San José State University
Environmental Studies Department
Energy & the Environment ENVS/ENGR 119 Sec. 1, Spring 2017
#27837 #29277

Course and Contact Information

Instructor:	Benoit Delaveau, M.S, CEM, BEAP
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Office Hours:	MoWe 1:00-2:30 PM (from 1/30 to 5/10) - ALWAYS email me.
Class Days/Time:	MoWe 10:30AM - 11:45AM (from 1/30 to 5/10)
Classroom:	Dudley Moorhead Hall 164
Prerequisites:	Passing the WST http://testing.sjsu.edu/wst/
GE/SJSU Studies Category:	Area R: Earth & Environment http://info.sjsu.edu/static/catalog/sjstudies.html

Course Format

Faculty Web Page and MYSJSU Messaging
You are responsible for **daily** checking with the messaging system through MySJSU and Canvas. Course materials such as the syllabus, assignments, readings, and handouts are posted to canvas: https://sjsu.instructure.com . Log in with your SJSU One account info. For assistance see: http://www.sjsu.edu/at/ec/support/

Course Description
In this course you will be introduced to the nexus of social, technical, and environmental challenges to providing sustainable energy supplies and patterns of use. You will learn physical principles underlying power generation, conventional forms of energy and their social and environmental impacts, sources of renewable energy, and means to transition to more sustainable energy sources. The political, economic, cultural, historical, and policy dimensions of energy procurement, generation, and consumption will show how energy issues are entangled in deeper social and environmental contexts. Human civilization cannot continue using fossil fueled based energy at our present rate of consumption; we must look for ways to decrease and decarbonize our energy use.

This course is divided into five parts. Part 1 reviews energy generation and consumption patterns and the scientific principles related to energy, heat, and work. Part II of this course explores various sources of energy from conventional forms of energy generation and their social and environmental impacts. Part III focuses on renewables including solar, wind, biomass, wave, tidal, hydroelectric, and geothermal. Part IV centers on questions about making infrastructure more sustainable: food systems, transportation, and buildings. In part V, we will synthesize planning efforts and proposals for making sustainable energy transitions.

Course Goals

At the end of this course, students should be able to:

- Understand the nexus of energy challenges and relevant economic, social, and environmental issues.
- Describe the physical principles related to the energy, heat, power, and work
- Complete basic calculations / conversions in energy, heat, power, and work
- Describe the scientific properties and spatial distribution of conventional and renewable energy sources
- Analyze the relative energy use in U.S. to other nations, and the forces that shift the mix of energy sources over time
- Describe basic principles to improve efficiency and design of energy delivery, recognize opportunities to reduce energy consumption, and promote sustainability;
- Assess basic economic, government policy, and social equity dimensions of energy options
- Utilize tools to evaluate an energy option and assess alternatives.

GE Learning Outcomes (GELO)

SLO1: Students will be able to demonstrate an understanding of the methods and limits of scientific investigation. SLO 1 will be assessed in assignments 1, 2, 3 and the final research report.
SLO2: Students will be able to distinguish science from pseudo-science. SLO 2 will be assessed in assignments 2, 3, and 4.
SLO3: Students will be able to apply a scientific approach to answer questions about the earth and environment. SLO 3 is assessed in the final research report and assignments 2, 3, and 5.

Course Learning Outcomes (CLO)

See "Course Goals" above.

Required Texts/Readings

Textbook: Energy for Sustainability: Technology, Planning, Policy 2nd Edition by John Randolph PhD, Gilbert M. Masters ISBN-13: 978-1597261036 ISBN-10: 1597261033 – Available at the university store or Amazon.com http://a.co/3UHwc5e

Other Readings: Articles and handouts are posted to canvas: https://sjsu.instructure.com/

Library Liaison

Peggy Cabrera, peggy.cabrera@sjsu.edu

Course Requirements and Assignments

Dropping and Adding: Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, … Refer to the current semester's Catalog Policies section at http://info.sjsu.edu/static/catalog/policies.html

Grading: Use the percentages below and your scores to monitor your grade. Real time grade will be available along the semester on Canvas.

Credit-hour statement: This three-unit course requires a minimum of 9 hours per week to complete class-related readings and assignments (roughly 2.5 hours in class and 6.5 hours outside class per week.) Careful time management will help you keep up with readings and assignments and enable you to succeed in all your classes. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf

Grading Information – Final Examination

10% in class participation. It is expected that you will engage in class discussions. Come to class having completed all of the assigned readings. Every article or chapter from the text book we read must be summarized or noted upon on your notebook. Hand written or printed personal notes may be allowed to refer to during exams.

We may have up to 5 quizzes in class this semester based on assigned readings (2% of your final grade for each quiz)

10% online participation. Reply to the articles "Current events in energy" posted on Canvas in the discussion section with a short description; and a link to an additional source related to the main article. Prepare a few remarks as we'll want to know more than just the headline. You are expected to reply to at least 10 discussions over the semester to get full online participation points (1% of your final grade for each posting).

20% Assignments: As part of the activities in this class, you will complete five graded assignments.
Assignment 1 – Unit conversions, power energy, energy/GHGs (SLO 1)
Assignment 2 – Energy and GHG problem sets (SLO 1 & 2)
Assignment 3 – Carbon footprint calculator (SLO 1, 2, & 3)
Assignment 4 – Energy policy review (SLO 2 & 3)

20% Midterm: Both the midterm and the final exams will be open notebook (your personal typed or handwritten notes). The exams will include short answers and essay questions. Your notebook should contain lecture notes and short annotations on the readings. If you take notes in the margins of your readings, make sure to transfer important ones to your notebook. You must bring a calculator to the examinations. You will **not** have access to any electronic devices (other than a calculator). To study for the tests, you should review the readings, course lecture notes, homework, and learning objectives well in advance of the test date. The midterm will include material covered during the first portion of the class. We will include both multiple choice and problems related to the scientific principles of energy, heat, and work. You are encouraged to review the problems sets before the midterm.

20% Final Research Paper: Students will individually write a research paper related to renewable or conventional energy technologies. More details on this assignment will be available on the course website.

20% Comprehensive Final Exam: There will be a comprehensive final exam. Same rules as Midterm exam (see above).

Determination of Grades
The course grade will be determined based on a total 100 possible points. Accumulated points that fall within the grade scale below determine your semester grade.
A+ 97–100
A 92–96
A- 89–91
B+ 86–88
B 81–85
B- 79–80
C+ 76–78 C 72–76
C- 69–71
D+ 67–68
D 64–66
D- 60–64
F < 60

- NO Extra Credit available (given the work load to deal with in this class).
- Penalty for late or missed work: -10% of the assignment's grade after 1st week of delay. -20% of the assignment's grade after 2nd week of delay. Not accepted after more than 14 days of delay (grade will be null)

Grading Information for upper division GE courses (R, S, V)

"Passage of the Writing Skills Test (WST) or ENGL/LLD 100A with a C or better (C- not accepted), and completion of Core General Education are prerequisite to all SJSU Studies courses. Completion of, or co-registration in, 100W is strongly recommended. A minimum aggregate GPA of 2.0 in GE Areas R, S, & V shall be required of all students."

Classroom Protocol

You are expected to come to every class on time. Class time starts with attendance check (not reflected in your final grade). However, classroom participation and results on the quizzes will be reflected in your final grade. No cell phone, emailing, or text messaging during class. If you need to make a phone call or send an email, or work on anything else that class material please excuse yourself from class or your instructor will ask you to leave the classroom.

University Policies

Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy F15-7 requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. Visit the Student Conduct and Ethical Development website for more information.
See here for other campus wide policies http://www.sjsu.edu/gup/syllabusinfo/

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Course Schedule

This schedule is subject to change with fair notice. If necessary, the electronic schedule available on Canvas will be updated along the semester on a week to week basis.

(Read = read before class, Question = question to think about and answer from the reading, Keywords & concepts = make sure to have a clear understanding of these after class)

1/30 **Part 1. Energy Science Fundamentals**

Read: Vaclav Smil. 2006. Energy. Encyclopedia of World History. Berkshire Publishing.

Q. *What are the key shifts in the evolution of energy use? What changed with the shift from biomass to fossil fuels?*

Keywords & concepts: Energy use in historical/evolutionary perspective, mass and energy flows through ecosystems, energy v. power, stationary and mobile prime movers, energy conversions/conversion efficiencies, primary energy supplies, energy types (mechanical, thermal, chemical, solar, nuclear, electrical).

2/1 **Energy, Society, Environment**

Introduction to the challenges and dilemmas related to energy and its impacts on the environment. Course and syllabus overview, logistics.

Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 1 and 2 (p. 3-70).

Read: Bill McKibben, B. 2012. "Global Warming's Terrifying New Math." *Rolling Stone.* July 24, 2012.

Q. *What are the three numbers to know about fossil fuels and climate change and what do they represent?*

Keywords & concepts: Environmental impacts of energy choices, GHGs quotas to avoid dangerous climate change.

2/6 **Energy Science Fundamentals II**

Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 4, Section 4.1 to 4.3.2 (p., 117–125), section 4.4 to 4.5.2 (p. 127–134) and section 4.8 to end of chapter (p. 157-164).

Q. *What are the differences between forces and energy? What are the key forms of energy? How is electricity made?*

Q. *What units do we use to measure power and energy? How are basic unit conversions calculated?*

Keywords & concepts: First and 2nd laws of thermodynamics, Energy Density, Entropy, Stocks and Flows, Energy units; efficiency.

2/8 **Part II: Energy systems - Coal Energy**

Assignment 1 due

Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 9, Section 9.1 to 9.4.7 (p., 359–274), section 9.5 to 9.6 (p. 376–382).

Q. *How coal is related to the US electricity supply?*

Read*: Jeff Goodell, 2007. Chapter. The Saudi Arabia of Coal. Big Coal: The Dirty Secret Behind America's Energy Future. NY: Mariner Books, p. 3-20.*

Q. *What state and more specifically coal reserve, is considered the Saudi Arabia of coal? What portion of coal supply does it provide to the USA?*

Keywords & concepts: Coal: regions, uses, sources, formation, Carboniferous period, labor hazards, noxious gases, mountain top removal, coal surface mining. China, export terminals, coal-to-liquids, syngas, clean coal, CCS

2/13 **Natural gas Energy I**

Read: Vaclav Smil. 2012. Placing American gas boom in perspective. *The American.* May 3, 2012.

Q. *What are the claims and counter-claims about the American gas boom?*

Keywords & concepts: politics of reserve estimates, Marcellus Shale, impacts to water, natural gas and energy security.

2/15 **Natural gas Energy II**

Read: Chris Mooney. 2011. The Truth About Fracking. *Scientific American.* November: 80–5

Q. *What are the key scientific debates around fracking? What do we know and not know?*

Keywords & concepts: natural gas production, horizontal slant drilling, hydraulic fracturing, shale, water impacts, risks to drinking water, heating value, chemical energy, heat of combustion

2/20 **Assignment #2 due** **Petroleum & energy for transportation (I)**

Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 13, Transportation Energy and efficient vehicles. p. 491-519

Read: Vaclav Smil. 2011. America's oil imports: A self-inflicted burden. *Annals of the Association of American Geographers* 101:1-4.

Q. *What are the factors that drive America's excessive consumption of petroleum?*

Keywords & concepts: Oil & petroleum consumption & production trends, oil impacts, unit: tons of oil equivalent, air pollution & photochemical smog from combustion

Additional, optional information

Gulf Spill Map: http://ngm.nationalgeographic.com/2010/10/gulf-oil-spill/gulf-map-interactive

Mapping Global Air Pollution Down to the Neighborhood Level: http://www.citylab.com/weather/2015/08/mapping-global-air-pollution-down-to-the-neighborhood-level/400337/

2/22 **Petroleum & energy for transportation (II)**

Read: Jeremy Miller. 2011. The Colonization of Kern County: A story of oil and water. Orion Magazine. January/February.

Q. *What are the largest oil fields in California?*

Read: Alan Taylor. 2014. The Alberta Tar Sands. *The Atlantic*. September 24, 2014. http://www.theatlantic.com/photo/2014/09/the-alberta-tar-sands/100820/

Keywords & concepts: Tar Sands, Synfuels, Bitumen, dilbit, Keystone XL pipeline Carbon intensity, emissions factors

Optional: Shifting Sands, review site: http://v1.theglobeandmail.com/v5/content/features/oilsands/index.html

Sierra Club video: http://www.rollingstone.com/politics/news/why-tar-sands-oil-isnt-worth-the-trouble-20120618

2/27 **Clean Vehicles: EVs & Hydrogen**
Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 13, Transportation Energy and efficient vehicles. p.519-538

Q*. What are the primary obstacles to widespread EV adoption?*

Q*. Depending on the feedstock for making hydrogen fuel, it could have substantial benefits or very limited benefits if at all. What are the primary challenges to making hydrogen fuel sustainable?*

Keywords: BEV, Hybrid cars, CAFÉ

3/1 **Carbon Footprint**
Read: Jessica Grady-Bensona and Brinda Sarathyb. 2015. Fossil fuel divestment in US higher education: student-led organising for climate justice. *Local Environment*.

Q. *What factor have helped and hindered divestment movements at US institutions of higher education?*

Keywords & concepts: Carbon Emissions Factor, divestment movement

3/6 **Nuclear Power I** **Assignment 3 Due**
Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 9, Nuclear Power. p.374-376

Read: Charles Perrow. 2013. Nuclear Denial: From Hiroshima to Fukushima. Bulletin of the Atomic Scientists. 65(5).

Q. What is being denied with nuclear denial?

Keywords & concepts: Sources of nuclear power, nuclear waste, low level radiation, yellow cake, Uranium 235/U238.

3/13 **Nuclear Power II**
Read: Philippe Boudes. "Nuclear Power" In Mulvaney 2011. *Green Energy: An A-to-Z Guide.* SAGE

Q. Is Nuclear a Green, Sustainable, or Renewable Energy?
Read: Alexander Cockburn. 2011. In Fukushima's Wake: How the Greens Learned to Love Nuclear Power. *New Left Review* 68: 75–79.

Q. Why do the greens love nuclear power? What are the consequences of their support for nuclear?

Keywords & concepts: Yucca Mountain, passive design, Chernobyl, Three Mile Island, sources of fear

3/15 **Hydro-Power**

Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 4, Section 4.3.3. p., 125–127.

Q. *How do you estimate the power output of a hydro-electric system?*

Read: Paul Robbins 2012. "Hydro-Electric Power." In Mulvaney 2012. *Green Energy: An A-to-Z Guide.* SAGE Publications.

Q. *What are the different kinds of hydro-electric power systems?*

Keywords & concepts: Hydro-electric power, challenges building dams, different kinds of dams.

10/12 **Hydro-Power II**
Read: Marc Reisner. 1993. Chapter 4. An American Nile. Cadillac Desert: The American West and its Disappearing Water. Penguin, New York.

Q. What were some of the challenges encountered at Boulder Canyon?

2/20 **Work/review session**

10/22 **Midterm** Open notebook; bring a calculator!

Spring break and MLK day.

4/3 **Part III. Renewable energy Wind** I
Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 12. Pp. 461-482
Q. *How is the potential wind power output calculated for a specific site and turbine?*
Keywords & concepts: Wind Power Basics, Power potential

4/5 **Wind II**
Read: Roopali Phadke. 2013. Public Deliberation and the Geographies of Wind Justice. *Science as Culture* 22(2): 247–255.
Q. *How can the social gap in renewable energy be overcome?*
Keywords & concepts: Wind Power, siting challenges, ecological compatibility, the social gap in renewable energy
Optional: Check out this cool map: http://eerscmap.usgs.gov/windfarm/

4/10 **Solar I (passive design)** **Assignment 4 due**
Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 7.
Q. *Explain passive design for buildings.*
Keywords & concepts: insolation, insulation, solar path, HDD

4/12 **Solar II (Photovoltaic systems)**
Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 11.
Q. *How do photovoltaics generate electricity?*
Keywords & concepts: Solar Photovoltaic (PV) Energy, Solar Thermal Energy, insolation

4/17 **Life Cycle Assessment I**
Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 5. Energy Analysis and Lifecycle Assessment.
Q. *What is EROI and how do you calculate it?*
Keywords & concepts: Life Cycle Analysis, EROI, EPBT for PV and Wind

4/19 **Life Cycle Assessment II (work session)**

4/24 **Biofuels, low carbon and carbon negative fuels**
Read: John Randolph and Gilbert Masters. 2011. Energy for Sustainability. Chapter 14. Biofuels Biomass and other alternative fuels.
Keywords & concepts: Second, Third Generation biofuels, water use, water quality.

4/26 **Biofuels, low carbon and carbon negative fuels Final paper draft due**

Read: M. Fatih Demirbas. 2011. Biofuels from algae for sustainable development. *Applied Energy* 88: 3473–3480.

Q. *What are the advantages and disadvantages of biofuel production using microalgae?*

Keywords & concepts: Second, Third Generation biofuels, water use, water quality.

5/1 **Geothermal**

Read: John Randolph and Gilbert Masters. Geothermal heat pumps. Ch. 6 pp 259-260

Q. *How does a geothermal heat pump work? What can it do?*

Read: Julie Cart. 2014. Geothermal power industry lost steam but may be poised for comeback. Los Angeles Times. October 19, 2014.

Q. What are the key challenges to California's geothermal energy industry and what are the emerging trends?

Keywords & concepts: Geothermal Energy

5/3 **Wave and Tidal Resources**

Read: Mohammad-Reza Alam. 2011. Wave Energy. Technology Avenue. *IRIS*.

Q. *What are the types of devices to collect wave power?*

Read: Dave Levitan. 2014. Why Wave Power Has Lagged Far Behind as Energy Source. *Yale Environment 360*. April 28, 2014.

Q. *What are the key challenges to deploying more wave power?*

Keywords & concepts: Wave and Tidal Resources

5/8 **Part IV - Energy in society: Agri-food systems & energy**

Read: Nathan Pelletier, et al. 2011. Energy Intensity of Agriculture & Food Systems. *Annual Review of Environment & Resources* 36: 223–46.

Q. *What are the key drivers of energy use and greenhouse gases in agriculture and food systems?*

Keywords & concepts: Food production, nitrogen fertilizer, food miles, carbon footprints, food security.

5/10 **Energy Efficiency and Conservation Final paper due**

Read: John Randolph and Gilbert Masters. 2011. Market transformation to sustainable energy. Ch. 16

Read: Tom Dietz. 2015. Altruism, self-interest, and energy consumption. Proceeding of the National Academies of Sciences. 112(6): 1654–1655.

Q. *What motivates people to conserve energy?*

Keywords & concepts: Energy use & conservation

5/15 **Energy & water**

Read: James McMahon & Sarah Price. 2011 Water & Energy Interactions. *Annual Review of Environment Resources* 36:163–91.

Q. *How is water used in energy production?*

Keywords & concepts: Uses of water in energy production, uses of energy in water distribution

5/19 **Final exam Friday, May 19 - 09:45 AM -12:00 (noon)**