

## EE8oS Sustainability Engineering & Ecological Design

Fall 2016

**Lecture:** MWF 9:20-10:25, Baskin 152

**Discussion sections (lab):**

Monday (12-1:05 and 4-5:05) and Thursday (5:20-6:25 and 6:40-7:45)

**Instructor:** Dr. Katie Monsen, [kmonsens@ucsc.edu](mailto:kmonsens@ucsc.edu)  
office hours Tues. 9:30-11:30, Nat Sci 2 471

**TA:** Jose Armando Oviedo, [xmando@ee.ucsc.edu](mailto:xmando@ee.ucsc.edu)

**Tutor & reader:** announced in Week 1



*Photo from Fossil Free UC Santa Cruz on Facebook*

*This is a dynamic class. Please consult the eCommons site for the most current class schedule and readings.*

**Course description:** This course is a topical introduction to principles and practices of sustainability engineering and ecological design (SEED), defined here as the planning, development and deployment of technological and social systems and institutions that can protect the earth's ecological systems for this and future generations.

The course provides students with an understanding of basic scientific, engineering and social principles in the design, deployment, and operation of resource-based human systems, and how they can be maintained for this and future generations. No specialized background in engineering, sciences or social sciences is required, and the course is open to all students. It is a gateway course to the Sustainability minor.

**Course organization and requirements:** The course has seven parts:

1. A series of required lectures on topics relevant to sustainable engineering and design
2. Weekly required lab (discussion sections)
3. Required and optional readings linked to topics
4. Brief weekly in-class problem sets on lecture and reading topics
5. Brief weekly online quizzes on reading material
6. A team research project to address a specific problem studied in class  
*(note five due dates on syllabus, when assignments are due in class)*
7. A final exam

**Grading:** Your final grade of 100% is based on these five components:

- Weekly in-class assignments, 20%
- Weekly online quizzes, 10%
- Lab participation & assignments, 25%
- Team research projects, 25%
- Final exam, 20%

**Texts:** There are no assigned texts for this course; all materials are online under “Resources” on eCommons and are listed or hyperlinked on the class schedule below.

**Disability accommodations:** If you qualify for classroom accommodations because of a disability, please submit your Accommodation Authorization Letter from the Disability Resource Center (DRC) to Katie during office hours or by appointment, preferably within the first two weeks of the quarter. Contact the DRC by phone at 831-459-2089 or by email at [drc@ucsc.edu](mailto:drc@ucsc.edu) for more information.

**Academic integrity at UCSC:** By enrolling in the university, students are automatically agreeing to abide by policies, including those on academic misconduct. Academic integrity and scholarship are core values that should guide our conduct and decisions as members of the UCSC community. Plagiarism and cheating contradict these values, and so are very serious academic offenses. Penalties can include a failing grade in an assignment or in the course, or suspension or expulsion from the university. Students are expected to familiarize themselves with and follow citation practices (<http://library.ucsc.edu/help/research/cite-your-sources>) and the university's Rules of Conduct regarding student conduct and discipline (<http://www2.ucsc.edu/judicial/handbook.shtml>).

Students who submit papers containing plagiarized material or information they did not collect or whose papers or exam answers are not clearly their own will fail the course and be referred to their college provost for disciplinary action. Please be aware that anyone who tries to help a friend by allowing copying of work is also considered guilty of academic dishonesty according to university regulations.

As a member of the campus community, you are expected to demonstrate integrity in all of your academic endeavors and will be evaluated on your own merits. So be proud of your academic accomplishments and help to protect and promote academic integrity at UCSC. The consequences of cheating and academic dishonesty — including a formal discipline file, possible loss of future internship, scholarship, or employment opportunities, and denial of admission to graduate school — are simply not worth it. If you are uncertain about the expectations for completing an assignment or taking a test or examination, be sure to seek clarification from your instructor or TA beforehand.

<b>Weeks 0 &amp; 1: Understanding &amp; analyzing wicked problems</b>		
<b>Date &amp; topics</b>	<b>Learning objectives &amp; connections</b>	<b>Required readings</b> ( <i>on eCommons, unless otherwise noted</i> )
Friday, Sept. 23	Overview of the course & topics (Ronnie Lipschutz, Katie)	Lipschutz, R. Sustainability as a social project.
Monday, Sept. 26	What are wicked problems? Are they solved by technological fixes? (Katie)	Brown, V.A. 2008. A collective social learning pattern. EuroPLOP Workshop, Klosters Irsee, Bavaria.  Sarowitz, D., and R. Nelson. 2008. Three rules for technological fixes. Nature 456: 821-22.
Wednesday, Sept. 28	Society and the design of things: what ghosts do we live with, and why does it matter? (Katie)	Winner, L. 1980. Do artifacts have politics? Daedalus 109: 121-136.  Small, K.A., and C.F. Ng. 2012. When do slower roads provide faster travel? ACCESS 41.
Friday, Sept. 30	Sustainability & statistical reasoning (Katie)  📅 Due: team members, initial topic area	UCSC. 2013. Campus sustainability plan.
<b>Lab:</b> Defining sustainability -- products & packaging; project groups & ideas		

<b>Week 2: Sustainability project &amp; process design, evaluation, execution</b>		
Monday, Oct. 3	What is a doable project? Does yours make economic & design sense? How do you share your findings?	Booth, A., and N. Skelton. 2011. Anatomy of a failed sustainability initiative: government and community resistance to sustainable landscaping in a Canadian city. Sustainability: Science, Practice & Policy 7: 56-68.  Kihm, S., and S. Hackel. 2012. Economic analysis in individual project selection. Consulting-Specifying Engineer.
Wednesday, Oct. 5	Lies, damned lies, and statistical reasoning: how to judge data; metrics; black boxes (Katie)	Pierce, R. 2008. Evaluating information: validity, reliability, accuracy, triangulation. Ch. 7 in Research Methods in Politics. SAGE Publications: London.  Mayfield Publishing. Undated. <a href="#">How to judge the reliability of internet information.</a>  LaBarre, S. 2013. <a href="#">Why we're shutting off our comments.</a> Popular Science.

Friday, Oct. 7	How do we evaluate the sustainability of a product or process? LCAs, with solar energy as an example (Katie)  📌 Due: proposed question & paragraph	Larsen, K. 2009. End-of-life PV: then what? Renewable Energy Focus.  Heller, M., and G. Keoleian. 2000. Life cycle-based sustainability indicators for assessment of the US food system. University of Michigan Center for Sustainable Systems.
<b>Lab:</b> Carbon footprints; project definition		

<b>Week 3: Built environments &amp; biofuels: what makes a system sustainable?</b>		
Monday, Oct. 10	What is the role of the built environment? Landscapes & infrastructures; buildings, energy, resources (Katie)  Statistical reasoning: Environmental data collection	Marszal, A.J. 2011. Zero Energy Building – a review of definitions and calculation methodologies. Energy and Buildings 4: 971-979.  Lockwood, Charles. 2006. Building the green way. Harvard Business Review 84: 129-137.
Wednesday, Oct. 12	Can cities minimize climate change? (Adam Millard-Ball)	Gandy, M. 2010. Rethinking urban metabolism: water, space and the modern city. City: Analysis of Urban Trends, Culture, Theory, Policy, Action 8: 363-79.  Millard-Ball, A. 2012. The limits to planning: causal impacts of city climate action plans. Journal of Planning Education and Research 33: 5-19.
Friday, Oct. 14	Can we run our world on biofuels? How we will grow them? (Jonathan Trent)	Fridley, D. 2010. Nine Challenges of Alternative Energy. Post-Carbon Institute.  Solomon, B.D. 2010. Biofuels and sustainability. Annals of the New York Academy of Sciences 1185: 119-134.
<b>Lab:</b> Biofuels Life Cycle Analysis; project development		

<b>Week 4: Food &amp; fuel: thermodynamics &amp; the body</b>		
Monday, Oct. 17	Energy and "civilization" (Ronnie)	Steinhart, J.S., & C.E. Steinhart. 1974. Energy use in the U.S. food system. Science 184: 307-16.  McMichael, A., et al. 2007. Food, livestock production, energy, climate change, and health. Lancet 370: 1253-63.

Wednesday, Oct. 19	Where food comes from, and where our food goes (Katie)	<p>Heinberg, R., and M. Bomford. 2009. The food and farming transition: toward a post-carbon food system.</p> <p>Suh, J. 2014. Theory and reality of integrated rice-duck farming in Asian developing countries: a systematic review and SWOT analysis. <i>Agricultural Systems</i> 125: 74-81.</p>
Friday, Oct. 21	<p>How much food do we need and how far does it come? (Katie)</p> <p>Statistical reasoning: Food energy input of your breakfast</p> <p> Due: problem background &amp; need, existing situation</p>	<p>Bybee, R. 2009. Growing Power in an urban food desert. <i>Yes!</i> Feb. 13, 2009.</p> <p>Budiansky, S. 2010. Math lessons for locavores. <i>New York Times</i>.</p> <p>Roos, E., and H. Karlsson. 2013. Effect of eating seasonal on the carbon footprint of Swedish vegetable consumption.</p>
Lab: Food miles; project development		

<b>Week 5: How much water do we really use?</b>		
Monday, Oct. 24	Where our water comes from & where it goes (Katie)	<p>Santa Cruz Municipal Utilities. 2011. Our current water resource challenges. <i>SCMU Review</i> 51: 1,2,8.</p> <p>Carle, D. 2004. The distribution system. pp. 85-131 <i>in</i>: <i>Introduction to Water in California</i>.</p>
Wednesday, Oct. 26	How much water is in things? (Katie)	<p>Mekonnen, M.M., &amp; A.Y. Hoekstra. 2011. The green, blue &amp; grey water footprints of crops &amp; derived crop products. <i>Hydrology &amp; Earth Science</i> 15: 1577-1600.</p> <p>Hoekstra, A.Y. and A.K. Chapagain. 2007. Water footprints of nations. <i>Water Resource Management</i> 21: 35-48.</p>
Friday, Oct. 28	<p>How much water do you use? (Katie)</p> <p>Statistical reasoning: How much wood do you need for your daily water use? relating water &amp; energy; chop wood, carry water</p>	<p>Water Footprint Network. <a href="#">Personal water footprint calculator</a>. (Try calculating your own)</p> <p>Makki, A.A., et al. 2011. Revealing the determinants of shower water end use consumption: enabling better targeted urban water conservation strategies. <i>Journal of Cleaner Production</i>.</p>
Lab: Water & energy; project development		

<b>Week 6: Mobility &amp; how transportation shaped the world</b>		
Monday, Oct. 31	How do we move people and goods around UCSC in a sustainable way? (Larry Pageler)	<p>City of Santa Cruz Master Transportation Study. 2003. ch. III (Mobility, vision, goals &amp; objectives) to V (Analysis of future travel).</p> <p>Toor, W. 2003. The road less traveled: sustainable transportation for campuses. <i>Planning for Higher Education</i> 31: 131-41.</p>
Wednesday, Nov. 2	Mobility & automobility (Ronnie)	<p>Badger, E. 2013. The myth of the commuting criminal. <i>Citylab</i>, Feb. 21.</p> <p>Freund, P. and G. Martin. 2007. Hyperautomobility, the social organization of space, and health. <i>Mobilities</i> 2: 37-49</p> <p>Deakin, E. 2011. Climate change &amp; sustainable transportation: the case of California. <i>Journal of Transportation Engineering</i> 137: 372-82.</p>
Friday, Nov. 4	<p>What is the role of bicycles, and what can it be? (Tawn Kennedy)</p> <p>Statistical reasoning: comparing metrics across modes – how do we get data into comparable units?</p> <p> <b>Due: goals &amp; objectives, economic feasibility, political &amp; social obstacles, infrastructural integration, proposed design</b></p>	<p>Martin, E., and S. Shaheen. 2011. The impact of carsharing on household vehicle ownership. <i>Access</i> 38: 22-27.</p> <p>Pucher, J., et al. 2011. Bicycling renaissance in North America? An update and re-appraisal of cycling trends and policies. <i>Transportation Research Part A: Policy &amp; Practice</i> 45: 451-475.</p>
Lab: Energy density & mobility; review project rough drafts		

<b>Week 7: Back to the built environment: can we be compact and distributed?</b>		
Monday, Nov. 7	How can we improve energy distribution?	<p>Bigerna, S., et al. 2016. Socio-economic acceptability for smart grid development – a comprehensive review. <i>Journal of Cleaner Production</i> 131: 399-409.</p> <p>Capehart, B.L. 2014. Distributed Energy Resources (DER). <i>Whole Building Design Guide</i>. National Institute of Building Sciences.</p>

Wednesday, Nov. 9	What makes a city sustainable? (Hilary Nixon)	Ellin, Nan. 2013. Integral urbanism: a context for urban design. Ch. 3 <i>in</i> : Pickett, S.T.A., et al., eds., Resilience in Ecology and Urban Design. Springer.  Daniels, T.L. 2009. A trail across time: American environmental planning from city beautiful to sustainability. <i>Journal of the American Planning Association</i> 75: 178-192.
Friday, Nov. 11, Veterans Day	<b>No class</b>	
Lab: Green roofs; project development		

<b>Week 8: Can we consume our way to sustainability?</b>		
Monday, Nov. 14	Limits to growth vs. ecological modernization; resources, economics & ethics (Ronnie)	Mol, P.J., and D.A. Sonnenfeld. 2000. Ecological modernisation around the world: an introduction. (Read through “Core themes of ecological modernisation theory”)
Wednesday, Nov. 16	Individual choice vs. social regulation; the problem of consumption; planned vs. perceived obsolescence (Katie)	Jensen, D. 2009. Forget shorter showers: Why personal change does not equal political change. <i>Orion</i> .  LeBel, S. 2016. Fast machines, slow violence: ICTs, planned obsolescence, and e-waste. <i>Globalizations</i> 13: 300-309.
Friday, Nov. 18	Fast fashion vs. slow permaculture; consumption & waste (Katie)  Statistical reasoning: visualizing data	McNeill, L., and R. Moore. 2015. Sustainable fashion consumption and the fast fashion conundrum: fashionable consumers and attitudes to sustainability in clothing choice. <i>International Journal of Consumer Studies</i> 39: 212-222.  Thorpe, A. 2007. <i>Fast. and Slow. The Designer’s Atlas of Sustainability</i> . Island Press: Washington. pp. 154-160.
Lab: Sustainability meets your cell phone; project development		

<b>Week 9: Bringing it home, part 1: is growth sustainable? Can UCSC be sustainable?</b>		
Monday, Nov. 21	Green growth vs. de-growth (Katie)  📅 Due: final team project paper	Jackson, T. 2011. Societal transformations for a sustainable economy. <i>Natural Resources Forum</i> 35: 155-64.
Wednesday, Nov. 23	How do we make a campus have zero waste? (Roger Edberg & Bradley Angell)	Seadon, J. 2010. Sustainable waste management systems. <i>Journal of Cleaner Production</i> 18: 1639-51.

		Zaman, A.U., and S. Lehmann. 2013. The zero waste index: a performance measurement tool for waste management systems in a 'zero waste city.' <i>Journal of Cleaner Production</i> 50: 123-132.
Friday, Nov. 25, Thanksgiving break	<b>No class</b>	
<b>No lab this week</b>		

<b>Weeks 10 &amp; finals: Bringing it home, part 2: Can UCSC be sustainable? What is your role?</b>		
Monday, Nov. 28	How do we make a campus food system sustainable? (Tim Galarneau)	<p>Bittman, M. 2015. The roots of organic farming on campus. <i>The New York Times</i>, Sept. 15, 2015.</p> <p>Gliessman, S. 2009. College 8 commencement. June 13, 2009.</p> <p>Perez, J., and P. Allen. 2007. Farming the college market: results of a consumer study at UC Santa Cruz.</p>
Wednesday, Nov. 30	How do we sustainably provide water and power on campus? (Patrick Testoni & Dean Fitch)	<p>Benayas, J., et al. 2010. The impact of universities on the climate change process. Ch. 4 <i>in</i> <i>Universities and Climate Change</i> (W.L. Filho, ed.). Springer.</p> <p>Saylor, A., et al. 2011. What's wrong with the tap? Examining perceptions of tap water and bottled water at Purdue University. <i>Environmental Management</i> 48: 588-601.</p>
Friday, Dec. 2	<p>Being sustainable at UCSC</p> <p>Statistical reasoning: using estimated data to evaluate alternatives</p>	<p>Fulton, J.R. 2011. The built environment – sustainable campus planning. <i>Sustainability Journal</i> 4: 22-25.</p> <p>Gernot Wagner. 2011. Going green but getting nowhere. <i>The New York Times</i>, Sept. 7.</p>
Tuesday, Dec. 6, 8-11 am	Final exam	
Lab: Presenting final projects		