Fall 2018

Sustainability: The City

CEE 368 - 0 - 20
Tues., 3:30- 6:30 pm
Tech A230

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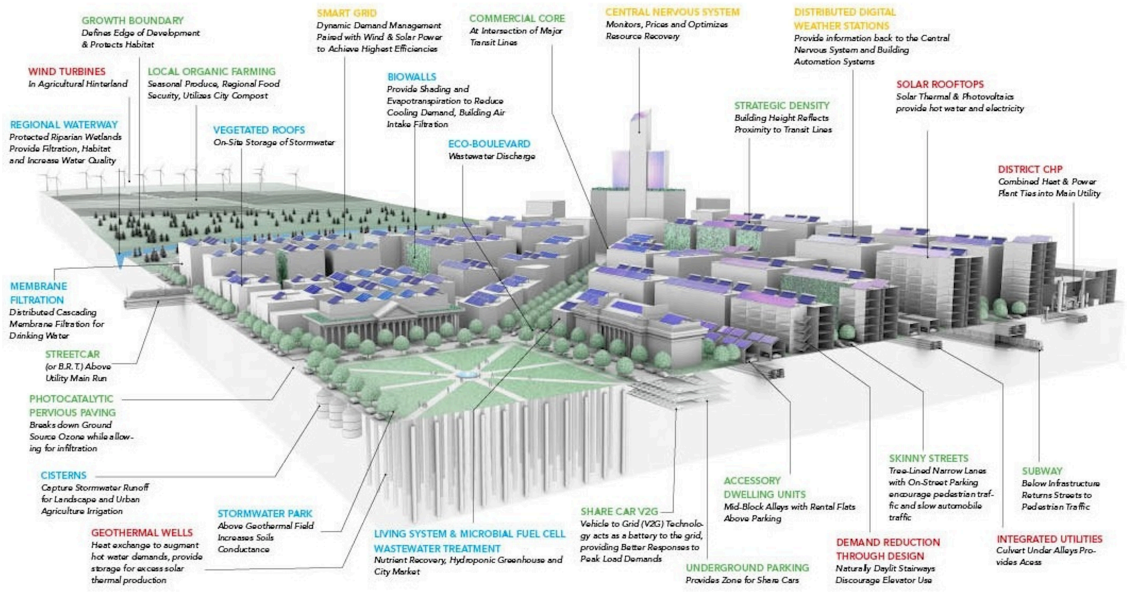
Course Description

Cities will shape our future.

Cities are the world's economic engines, driving 75% of global productivity. Cities magnify human strengths and are "our greatest invention mak(ing) us richer, smarter, greener, healthier and happier." Cities may be our greatest invention, but in 2018 the typical city in U.S and elsewhere is woefully inefficient in the way it transports its citizens and goods, supplies information, manages its water supply, produces food and energy, and treats its wastes. The development and operation of today's cities injure ecosystems and contribute heavily to global climate change. We must reinvent our cities, both old and new, by devising strategies for sustainable, resilient and adaptive urban design that are based on the ecological principles of material and energy cycling and on policies and incentives that make business and social sense.

We have entered the age of cities. Since 2008 more than half the world's population, a proportion expected to grow to 70% by 2050, lives in cities, creating a precarious condition where 3.75 billion people occupy about 2% of the earth's land area. Although cities around the world are threatened by a rapidly changing climate, stressed ecosystems and altered environmental processes, they are also the locus of innovation and invention where solutions are created. The challenge for cities, then, is to grow in wealth and well-being without tipping. Sustainable urban design offers an adaptive and robust approach to the problems of demographic shifts, environmental dangers and equitable prosperity.



The theme of this course is **urban reinvention** and the sustainable, resilient and adaptive reinvention of cities must integrate ecological, economic and socially just principles. Cities are dynamic and constantly changing. They behave much more like living organisms than machines, and their functions are mediated by metabolic processes governed by a central nervous or information system that controls energy, material and economic flows. Among the many questions we will ask in this course, are "smart cities" also *sustainable* cities?

The concept of sustainability is fuzzy. In many cases, sustainability efforts are focused on being "less bad" or a "little better" than current practice. Sustainability often concentrates on the technical performance of individual devices or buildings to reduce energy or water use, rather then the larger system into which these pieces fit. In the absence of clear and rigorous definitions, metrics and targets, sustainability has come to mean vaguely, almost anything and a growing number of environmental experts are beginning to question whether it is even possible any more. Sustainability is dynamic, rather than a fixed state or destination and is a process of *learning* to detect, interpret and act to promote the long-term health of human and natural systems. Urban sustainability, then, must promote the dynamic potential of adaptation and resilience synergistically between human and natural systems.

There are many divergent views on what *sustainability* means to scientists, social scientists and engineers. The purpose of this course is to explore the issues that drive and the various approaches to sustainable urban development. First we will consider the *why* and the *how* of redesigning cities or human settlements to be adaptive and resilient, and to function via coupled cycles of energy, water, food/materials and waste. We will make use of published research, case studies and current project examples. Students will work in teams on short and long-term projects throughout the course. Weekly readings will be assigned and discussed, periodically guest speakers may visit, and presentations will be made by students throughout the quarter. This class is modeled on a seminar style, although there will be some lectures. Active student participation is required.

Course Objectives

1. **Develop understanding of general principles of Sustainability, Resilience & Adaptation.**
2. **Tailor general understanding of SRA to urban systems.**
3. **Engage in an integrated, conceptual design of an actual site applying the principles and metrics of sustainability.**

Books:
- **Collapse**, Jared Diamond (Penguin, N.Y., 2005).

Suggested:
- **Can a City Be Sustainable**, State of the World, 2016, Worldwatch Institute (Island Press, Washington, D.C. 2016).
- **Is Sustainability Still Possible?** The State of the World 2013, The Worldwatch Inst. (Island Press, Washington, D.C., 2013).
- **Natural Capitalism,** P. Hawken, A. Lovins, L.H. Lovins (Little, Brown & Co., N.Y., 2000)
- **Cradle to Cradle: Remaking the way we make things**, W. McDonough, M. Braungart (North Point Press, NY, 2002).
- **The Upcycle,** W. McDonough, M. Braungart (North Point Press, NY, 2013).
- **Sustainable Urbanism: Urban design with nature,** D. Farr (John Wiley, NY, 2008).

Evaluation:
- Participation + Group Work – 20% (Graded for each class meeting & progress presentations)
- Short Position Papers on Readings (5/6) – 40%
- Final Proposal/Project – presentation/summary 25% + 15% peer evaluation = 40%

Class Schedule

1. Oct. 2 - Introduction

2. Oct. 9 - Principles of Sustainability; Project & Organize Groups

3. Oct. 16 - The Case for Sustainability

Readings:
- Garrett Hardin (1968). "The Tragedy of the Commons," *Science*, 162: 1243-1248. (Canvas)
- Johan Rockström et al. (2009) "A safe operating space for humanity," *Nature* **461**, 472-475. (Canvas) https://www.nature.com/nature/journal/v461/n7263/full/461472a.html
- J. Zalasiewicz, M. Williams, W. Steffen, P. Crutzen (2010). "The New World of the Anthropocene," *Environ. Sci. Technol.* 44:2228-2231. (Canvas)
- G. Ceballos, P.R. Ehrlick, A.D. Barnosky, A. Garcia, R.M. Pringle, T.M. Palmer (2015) "Accelerated modern human-induced species losses: Entering the sixth mass extinction," *Sci. Adv.* 1, e1400253. (Canvas)
- Selected Chapters from **Collapse** (Prologue, Ch. 1, 2, 9, 14,15,16).

Assignment – Position paper 1 (Reflect on these readings –Do you think that the "Collapse" of society as we know it is at all a possibility? If so, what is the threat and what is the solution? These position papers should be short and personal – what are your thoughts in response to the readings – 1-2 pages) – **REQUIRED**

4. Oct. 23 - The Principles of Sustainability: Eco-districts, Smart Cities, & Future Cities

Readings:
- McMichael, A. J.; Butler, C. D.; Folke, C. (2003). "New visions for addressing sustainability," *Science*, 302:1919-1920. (Canvas)
- D. Schaffer, D. Vollmer (2010). Pathways to Urban Sustainability, Committee on the Challenge of Developing Sustianable Urban Systems, National Research Council, National Academies Press. (Canvas)
- Robert Engelman. (2013) Beyond Sustainababble, in *Is Sustainability still possible?* State of the World 2013, Worldwatch Inst. (Island Press, Washington, D.C.) Ch. 1, p. 3–16. (Canvas)
- Jennie Moore & William E. Rees. (2013) Getting to One-Planet Living, in *Is Sustainability still possible?* State of the World 2013, Worldwatch Inst. (Island Press, Washington, D.C., 2013) Ch 4, p. 39-50. (Canvas)
- Gary Gardner. (2016) Cities in the Arc of Human History: A Materials Perspective. *Can a City Be Sustainable?* State of the World 2016, Worldwatch Inst. (Island Press, Washington, D.C., 2016) Ch. 2 - 4, p. 11- 64. (Canvas) https://link.springer.com/content/pdf/10.5822%2F978-1-61091-756-8_2.pdf
- K. Gray, D. Farr, et al. (2011) Living Cities: Transforming APEC Cities into Models of Sustainability by 2030. Report to Business Advisory Committee of Asia Pacific Economic Cooperation, Nov, 2011. (Canvas)
- H. Suzuki et al. (2010) Eco^2 Cities – Synopsis (p. 1 – 16) & Ecological Cities as Economic Cities; Part 3, The Field Reference Guide (The World Bank) p. 165 – 224. (Canvas)
- The EcoDistrict™ Framework: Building Blocks of Sustainable Cities. May 2013, p. 1-17; http://www.wsdot.wa.gov/NR/rdonlyres/6F915B3C-4206-437A-8798-C595D5729901/0/EcoDistrictsFrameworkMay2013.pdf
- A.M. Berger (2017). The Suburb of the Future, Almost Here. NYT, 09/15/17; https://www.nytimes.com/2017/09/15/sunday-review/future-suburb-millennials.html?emc=edit_th_20170916&nl=todaysheadlines&nlid=54489381&_r=0

Recommended:
- D. Waldron D. Miller (2013). Neighborhood Sustainability Strategies: A review of neighborhood-relevant approaches to sustainability in North America, A report from the

Regenerative Neighborhoods Project at the University of British Columbia, Vancouver, BC, Canada, July 31, 2013 Discussion Draft; p. 4 - 36. (Canvas)

Assignment – Position paper 2 – Define sustainability; Why if there are so many examples of "eco-cities" do we still question their feasibility? (Alternative question – is a smart city a sustainable city?)

Progress Reports from each group – Project vision & goals, organization

5. Oct. 30 - Energy & Climate

Readings:
- E. Porter. (NYT 09/10/13) Counting the Cost of Fixing the Future, http://www.nytimes.com/2013/09/11/business/counting-the-cost-of-fixing-the-future.html?pagewanted=all&_r=0
- O. Morton (2007). Is this what it takes to save the world? *Nature,* 447:132-136; http://www.nature.com/nature/journal/v447/n7141/pdf/447132a.pdf?foxtrotcallback=true
- Richard Heinberg (2016)." The Energy Wildcard: Possible Energy Constraints to Further Urbanization," in *Can a City Be Sustainable?* State of the World 2016, Worldwatch Inst. (Island Press, Washington, D.C., 2016) Ch. 5, p. 65-76. (Canvas) https://link.springer.com/content/pdf/10.5822%2F978-1-61091-756-8_5.pdf
- M. Renner (2016). "Reducing the Environmental Footprint of Buildings," in *Can a City Be Sustainable?* State of the World 2016, Worldwatch Inst. (Island Press, Washington, D.C., 2016) Ch. 8, p. 115- 140. (Canvas) https://link.springer.com/content/pdf/10.5822%2F978-1-61091-756-8_9.pdf
- J. Rockström et al. (2017). A roadmap for rapid decarbonization. *Science*, 355:6331:1269-1271. http://science.sciencemag.org/content/355/6331/1269/tab-figures-data
- K.A. Gray (2018). Geoengineered Strategies: The Feasibility of Climate Intervention on a Global Scale, in **Global Climate Change Governance & Geoengineering**, David Dana and Wil Burns, eds., Springer Publisher, in press. (Canvas)

Recommended:
- R.J. Lazarus (2009). Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future. 94 Cornell L. Rev. 1153-1234. (Canvas) OR http://www.law.harvard.edu/faculty/rlazarus/docs/articles/Lazarus_WickedELRArticle.pdf
- Deep Decarbonization Pathways Project - http://deepdecarbonization.org ; 2015 Executive Summary (Canvas)

Assignment – Position paper 3 – Reflect on current energy direction & recent climate policy in U.S. – will technology be the solution?

PLUS -- Each group will compile the C-footprint of its members using one of web-based calculators (e.g., http://www.nature.org/greenliving/carboncalculator/, https://www.carbonfootprint.com/calculator.aspx, etc.)

6. Nov. 6 – Water (Scarcity & Floods) & Ecosystem Good & Services

Readings:
- E.H. Oelkers, J.G. Hering, C. Zhu (2011). "Water: Is There a Global Crisis?" *Elements,* 7:157-162. (Canvas)
- K. Brauman (2016). We're (not) running out of water – a better way to measure water scarcity. *The Conversation*; https://theconversation.com/were-not-running-out-of-water-a-better-way-to-measure-water-scarcity-58699
- R. I. McDonald, P. Green, D. Balk, B.M. Fekete, C. Revenga, M. Todd, M. Montgomery. (2011). "Urban growth, climate change, and freshwater availability," *PNAS*, 108(15): 6312–6317. (Canvas)
- J.G. Hering, T.D. Waite, R.G. Luthy, J.E. Drewes, D.L. Sedlak (2013). A changing framework for urban water systems. *Environmental Science & Technology,* 47:10721-10726. (Canvas)

- M. Grunwald (08.29.17). How Washington Made Harvey Worse, *Politico,* http://www.politico.com/magazine/story/2017/08/29/a-storm-made-in-washington-215549
- The Value of Green Infrastructure (2010), Center for Neighborhood Technology, Chicago, IL. (Canvas)
- M.B. Junca, R.M. Zaragoza, P. K. Guelar (2016). "The Vital Role of Biodiveristy in Urban Sustainability," plus City View – Jerusalem, Israel, in *Can a City Be Sustainable?* State of the World 2016, Worldwatch Inst. (Island Press, Washington, D.C., 2016) Ch. 17, 297 - 316. (Canvas) https://link.springer.com/content/pdf/10.5822%2F978-1-61091-756-8_25.pdf
- W.J. Mitsch, J.W. Day, J.W. Gilliam, P.M. Groffman, D.L Hey, G.W. Randall, N. Wang (2001). Reducing nitrogen loading to the Gulf of Mexico from the Mississippi River Basin: Strategies to counter a persistent ecological problem, *BioScience*, 51:5:373-2388. (Canvas)

Assignment – Position paper 4 – Within the context of water-based "natural" disasters, what role do human actions play?

7. Nov. 13 – Cities & Materials: Food, Waste, & Cycles of Use/Reuse

Readings:
- P. Anastas, J.B. Zimmerman (2003). "Design Through the 12 Principles of Green Engineering," *Environ. Sci. Technol.* 37:95A-101A. (Canvas).
- W. McDonough, M. Braungart, P.T. Anastas, J.B. Zimmerman (2003). "Applying the Principles of Green Engineering," *Environ. Sci. Technol.,* 37:434A-441A. (Canvas).
- R.D. Perlack, L.L. Wright, A.F. Turhollow, R. L. Graham (2005). Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply. A joint study by DOE and USDA, DOE/GO-102005-2135; ORNL/TM-2005/66 (Canvas).
- ARUP (2017). The Urban Bio-Loop: Growing, Making and Regenerating (Canvas) https://www.arup.com/perspectives/publications/research/section/the-urban-bio-loop
- C.L. Weber, H.S. Matthews (2008). Food-miles and the relative climate impacts of food choices in the United States. *Environmental Science & Technology*, 42:3508-3513. (Canvas)
- R. Cernansky (2014). On front lines of recycling, turning food waste into biogas; *Yale Environment 360*, 06/26/14, http://e360.yale.edu/feature/on_front_lines_of_recycling_turning_food_waste_into_biogas/2779/
- L. Palmer (2014). How weed could help feed billions in a warming world, *Yale Environment 360,* 06/05/14; http://e360.yale.edu/feature/how_weeds_could_help_feed_billions_in_a_warming_world/2772/

Recommended:
- M. Pollan (2006). The Omnivore's Dilemma (Penguin Books, NY).
- Polyface Farm "the farm of many faces" - http://www.polyfacefarms.com

Assignment – Position paper 5 – Are there real benefits to urban farming?
Rethink the technical limits and boundaries of agriculture – how local can we make it?

Progress Reports from each group – Project progress

8. Nov. 20 – No Class; Thanksgiving

9. Nov. 27 – Transportation

Readings:
- K.A. Gray (2016). "Transportation Infrastructure and the Future of Cities" in *Mobility 2050. A vision for transportation infrastructure*. Ch. 9, p, 109-135. (Canvas)
- E. Anzilotti (07.06.17) The end is in sight for the internal combustion engine in France. *Fast Company*. https://www.fastcompany.com/40438489/the-end-is-in-sight-for-the-internal-combustion-engine-in-france

- A. Peters (04.04.17). Inside Paris Mayor Anne Hidalgo's ambitious plans to create the post-car city. *Fast Company*. https://www.fastcompany.com/3069004/the-mayor-of-pariss-quest-to-get-rid-of-cars
- A. Peters (05.30.17). It could be 10 times cheaper to take electric robo-taxis than to own a car by 2030. *Fast Company*. https://www.fastcompany.com/40424452/it-could-be-10-times-cheaper-to-take-electric-robo-taxis-than-to-own-a-car-by-2030
- Move this way. Making Neighborhoods More Walkable and Bikeable. (2013). Change Lab Solutions-Law & policy innovation for the common good. http://www.changelabsolutions.org/sites/default/files/MoveThisWay_FINAL-20130905.pdf
- J. Jarvie & R. Friend (2016). "Urbanization, Inclusion, and Social Justice, in *Can a City Be Sustainable?* State of the World 2016, Worldwatch Inst. (Island Press, Washington, D.C., 2016) Ch.19, 343-353. (Canvas) https://link.springer.com/content/pdf/10.5822%2F978-1-61091-756-8_29.pdf

Assignment – Position paper 6 – Is a walkable/bikeable community the result of culture or design?

10. Dec. 4 – Project Presentations

Quarter Project – The class will be divided into 6 groups of 5; Everyone will focus on a Eco-district design for a cluster of abandoned industrial sites (Finkl Steel) in Lincoln Park. Following issues must be addressed:

1. Initial assessment – what are locally unique characteristics & challenges (geography, key physical, biological, human systems)
2. Identify goals of project; select a theme appropriate to this location and history – I h (food, recreation, health, manufacturing, residential, transportation hub, etc.)
3. A sense of place
4. Organize around ecosystem goods & services
5. Energy-Water-Food-Waste cycles – how locally tailored and self-sufficient can you make the Eco-district; Seek to maximize coupling of these cycles
6. Shelter & Buildings – how do buildings and shelters facilitate above cycles
7. Economic driver – how will project be financed, job opportunities
8. **Metrics – how will you measure and monitor the sustainable features of design and its function; <u>carbon footprint; energy footprint; water footprint</u>**
9. Transportation – auto independence, walkable, bikeable, transit
10. Connections & flows within & to surrounding region – social, ecological, economically, etc.
11. Adaptive & Resilient
12. Policy – are there any policy initiatives that can facilitate project?

Deliverables: Specific tasks will be divided among team members; there will be 3 presentations – **Oct. 23rd** (each team will provide site background and vision for site (#1), state goals (#2) and explain general project overview and plan (who is doing what)); on **Nov. 13th** progress report – 10 minute update. At end of quarter, final project presentation will cover # 3 – 12. Students will submit electronic copy of presentation and an executive summary of project description (< 10 pages with references).

For reference see "Staying in the Game: Exploring options for urban sustainability," Resources for Dialogue and Action, Created by the Urban Sustainability Learning Group, The Tides Center, June, 1996. (Canvas)