

**ESPM 290 Sustainability & Society:
Science, Technology & Environment
Spring 2009 (3 credits)**

Class meetings: Tolman 2301, Wednesdays 12-2 pm.

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Our seminar focuses on science-based technologies and their environmental impacts. At the turn of the 21st century, many citizens and practitioners recognize that technologies are central to the search for sustainability in contemporary societies. Technologies have vastly increased resource extraction and consumption, yet can contribute to greater sustainability through the redesign of existing technologies or the introduction of new (or the resurrection of “old”) technologies. How can societies move closer to sustainable technological systems? Who needs to be involved? Whose priorities and needs are being met in introducing technologies? Can adverse impacts be prevented through policy?

One approach to address such issues is to work out why, how, when, and where science, technology, and environment may intersect and shape each other. For example, we can learn much about the likely issues that current electric car developments face by studying how previous electric car systems “failed”. We can see how renewable energy technologies may depend on changing the norms of energy use within society, by considering the politics of why and how users shape the broader systems surrounding a specific technology such as the automobile. We can identify potentials for technical experts to reform their ways of solving problems, as we may be observing in the recent emergence of green chemistry. And we can gain insight into whether emerging technologies can be designed to reduce their inherent risks by evaluating different models of risk assessment.

This is the first time that the seminar has been taught: it will therefore be an experiment that you are invited to join – in helping develop some theories and tools for this “intersectional” analysis!

The course will begin with five weeks of considering some theoretical approaches to investigating how science, technology, and environment intersect. Then we will briefly consider whether and how participatory democracy in science and technology may be nurtured, and visit regulatory and policy processes for assessing technology impacts on the environment. Next, we will explore important tools for analyzing science, technology, and environment through three case studies of contemporary developments: green chemistry (social movements and metrics), electric cars (competing technological modes

and competing solutions), and nanotechnology (risk assessment and anticipatory governance). These case studies combine social science material with technical material to give you a taste of the worlds within which policy-makers and technologists work. We will end with a critical look, using our cumulative learning, at whether and how entrenched technologies can be challenged, changed, or even redirected.

The goals of our course include:

- To look at theories of why, how, when, and where technologies intersect with the environment.
- To understand why and how technologies and technological systems (such as energy, transportation, or industrial production) develop along particular trajectories, with resulting impacts on environments and societies.
- To evaluate tools, policies, and institutions to aid policy-makers, designers, companies, and consumers in helping ensure that technologies are much less likely to harm humans and ecosystems, and are much more likely to be sustainable.
- To develop the practical skills of graduate students in social science, policy, law, and technology in addressing the intersections between science, technology, and environment.

ASSESSMENT

Weekly Response Papers (1 page each)	10%
Two 10-minute Oral presentations	15%
Participation in class discussion	15%
Paper(s) (2 of 8-10 pages, OR 1 of 20 page)	60%

You are encouraged to participate vigorously in class discussions!

You will be required to volunteer for two sets of 1-2 readings from the course to make a presentation on. Your presentation will summarize the readings, analyze their ideas, and pose 1-2 questions that the class meeting will discuss. We will provide collective feedback on your presentations to help improve your skills. We will ask for volunteers on Bspace in the first week, with presentations beginning in the second week.

After each meeting, you will be asked to write a short response paper of up to 1 page, reflecting on the readings and discussion, and raising issues that you are interested in.

Paper Option 1: Two Short Papers (up to 2500 words each)

In this option, one paper will be due the week before Spring Break, the other on the last day of class. The two papers should engage with important questions, problems, and themes from the readings in the course. You may want to discuss in a more extended way, the questions posed for each week of reading, and you can focus on a week of particular interest to you. Your papers may also compare across two or more weeks of

readings and discussions. You can delve more fully into the work by a specific author, such as Thomas Hughes or Thomas Princen.

The first paper is due on March 18, 2009. The second paper is due on May 6, 2009. If no paper is turned in before Spring Break, this option is no longer available.

Research Paper Option 2: One Long Paper (up to 5000 words).

This option entails one longer, research paper, requiring that you develop a topic around a technology or technological system that you are particularly interested in. The paper will involve research: you will need to develop theoretical, analytical, or empirical arguments to approach a problem or challenge that may be covered in the course, or may come from other examples. For example, you may wish to investigate the possibilities of deliberative participation in shaping energy systems, analyze the role of the private sector (as contrasted to governments) in designing technologies for greater sustainability, or critique emerging technologies in terms of their impacts and existing oversight. If you want, you can write a policy (or regulatory) memorandum: a paper that lays out the issues in terms that are accessible to policy-makers and that makes recommendations for how to oversee a technology. Or you may create a brief for industrial or technology designers, drawing their attention to the lessons that can be gleaned from past technology developments. This paper could serve as the launching base for your dissertation thinking.

You will need to see me to have your topic approved **by no later than March 18, 2009.** Please bring a potential research topic as well as a research strategy, ideally in a Word file to facilitate feedback. You will also need to compile a short outline of your paper by **no later than April 15, 2009.** We will use peer feedback from your fellow students, so you will exchange your outlines in small groups. **The paper will be due by May 6, 2009.**

REQUIRED COURSE READINGS

All readings will be in the Course Reader unless noted otherwise, available from Odin Readers at Ned's Books on Bancroft Avenue. Several required pieces will be posted on our Bspace course site.

Optional readings will also be placed on our Bspace course site. These readings are "recommended" and you may read them any time you wish. However, reading them will add to your understanding of the particular week's topic.

Please ensure that you are prepared for each class since we will base our discussions on the readings. You are responsible for printing out and bringing to class all required materials posted on Bspace.

STATEMENT ON PLAGIARISM

Official university policy states that “students who submit plagiarized work will be subject to consequences ranging from a grade of F on the assignment to suspension from the university.” I take plagiarism very seriously, so please cite all your sources properly. I will help you to learn about proper referencing as part of your research responsibilities in this class. I will penalize plagiaristic actions stringently. The Campus Office of Student Judicial Affairs has produced a comprehensive guide to academic honesty. Please see http://uga.berkeley.edu/sas/rtf/guide_student.rtf

The following excerpt from this document outlines the elements of plagiarism:
“Plagiarism is defined as the use of intellectual material produced by another person without acknowledging its source, for example:

- Wholesale copying of passages from works of others into your homework, essay, term paper, or dissertation without acknowledgment.
- Using the views, opinions, or insights of another without acknowledgment.
- Paraphrasing another person's characteristic or original phraseology, metaphor, or other literary device without acknowledgment.”

If you have a question about a citation or quotation, please ask me!

Week 1, January 21: Technology versus Environment?

Barry Commoner, *Closing the Circle: Man, Nature and Technology* (1971), pp. 140-158; 178-193. In the reader.

Gary Cross and Rich Szostak, “Technology and the Modern Corporation”, in *Technology & American Society: A History* (1995), pp. 163-178. In the reader.

Robert Heilbroner, “Do Machines Make History?” in Merritt Roe Smith and Leo Marx (eds), *Does Technology Drive History? The Dilemma of Technological Determinism* (1994), pp. 51-65. In the reader.

Lester Brown, “An Eco-Economy in Harmony with Nature”, in Robert Olsen and David Rejeski (eds), *Environmentalism and the Technologies of Tomorrow* (2005), pp. 20-28. In the reader.

Recommended: Robert McGinn, “What is Technology?” in Larry Hickman (ed), *Technology as a Human Affair* (1990), pp. 10-25. On Bspace.

Week 2, January 28: Histories of Technological Systems

Thomas Hughes, “The Evolution of Large Technological Systems”, in Wiebe Bijker, Thomas Hughes, and Trevor Pinch (eds), *The Social Construction of*

Technological Systems (1987), pp. 51-82. In the reader.
William Cronon, "Pricing the Future: Grain", in *Nature's Metropolis: Chicago and the Great West* (1991), pp. 97-147. In the reader.
Thomas Princen, "Efficiency: A Brief and Curious History", in *The Logic of Sufficiency* (2006), pp. 49-86. In the reader.

Recommended: Thomas Hughes, "Conflict and Resolution", in *Networks of Power: Electrification in Western Society 1880-1930* (1983) pp. 106-139. On Bspace.

Week 3, February 4: Social Constructions of Technology

David Kirsch, "Rescuing the Alternatives to Internal Combustion" in *The Electric Vehicle and the Burden of History* (2000), pp. 11-25. In the reader.
Wiebe Bijker, "The Fourth Kingdom: The Social Construction of Bakelite", in *Of Bicycles, Bakelite, and Bulbs* (1995), pp. 101-197. In the reader.
Thomas Mesa, "Controversy and Closure in Technological Change: Constructing 'Steel'", in Wiebe Bijker and John Law (eds), *Shaping Technology, Building Society: Studies in Sociotechnical Change* (1992), pp. 225-258. In the reader.

Week 4, February 11: Agency, Networks, and Technology

Peter Norton, "Blood, Grief, and Anger", "Whose Street? Joyriders versus Jaywalkers", "Traffic Efficiency versus Motor Freedom", in *Fighting Traffic: The Dawn of the Motor Age in the American City* (2008), pp. 21-46; 65-101; 149-174. In the reader.
Bruno Latour, "Third Source of Uncertainty: Objects Too Have Agency", in *Reassembling the Soul: An Introduction to Actor-Network Theory* (2005), pp. 63-86. In the reader.
Ronald Kline, "Resisting Consumer Technology in Rural America: The Telephone and Electrification", in Nelly Oudhoorn and Trevor Pinch (eds), *How Users Matter: The Co-Construction of Users and Technologies* (2003), pp. 51-66. In the reader.

Recommended: Johan Schot and Adri Albert de la Bruheze, "The Mediated Design of Products, Consumption, and Consumers in the Twentieth Century", in Nelly Oudhoorn and Trevor Pinch (eds), *How Users Matter: The Co-Construction of Users and Technologies* (2003), pp. 229-245. On Bspace.

Week 5, February 19: Production Chains & Organizations

Leslie Byster and Ted Smith, "The Electronics Production Life Cycle" in Ted Smith, David Sonnenfeld, and David Pellow, *Challenging the Chip: Labor Rights and Environmental Justice in the Global Electronics Industry* (2006), pp. 205-214. In the reader.
Giles Slade, "Introduction" and "Hard Times", in *Made to Break: Technology and Obsolescence in America* (2006), pp. 1-7; 57-81. In the reader.
Boy Luchte, "The Changing Map of Global Electronics: Networks of Mass Production in

- the New Economy”, in Ted Smith, David Sonnenfeld, and David Pellow, *Challenging the Chip: Labor Rights and Environmental Justice in the Global Electronics Industry* (2006), pp. 17-30. In the reader.
- Jennifer Howard-Grenville, “The Persistence of Flexible Organizational Routines: The Role of Agency and Organizational Context”, *Organization Science* (2005) 16:6, pp. 618-636. In the reader.
- Jeffrey Meikle, “An Industry Takes Shapes”, in *American Plastic: A Cultural History* (1995), pp. 91-124. On Bspace.

Week 6, February 25: Societies, Technology & Expertise

- Daniel Lee Kleineman, “Democratizations of Science and Technology”, in Daniel Lee Kleineman (ed), *Science, Technology & Environment* (2000) pp. 139-165. In the reader.
- Steven Epstein, “The Construction of Lay Expertise: AIDS Activism and the Forging of Credibility in the Reform of Clinical Trials”, *Science, Technology & Human Values*, 20(4), 408-437. In the reader.
- Helga Nowotny, Peter Scott and Michael Gibbons, “Strongly Contextualized Knowledge” and “From Reliable Knowledge to Socially Robust Knowledge” in *Re-Thinking Science: Knowledge and the Public in an Age of Uncertainty* (2001), pp. 131-142; 166-178. On Bspace.
- Sheila Jasanoff, “Technologies of humility: Citizen participation in governing science”, *Minerva* (2003), 41:223-44. In the reader.

Week 7, March 4: Assessing Science & Technology Impacts

- Janna Koppe & Jane Keys, “PCBs & the Precautionary Principle”, in *Late Lessons From Early Warnings: The Precautionary Principle, 1896-2000* (2002), pp. 64-75. In the reader.
- Poul Harremoës et al, “Twelve Late Lessons” in *Late Lessons From Early Warnings: The Precautionary Principle, 1896-2000* (2001), pp. 168-191. In the reader.
- John Gibbons and Holly Gwin, “Technology and Governance: The Development of the Office of Technology Assessment”, in Michael Kraft and Norman Vig, eds, *Technology and Politics* (1988), pp. 98-122. In the reader.
- Edward Woodhouse, “Sophisticated Trial & Error in Decision-Making About Risk”, in Michael Kraft & Norman Vig, eds, *Technology and Politics* (1988), pp. 208-223. In the reader.
- Mary O’Brien, “How do Risk Assessments Actually Work?”, “When a Society Isn’t Serious About Environmental Health: Assessing A Narrow Range of Options”, and “Alternatives Assessment: The Case of Bovine Growth Hormone and Rotational Grazing”, in *Making Better Environmental Decisions: An Alternative to Risk Assessment* (2000), pp. 17-38; 89-100; 129-138. On Bspace.

Week 8, March 11: Green Chemistry I: Social Movements

- Martin Poliakoff, Michael Fitzpatrick, Trevor Farren, and Paul Anastas, “Green

Chemistry: Science and Politics of Change”, *Science* (2002) 297: 807-810. In the reader.

James Clark, “Green Chemistry and Environmentally Friendly Technologies”, in CAM Alfonso and JG Cresp, *Green Separation Processes* (2005), pp. 3-18. In the reader.

Jean Jenck, Frank Agterberg and Michael Droescher, “Products and Processes for A Sustainable Chemical Industry: A Review of Achievements and Prospects”, *Green Chemistry* (2005), 5: 544-556. In the reader.

Edward Woodhouse and Steven Breyman, “Green Chemistry as Social Movement?”, *Science, Technology & Human Values* (2005) 30: 199-222. In the reader.

Michael Wilson et al, *Green Chemistry: Cornerstone to a Sustainable California*, Center for Occupational and Environmental Health, UC Berkeley, 2008, 26 pp. To be handed out in advance.

Recommended: Qunlai Chen and Eric Beckman, “One-pot green synthesis of propylene oxide using in situ generated hydrogen peroxide in carbon dioxide”, *Green Chemistry* (2008)10: pp. 934-938. On Bspace.

Around this time, we will do experiments out of class, using the recipes at the back of E.S Stevens, *Green Plastics: an introduction to the new science of biodegradable plastics* (2002). We’ll cook up some bioplastics, using ingredients available in supermarkets. The venue/date/time: To be agreed with the class.

Week 9, March 18: Green Chemistry II: Measuring Greenness

Roger Sheldon, “Editorial: Green Chemistry – One Year On”, *Green Chemistry*, February 2000, G1. In the reader.

Itaru Yasui, “Metrics for Green and Sustainable Chemistry”, *Green Chemistry* (2003), pp. G70-73. In the reader.

David Constable, Alan Curzons, and Virginia Cunningham, “Metrics to ‘Green’ Chemistry – Which are the Best?”, *Green Chemistry*, (2002) 4: 521-527. In the reader.

Stefanie Hellweg, Ulrich Fischer, Martin Scheringer and Konrad Hungerbuehler, “Environmental assessment of chemicals: methods and application to a case study of organic solvents”, *Green Chemistry* (2004) 16, pp. 418-427. In the reader.

Stefan Boschen, Dieter Lenoir, and Martin Scheringer, “Sustainable Chemistry: Starting Points and Prospects”, *Naturwissenschaften* (2003), 90(3): pp. 93-102. In the reader.

Also visit <http://www.basf.com/group/corporate/en/content/sustainability/eco-efficiency-analysis/seebalance> (to see BASF’s SeeBalance concept).

Recommended: Thomas Princen, “Whose Ratios? From Technic to Rhetoric”, in *The Logic of Sufficiency* (2006), pp. 87-123. On Bspace.

Week 10, April 1: Electric Cars I: Competing Transport Modes

- Michael Westbrook, “The History of Electric Cars up to 1990”, in *The Electric Car: Development and Future of Battery, Hybrid, and Fuel-Cell Cars* (2001), pp. 6-28. In the reader.
- David Kirsch, “William Whitney, Albert Pope, Richard Meade, ” in *The Electric Vehicle and the Burden of History* (2000), pp. 29-84. In the reader.
- Gijs Mom, *The Electric Vehicle: Technology and Expectations in the Automobile Age* (2003), pp. 1-3; 30-43; 50-63. In the reader.
- Mark Brown, “The Civic Shaping of Technology: California’s Electric Vehicle Program”, *Science, Technology & Human Values* (2001) 26(1), pp. 56-81. In the reader.
- Martin Eberhard and Marc Tarpenning, “The 21st Century Electric Car”, Tesla Motors, Inc, October 6, 2006. In the reader.

Week 11, April 8: Electric Cars II: Battery vs. Infrastructure

- Jeffrey Tollefson, “Charging Up The Future”, *Nature* (2008) 456, pp. 436-440. In the reader.
- David Kirsch, “Infrastructure, Automobile Touring and the Dynamics of Automobile System Choices” and “Expectations Past and Imperfect” in *The Electric Vehicle and the Burden of History* (2000), pp. 167-187; 195-208. In the reader.
- Michael Westbrook, “Storage Batteries”, in *The Electric Car: Development and Future of Battery, Hybrid, and Fuel-Cell Cars* (2001), pp. 65-87. In the reader.
- Henry Oman, “Battery Developments That Will Make Electric Vehicles Practical”, *IEEE AES Systems Magazine*, August 2000, pp. 11-21. In the reader.
- DM Lemoine, DM Kammen, and AE Farrell, “An innovation and policy agenda for commercially competitive plug-in hybrid electric vehicles”, *Environmental Research Letters* (2008) 014003 (10 pp). In the reader.
- Jonathan Rauch, “Electro-Shock Therapy”, *The Atlantic Monthly*, July-August 2008. In the reader.

Newspaper news to be handed out.

Week 12, April 15: Nanotechnology I: Risk and Nano-toxicology

- Clarence Davies, *Nanotechnology Oversight: An Agenda for the New Administration*, PEN Report 13, Woodrow Wilson Center (2008) 39 pp. In the reader.
- Stephan Stern and Scott McNeil “Nanotechnology Safety Concerns Revisited”, *Toxicological Sciences* (2008) (1), pp. 4–21. In the reader.
- Andre Nel, et al, “Toxic Potential of Materials at the Nanolevel”, *Science* (2006) 311, pp. 622-627. In the reader.
- Kostas Kostarelos, “The long and short of carbon nanotube toxicity”, *Nature Biotechnology* (2008) 2(7), pp. 774-776. In the reader.
- Sheila Jasanoff, “The Songlines of Risk”, *Environmental Values* (1999), vol. 8, pp. 135-152. In the reader.

Recommended: Steffen Hansen and David Rejeski, "Applying the Chemical Policy Options to Emerging Technologies and Materials: Adaptations and Challenges", in *Options for State Chemical Policy Reform* (2008), Lowell Center for Chemicals Policy, pp. 205-235. On Bspace.

Week 13, April 22: Nanotechnology II: Participating in R&D

Daniel Barben, Erik Fisher, Cynthia Selin, and David Guston, "Anticipatory Governance of Nanotechnology: Foresight, Engagement, and Integration", in Edward Hackett, Olga Amsterdamska, Michael Lynch, and Judy Wajcman (eds), *The Handbook of Science and Technology Studies*, Third Edition (2007), pp. 979-1000. In the reader.

Edward Woodhouse, "Nanotechnology Under Democratic Control?", paper for Consortium on Science and Policy Outcomes (CSPO), available at http://www.cspo.org/ourlibrary/perspectives/Woodhouse_September05.htm. In the reader.

Richard Sclove, "Town Meetings on Technology: Consensus Conferences as Democratic Participation" in Daniel Lee Kleineman (ed), *Science, Technology & Environment* (2000), pp. 33-48. In the reader.

The Center for Nanotechnology in Society at Arizona State University, *The Final report of the National Citizens' Technology Forum on Nanotechnologies and Human Enhancement* (2008), 20 pp. In the reader.

Recommended: Cynthia Selin, "Expectations and the Emergence of Nanotechnology", *Science, Technology & Environment* (2007) 32(2), pp. 196-220. On Bspace.

Week 14, April 29: Can systems be changed?

Robert Olson and David Rejeski, "The Challenge Ahead", in Robert Olsen and David Rejeski (eds), *Environmentalism and the Technologies of Tomorrow* (2005), pp. 160-175. In the reader.

Paul David, "Clio and the Economics of QWERTY", *American Economic Review*, Vol. 75(2): pp. 332-337. In the reader.

Peter Norton, "Conclusion: History, Technology and the Dawn of the Motor Age", in *Fighting Traffic: The Dawn of the Motor Age in the American City* (2008), pp. 255-262. In the reader.

Thomas Princen, "Toronto Island: Resisting Automobility", in *The Logic of Sufficiency* (2006), pp. 291-339. In the reader.

Recommended: Richard Sclove, "Everyone Contributes: Participation in Research, Development, and Design", in *Technology and Democracy* (1995) pp. 180-195. On Bspace.

Week 15, May 6: Review and Presentations of Research

Your papers are due today.