# Foundations of Sustainable Systems

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## Course Description

The sustainability movement first took formal shape following the publication of the Brundtland Commission report, *Our Common Future*, in 1987. Despite the increased traction it's getting in science, engineering, policy and business domains, sustainability remains an ambiguous – and at times contentious – concept that is difficult to operationalize. The reasons for this are many: sustainability is framed in terms of multiple dimensions (economic, environmental and social) that at times conflict with each other, across geographies and time scales, there are varying degrees of uncertainty about the scientific underpinnings of environmental phenomena, decisions involve stakeholders with different value frameworks and different incentives, the prevailing economic system emphasizes short-term returns while sustainability requires a long-term view, etc.

The goal of this course is to provide students with an understanding of these fundamental considerations, and the ability to navigate them systematically and critically, for decision-making where a systems focus on the environmental, social, and cultural dimensions of a design, project, innovation or business model are explicitly considered, incorporated and communicated. We will frame the discussions in the context of a number of "case studies" that inform different course modules and span different geographies and time scales (e.g. ozone depletion, climate change, materials use and waste, renewables introduction). There will be a particular focus on the social dimension of sustainability at a community level.

## Learning Outcomes:

- Identify basic physical, ecological, economic and social dimensions, and their interconnections, in a given sustainability-related context.
- Analyze the impact of choices on different constituencies, entities, and at different scales, including communities and the environment.
- Communicate effectively with diverse audiences around issues in creating sustainable systems and communities, and approaches to address them.
- Develop the ability to do group work and engage with diverse stakeholders, to view a problem from different angles, and to engage in systems thinking.
- Describe how creating sustainable systems and communities relates to their major.

## Background Information:

This course is part of Georgia Tech's Serve-Learn-Sustain (SLS) initiative, which provides students with opportunities inside and outside the classroom designed to help them combine their academic and career interests with their desire to improve the human

condition, allowing them to help build healthier, more sustainable communities where people and nature thrive. More information about SLS can be found at www.serve-learn-sustain.gatech.edu. Visit the website to sign up for the SLS Email List and find links to Facebook, Instagram and Twitter.

**Prerequisites:** Junior status or permission of instructor

**ADAPTS:** The Office of Disability Services assists students self-identifying as having a disability to obtain reasonable accommodations. Documentation of disability is required to determine appropriate accommodations or modifications that may be helpful on campus. See http://www.adapts.gatech.edu/

**Academic Integrity**: If you quote, paraphrase, or summarize information in your written assignment that you originally obtained from a written or a verbal source, this source reference should be cited in your text. Questions about appropriate forms of citation can be asked of the course instructor or the reference staff at the library. You should become familiar with the provisions of the Georgia Tech academic honor code and the policies governing violations of the honor code, both published in the Georgia Tech course catalog. For more information, see http://www.honor.gatech.edu.

**Classroom Etiquette:**
We will collectively strive to have a classroom environment that supports learning for everyone and that is courteous to guest speakers. All electronics must be turned off and put away during class.

**Course Materials:**
The following class materials will be posted on T Square: readings, class presentations, and assignments. You're responsible for doing all the reading and preparatory work before each session so we can have active and productive engagement. A list of representative readings is provided at the end of the syllabus.

**Grading Policy:**
Grading for the course will be as follows:

| | |
|---|---|
| Class Participation: | 10% |
| Assignments (2): | 10% each |
| Midterm | 25% |
| Project: | 45% |

**Class participation:** This is not a straight lecture course and student participation will be an important contributor to actively learning and learning from each other. Class participation will be evaluated as follows:

90-100%: always attend, participating often (at least once every other class), demonstrate mastery of relevant readings and contribute new ideas and perspectives to discussions and

exercises
80-90%: always attend, participating regularly and demonstrate knowledge of relevant readings
70-80%: always attend but never participate
below 70%: attendance irregular

<mark>**Institute Approved and Other Absences:** Individual students may make requests for Institute Approved Absences. The guidelines and deadlines that can be found at http://www.registrar.gatech.edu/students/formlanding/iaabsences.php apply. Students should discuss these and other planned absences (e.g. due to major religious observances) with the instructors as soon as possible after the beginning of an academic term. Work missed may be made up at the discretion of the instructors.</mark>

**Assignment 1.** Guided reflection on a sustainable communities talk (e.g. drawn from SLS event series).

**Assignment 2.** Analysis of current state and future solutions relating to a sustainability issue (e.g. palm oil production/deforestation/sustainable sourcing, cars/emissions/sustainable mobility)

**Midterm:** This in-class exam will be based on course lectures and readings. Make-ups can be given for documented excused absences and official Georgia Tech events.

**Course Project: Defining GT's role in creating sustainable communities:** The assignment is to scope a project through which Georgia Tech and an external partner (e.g. the City, a corporation, an NGO, etc.) can work together to promote the creation of sustainable communities via 1) CO2 reductions, AND 2) improving social indicators. Meet with relevant parties to develop your plan and to characterize its benefits. You must quantify the CO2 reductions and economic implications of your proposed project, and apply a social indicator(s)/metric(s) to gauge the social impact of your proposed project. Be specific about the boundaries you're drawing to define the project's impact. Discuss the most salient uncertainties and stakeholder incentives that may have implications for the project's success. In addition to a written report and a poster presentation, you will write "elevator pitches" that seek to enlist the following stakeholders as advocates for your project:  1) your parents, 2) the GT administration (President, Provost, etc), 3) the mayor of Atlanta or other community leader, and 4) a member of Congress from Georgia.

**Project Grading:**
The project grade will consist of several staged deliverables that together will count for 45% of the course grade. Details about staged deliverables and evaluation rubrics will be posted on T-square.

Individual grades for the project will be allotted based on peer assessments of individual team member contributions, combined with the instructor's own assessment of relative

contributions. Ex: If individual team members performed their fair share of the work or more, they will each receive 100% of the credit. If not, they will get less than full credit, on a sliding scaled based on their relative contributions. This can make or break your final grade, so be sure that you do what you need to do to contribute fairly to the project.

Please note that late assignments and project deliverables will be penalized 5% per day late, without prior permission from the instructor.

**Topics and Sequence:**

The following is the proposed course schedule. In general, even if the specific date of coverage may change slightly, the order of coverage should remain as presented below. Modifications may be made as the semester progresses and the appropriate changes will be announced in class. Some sessions will feature guest speakers.

| Date | Sessions | Project Deliverable and Assignment Due Dates |
|---|---|---|
| *Module 1: Foundations of Sustainable Systems and Communities* | | |
| 9-Jan | Introduction + What's Sustainability Assessment prompt | |
| 11-Jan | Dimensions of Sustainability + Cmap Assessment exercise | |
| 18-Jan | Operationalizing Sustainability - Environmental & Social Governance in Organizations | |
| 23-Jan | Operationalizing Sustainability - Measurement (intro to LCA) | |
| 25-Jan | Operationalizing Sustainability - Measurement (intro to carbon footprint) | Launch project in class |
| 30-Jan | Trade-offs and Stakeholder Perspectives in Decision Making: A Product View (to use or not to use - Styrofoam cups) | |
| 1-Feb | Trade-offs and Stakeholder Perspectives in Decision Making: Community Engagement and Social License | |
| 6-Feb | Decision-making: Collaborative governance, participatory process | |
| 8-Feb | Equity as a lens for sustainability decision making | |
| 13-Feb | Individual project pitches and group formation | Part 1 deliverable for Project |
| *Module 2: International Action – From the Montreal Protocol to the Paris Climate Accord* | | |
| 15-Feb | Of ozone, innovation and international equity | |
| 20-Feb | Trade-offs in refrigerant technologies: no free lunch | |
| 22-Feb | Greenhouse gases: sources, sinks, and effects | Assignment 1 due |
| 27-Feb | Guest speaker (Climate Policy - From Paris to Peachtree, Dan Rochberg, Emory University) | |
| 1-Mar | Climate solutions: Afforestation – Economic, Environmental & Social dim | |
| 6-Mar | Climate solutions: Carbon Capture-Economic, Environmental & Social dir | |
| *Module 3: Climate Action & Environmental Stewardship in California* | | |
| 8-Mar | Emergence of cap & trade in CA | Project Part 2 submitted |
| 13-Mar | Impacts of AB32: environmental, economic, and social metrics | |
| 15-Mar | Midterm Exam | |
| **Spring Break** | | |

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|---|---|---|
| 27-Mar | Recycling: Carpet Recovery Technology & Economics | |
| 29-Mar | Carpet Recovery Case Study: Extended Producer Responsibility in CA (Bob Peoples, Executive Director, Carpet America Recovery Effort) | Assignment 2 due |
| *Module 4: Renewables in Georgia* | | |
| 3-Apr | Climate impacts in GA - a sea of uncertainty | |
| 5-Apr | Renewables in GA - environmental, economic, and social metrics | |
| 10-Apr | Prospects for GA solar - policy & technological drivers | Project Part 3 submitted |
| 12-Apr | Energy equity ("solar for all") in Georgia (Nathaniel Smith, Executive Director, Partnership for Southern Equity) | |
| 17-Apr | Project presentations | Submit poster + elevator pitch |
| 19-Apr | Project presentations | |
| 24-Apr | Reflection + Cmap Assessment Activity | |

*Note*: All deliverables are due by uploading to T-square by 12pm on the date specified.

**Reading List:**

Sustainable Systems Articles and Book Chapters
- Hardin, G. (1986), "The Tragedy of the Commons," *Science*, Vol. 162, No. 3859, pp. 1243-1248 (also watch – youtube video)
- Ostrom, E. et al. (1999), "Revisiting the Commons: Local Lessons, Global Challenges," *Science*, Vol. 284, pp. 278-282 (also watch – youtube video).
- Simon, J.L. (1980), "Resources, Population, Environment: An Oversupply of False Bad News," *Science*, Vol. 208, No. 4451, pp. 1431-1437.
- Friedman, M. (1970), "The Social Responsibility of Business is to Increase its Profits," *The New York Times Magazine*, September 13.
- Porter, M. and M.R. Kramer (2011), "Creating Shared Value," *Harvard Business Review,* Jan-Feb Issue.
- Arnstein, S.R. (1969), "A Ladder of Citizen Participation," *Journal of the American Institute of Planners,* 35:4, 216-224.
- Zint, M. and K. Wolske (2014), "From information provision to participatory deliberation: engaging residents in the transition toward sustainable cities," in Mazmanian D. and H. Blanco, Eds., The Elgar Companion to Sustainable Cities: Strategies, Methods, Outlook, Edward Elgar Publishing, Northampton, MA, pp. 188-209.
- Irvin, R.A., J. Stansbury, "Citizen Participation in Decision Making: Is It Worth the Effort?" *Public Administration Review*, pp. 55-65.
- Meadows, D.H., Randers, J. and D.L. Meadows (2004), "Back from Beyond the Limits: The Ozone Story" in *Limits to Growth: 30 Year Update,* pp. 181-202.
- Bridger and Luloff (1999), "Toward an interactional approach to sustainable community development," *Journal of Rural Studies*, Vol. 15, 377 – 387.
- Fried, K (2014), "Principles of Environmental Justice," in *Seeing Systems: Peace, Justice and Sustainability*, Northwest Earth Institute.

Methods-Focused Material

- *Thinking in Systems: A Primer* by D. Meadows, edited by D. Wright, Chapters 5 and 6.
- Matthew, H.S, Hendrickson, C.T., and D.H. Matthews (2015), *Life Cycle Assessment: Quantitative Approaches for Decisions that Matter,* Chapters 1 and 2
- United Nations Environment Programme, Guidelines for Social Life Cycle Assessment of Products, 2009
- Toffel, M.W and S. van Sice (2011), "Carbon Footprints: Methods and Calculations," HBR Industry and Background Note

Reports, White Papers and Case Studies

- *Report of the World Commission on Environment and Development: Our Common Future* (Brundtland, 1987), pp. 9-27.
- *Costs of Company-Community Conflict in the Extractive Sector*, R. Davis and D. Franks, Corporate Social Responsibility Initiative Report No. 66. Cambridge, MA: Harvard Kennedy School (2014).
- *IPCC, 2013: Summary for Policymakers.* In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Leiserowitz, A., Maibach, E., Roser-Renouf, C., Cutler, M., & Rosenthal, S. (2017). "Voters & Global Warming." Yale University and George Mason University. New Haven, CT: Yale Program on Climate Change Communication.
- Calm, J.M. (2008), "The next generation of refrigerants – Historical review, considerations, and outlook," *Journal of Refrigeration*, Vol. 31, pp. 1123-1133.
- "Overview of ARB Emissions Trading Program," California Environmental Protection Agency, last accessed on December 2016 at https://www.arb.ca.gov/cc/capandtrade/guidance/cap_trade_overview.pdf.
- Orsato, R.J., (2014), "The Palm Oil Dilemma," INSEAD Case Study.
- Lee, D. and L. Bony (20 ), "Cradle-to-Cradle Design at Herman Miller: Moving Toward Environmental Sustainability," HBS Case Study (2007).

News Articles and Opinion Pieces

- Tierney, J., (1990), "Betting on the Planet," Tierney, J., *New York Times*, Dec. 2.
- Davenport, C. (2016), "Nations, Fighting Powerful Refrigerant That Warms Planet, Reach Landmark Deal," *New York Times*, October 15.
- "Nasty chemicals abound in what was thought an untouched environment," *Economist*, Feb. 19, 2017.
- Agyeman, J. (2011), "Equity? That's not an issue for us, we're here to save the world," www.julianagyeman.com, August 24.

- Finnegan, W. (2016), "Flint and the Long Struggle against Lead Poisoning," *New Yorker*, February 4.
- Fields, T. Jr. (2014), "A Dream Realized: Community Driven Revitalization in Spartanburg," https://blog.epa.gov/blog/category/environmental_justice/, August 26.
- Tabuchi, H. (2017), "In America's Heartland, Discussing Climate Change without Saying 'Climate Change'," *New York Times*, Jan. 28.

## **Your help with SLS Assessment:**

This class is a cornerstone class for the Serve-Learn-Sustain program. As such, we are expected to measure how effectively we contribute to your learning. We will do this with two pre- post- assessments. **These will not be graded**. Still, we ask that you give it your best anyway each time so that we have the most accurate measure of how we're doing as instructors.

Since we need to do the initial assessment before we teach anything, we will ask you to draw a concept map in Lecture 2. Before coming to Lecture 2, please do the following:

1. Download CmapTools from http://cmap.ihmc.us/ on your laptop.

2. Watch this 20 minute video:
https://www.dropbox.com/s/h3tbdp71dwzw8ut/cmapvid720.mp4?dl=0

3. From minute 10 onwards, follow along the video in your own CmapTool to build the same concept map. Then do the French fries training exercise and e-mail it to Allie by midnight Tuesday at almiller263@gmail.com. Finish watching the video for the French fries debrief to compare it to your own.

4. Bring your laptop with CmapTools loaded to class on Wednesday!