ii. Research Questions & Main Arguments iii. The Structure of the Book d. Chapter 2. Definitions & Concepts pp. 17-34 [17 pp] i. Energy Consumption in the Economic Sense ii. Market Widening & Market Suction **Topic: EU & International Energy Profile** We examine Europe's available energy resources, energy consumption, production, prices and CO_2 emissions and compare to the USA & world. **Reading:** 2. Energy Information Agency's International Energy Outlook (IEO), May 2016: Executive Summary, [6 pp]
Session 2	**Topic: European Energy Transitions: Pre-Industrial Societies** Organic energy era; Transition to mineral energy: 11th-to-18th centuries **Reading:** 1. *Power to the People* a. Chapter 3. Traditional Sources pp.37-80 [44 pp] i. Energy in Pre-Modern Societies ii. Organic Sources and Agricultures iii. Non-organic Sources iv. Seven Long-run propositions v. Conclusion
Session 3	**Topic: European Energy Transitions: 1st Industrial Revolution** Rise of "King Coal" and modern industrial society: late-18th to late-19th C.

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	Readings: 2. *Power to the People* a. The First Industrial Revolution, P. Warde pp. 129-30 [2 pp[b. Chapter 5. Modern Energy Regime pp. 131-58] [27 pp] i. The Take-off of Coal ii. Traditional Sources: Rise but Relative Decline iii. Conclusion c. Chapter 6. The Coal Development Block pp.209-248 [39 pp] i. The Core Innovations ii. The Growth Dynamics of the Coal Development Block iii. The Transport Revolution
Session 4	**Topic: European Energy Transitions: 2nd & 3rd Industrial Revolutions** 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. *Power to the People* a. Chapter 9: Major Development Blocks in the 20th Century and their Impacts on Energy p.287-331 [44 pp] i. The ICE-Oil Block p.287 ii. The Electricity Block p.303 iii. The ICT Development Block p.318 iv. Conclusion p.330
Session 5	**Topic: European Energy Transitions: Overview & Conclusions. Critique of "Power to the People" Approach** **Reading:** 1. *Power to the People.* a. Chapter 11: Summary & Implications for Future. p. 366-86 [21 pp] i. Summing up the Book. p.366 ii. Thinking About the Future p.374 iii. Some Remarks About the Future p. 382 2. Marx, Karl. *Capital*. Volume I, Part IV, Chapter 15. "Machinery and Modern Industry" Section 1. The Development of Machinery, London, 1865, [~10 pp]
Session 6	**Midterm Exam**
Session 7	**Topic: Germany's *Energiewende*. Part 1:** Germany's *Energiewende* aims to replace coal and nuclear energy with wind and solar in electrical generation. This is the most ambitious such program in the EU or globally. It is rooted in German moral, environmental consciousness and political-economic and social convictions.

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	What are the *Energiewende's* challenges and trajectory, the support or criticism from various stakeholders and its recent adjustments? How does it differ from the US approach, which has seen recent advances? (Sessions 7 & 8) Political & ideological origins, goals. Compared to other EU states & USA **Reading:** 1. Energy Policy, Volume 39, Issue 11, November 2011, Pages 7422–7431, The coming sustainable energy transition: History, strategies, and outlook, Barry D. Solomona, Karthik Krishnab [9 pp] 2. Energy Policy, Volume 34, Issue 15, October 2006, Pages 2279–2297, Energy in transition: From the iron curtain to the EU, Diana Ürge-Vorsatza, Gergana Miladinovab, László Paizsc [18 pp] 3. Paul Hockenos, Blame California for the Energiewende, IP Journal, 18 Dec 2012. Also printes as a Heinrich Boll Stiftung Report. [2 pp] 4. Energy Policies of IEA Countries: Germany, 2013 a. Read: Exec. Summary & Key Recommendations [16 pp] 5. David Buchan, The *Energiewende*: Germany's Energy Gamble, Oxford Institute for Energy Studies (OIES), June 2012 [35 pp]
Session 8	**Topic: Germany's *Energiewende*. Part 2:** Recent adjustments and critiques; trajectory **Readings:** 1. The Lost Honor of Germany's Energiewende: An Analyst [Claudia Kemfert] Returns Fire in the War of Words, by Paul Hockenos [4 pp] 2. Sonal Patel, Germany's Energy Transition Experiment, Power, 05 January 2013. [10 pp] 3. Energy hit: Germany's decision to slow the expansion of green-energy production is a reasonable move. This Week Editorials, NATURE, p. 152, v. 534, 9 June 2016. 4. Kirsten Verclas, The Reform of the German Renewable Energy Act in 2014, AICGS, 22 August 2014.[5 pp] 5. Severin Fischer, Oliver Geden. Europeanising the German Energy Transition, SWP Comments 2011/C 33, November 2011. [4 pp] 6. Severin Fischer, Oliver Geden, Moving Targets: Negotiations on the EU's Energy and Climate Policy Objectives for the Post-2020 Period and Implications for the German Energy Transition, SWP Research Paper 2014/RP 03, March 2014. [30 pp] 7. Polish energy policy: A different Energiewende Poland moves closer to its own nuclear energy. The Economist, 8 February2014 [1 p]
Session 9	**Topic: Oil & Congestion: A Sustainable EU Transport Transition?** Building on Session 2, we examine how continued German and EU dependence on petroleum-fueled personal vehicles and trucks exacerbates both carbon emissions and the social-economic curse of

	traffic congestion. We examine 15 years of EU policies to combat these problems, and consider how a transition ("*Transportwende*") from individual vehicles to mainly electrical-powered shipping and mass transit, (that is, to alternative modes as versus to alternative fuels) could resolve these coupled crises. **Readings:** 1. Illustrated Brochure, White Paper on Transport, European Commission, 2011 [16 pp] 2. Vehicle Ownership and Income Growth, Worldwide: 1960-2030, Joyce Dargay, Dermot Gately and Martin Sommer, The Energy Journal, IAEE, vol. 0(No. 4), Jan 2007. Read: pp. 1-6 & 18-28, [17 pp] 3. "The Slow Lane, Can anyone solve the problem of traffic?" John Seabrook, New Yorker, 2 Sept. 2002. [15 pp]
Session 10	**Topic: The Natural Gas Conundrum. Part 1:** **EU pipeline and market integration; Energy Union** In addition to renewable energy, Europe will require natural gas for its remaining electrical generation, heating and industrial processes. While gas is superior to coal and oil on carbon emissions and pollution, the EU is dependent on Russian gas and Europe's security order has collapsed with Russia's seizure of Crimea and intervention in east Ukraine. Furthermore, gas pipelines from alternative countries face unrest and Russian counter-moves, while gas prices in Germany and the EU far exceed the USA's with its fracking revolution. The new European Energy Union aims to foster new gas infrastructure, market-liberalization and anti-monopoly regulations (esp. against Gazprom), though the EU generally rejects fracking. What is the EU gas trajectory? Are energy crises like those of late-20th-century Europe likely? (Sessions 10 & 11) **Readings:** 1. Westphal, Kirsten, "Russian Energy Supplies to Europe, The Crimea Crisis: Mutual Dependency, Lasting Collateral Damage and Strategic Alternatives for the EU," SWP Comments 2014/C 16, Mar 2014. [4 pp] 2. Sharples, J. and Judge, A. "Russian Gas Supplies to Europe: the Likelihood, and Potential Impact, of an Interruption in Gas Transit via Ukraine," European Geopolitical Forum, 24 Mar 14. [13 pp] 3. Geden, Oliver, "Effective Provisions for Emergency Prevention and Response in the Gas Sector: Pioneering Proposals of the Commission for a New Risk Management Architecture," SWP Comments 2009/C 21, Aug 2009. [4 pp] 4. "How the EU can progress towards an "Energy Union," IEA review praises bloc's low-carbon leadership but notes that deeper market integration is essential to manage costs of clean-energy shift, 1 Dec 2014, Brussels [2 pp] 5. O'Donnell, Thomas, "Washington Viewpoints: Assessing Berlin's Role in EU Energy Security" (Report on interviews with US experts on EU

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	energy), Amer. Institute for Contemporary German Studies (AICGS), 30 June 2015. [11 pp] 6. Containing Gazprom'' and ''Bypass Operation'' from Berlin Policy Journal, 2015, by T.O'D. 7. O'Donnell, T., "Addressing Europe's Energy Dependence on Russia: Globalizing gas market, creating OECD strategic reserves could make embargoes history," IP Journal, DGAP, 06 May 2014.[3 pp]
Session 11	**Topic: Europe's Natural Gas Conundrum. Part 2:** The fracking controversy; LNG imports; Energiewende v. shale gas **Readings:** 1. Susanne Dröge, Kirsten Westphal, "Shale Gas for a Better Climate? The US Fracking Revolution Challenges European and International Climate Policy." Stiftung Wissenschaft und Politik - Berlin (SWP) Comments 2013/C 25, August 2013 , [8 pp] 2. Tim Boersma, Corey Johnson, "Risks and Potentials of the Shale Gas Revolution: Consequences for Markets and the Environment." Stiftung Wissenschaft und Politik - Berlin (SWP) Comments 2012/C 39, December 2012. [8 pp] 3. Interpretation controversy: a. Arthur Neslen, "Germany moves to legalize fracking: Four-year moratorium on shale drills set to be overturned as country initiates process to allow regulated hydraulic fracturing for shale gas." Guardian, 14 February 2015.[2 pp] b. Craig Morris, "German government did not just approve fracking," Heinrich Boll Stiftung, 16 Feb 2015 [2 pp] 4. Thomas O'Donnell, "Energiewende vs. Shale Gas: Can German Industry Compete?" 30 Dec 2013 [3 pp] 5. "The right way to develop shale gas" By Michael R. Bloomberg and Fred Krupp, April 29, 2014: NY Times Op-Ed 6. "The Missing Shale Miracle: Why Cheap Energy Won't Spark a U.S. Manufacturing Renaissance," Nikos Tsafos Foreign Affairs, March 23, 2014.
Session 12	**Topic: Germany's Non-Nuclear Transition** Germany resoundingly rejects nuclear power. There is a long cultural and political history to this preference. Nuclear plants being shut early in Germany are based on designs from the 1950's to 1970's as was Japan's Fukushima (1950's). However, "next-generation" reactors differ significantly in safety, radioactive waste production, and energy efficiency. Given nuclear energy's zero-carbon footprint, and the risks v. promises of these next-generation reactors, is across-the-board rejection of nuclear advisable? We compare old-style versus next-generation reactors (GenIV, SME, Breeder & Thorium) on safety, waste, carbon-footprints, cost.

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	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 nuclear reactors could not only satisfy many of our future energy needs but could combat global warming as well; 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**