



## **ENGR 499 - Systems Thinking for Sustainability**

**Spring Semester 2024**

**Tuesday/Thursday 10:00 - 11:50**

**Units: 4**

**Location: LVL 17**

**Instructors:**

**Dr. Julie Albright**

**Office:**

**Office Hours: TBD**

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**Prof. Edward Maby**

**Office: PHE 536**

**Office Hours: Tuesday/Thursday 9:00 - 9:50**

**Contact Info: [maby@usc.edu](mailto:maby@usc.edu)**

**Teaching Assistant: TBD**

### **Course Description:**

Have you ever thought about what goes into making a simple sandwich? It starts with wheat from a field that turns into flour at a mill, becomes bread at a bakery, and finally ends up at your home via a supermarket. The journey involves trains, trucks, and complex information systems, all enabled by various energy sources. In ENGR 499, we'll explore these interconnected systems. But we won't stop at just the nuts and bolts: we'll also look at the people, their social settings, and the psychological, economic, and regulatory factors that shape their interactions with infrastructure.

Several important mega-trends are now underway including population growth, a growing appetite for data, and the economic development of countries including India, China, and the Global South, leaving communities struggling to keep pace with growing infrastructure demands. Commodity, energy, water, transportation, and information infrastructures are complex and highly interrelated in a physical sense. However, none of these systems can successfully operate without taking into account the social, political, economic, and environmental context in which they operate. We'll consider each of these interrelated systems in the green transition and the role of stakeholders, including indigenous and underserved communities, and how they may be inordinately impacted by things like mining for the minerals that make our smart phones and electric vehicles and contribute to pollution and e-waste. We'll consider issues of inclusion and environmental justice to ensure that sustainable development is equitable and that it honors traditional ecological knowledge.

Finally, we'll explore how psychological and social psychological principles like persuasion and conformity play a role in impacting people's views on sustainable infrastructure. We'll examine how these principles can be embedded in gamification to promote pro-environmental actions and attitudes, and how documentaries and social media can influence public opinion and encourage change.

Overall, ENGR 499 aims to show you how systems thinking can be used to understand the physical and social nature of complex systems. By the end of the course, you'll be equipped with a rich toolkit of strategies for encouraging sustainable behaviors and systems—leveraging the power of psychology and social psychology to navigate the complex challenges of our increasingly interconnected world.

## Learning Objectives

Students who complete ENGR 499 will be able to:

- Analyze the physical structure of an infrastructure system in terms of accumulated stocks, directed flows, and controlling linkages.
- Analyze the roles and behaviors of stakeholders in an infrastructure system.
- Assess sustainability factors (environmental, economic, social, and resilience) for an infrastructure system.
- Relate the dynamic behavior of an infrastructure system to one or more common system archetypes.
- Determine system intervention strategies that effectively promote sustainability.

**Prerequisite(s):** None

**Co-Requisite(s):** None

**Concurrent Enrollment:** None

**Recommended Preparation:** None. The course assumes no particular mathematics/technical background.

## Course Notes

Grading: Letter grade.

ENGR 499 operates in a “flipped” mode in which students view a prerecorded lecture and read a pertinent paper BEFORE in-class discussions. Lectures (and slides) can be accessed via Blackboard.

## Required Readings and Supplementary Materials

There is no textbook. Papers and optional readings from the literature will be posted on Blackboard.

## Description and Assessment of Assignments

Short papers are graded qualitatively. Scores between 0 and 5 reflect the logic of argument, resources cited, and quality of writing. Students will submit six short papers as individuals.

The major project paper and presentation is a team effort that analyzes an infrastructure system of interest. Qualitative scoring is similar to that for short papers in the following categories: system causal description, social analysis, environmental analysis, economic analysis, resilience analysis, conclusions, writing quality. Teams members will receive identical scores.

## Participation

Class participation in the assessment of case-study exercises is crucial for fulfilling course objectives. Students will receive 15 points (the maximum score for 15% of the grade) if they are absent for no more than four class sessions. Scores will drop by 3 points for each absence beyond four (zero points minimum).

## Grading Breakdown

Assessment Tool (assignments)	Points	% of Grade
Short papers (6)	30	30
Class participation	15	15
Project paper	30	30
Project presentation	10	10
Final exam	15	15
<b>TOTAL</b>	<b>100</b>	<b>100</b>

## Assignment Submission Policy

Short papers are due by the end of the Monday that follows weeks 2, 4, 6, 8, 10, and 12. Scores will be reduced by 25% for each day of a late submission. Papers will be returned the following Monday.

## Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

Since creating, analytical, and critical thinking skills are part of the learning outcomes of this course, all assignments should be prepared by the student working individually or in groups. Students may not have another person or entity complete any substantive portion of the assignment. Developing strong competencies in these areas will prepare you for a competitive workplace. Therefore, using AI-generated tools like ChatGPT is prohibited in this course, will be identified as plagiarism, and will be reported to the Office of Academic Integrity.

## Class Schedule

Black - Class Topic  
Blue - Required Reading Prior to Class Discussion  
Red - Deliverables

### Week 1 -

*Tuesday, 9 January*

Sustainability and the Built Environment  
*Sustainability: An Economist's Perspective* - Solow

*Thursday, 11 January*

Systems Thinking  
*Systems Thinking as a Paradigm Shift for Sustainability Transformation*  
- Voulvoulis et al.

Assignment: Personal introduction and sustainability perspective (Paper 1) - Due 22 January

### Week 2 -

*Tuesday, 16 January*

Running the System: Core Actors  
*The Role of Organizational Structure and Values in the Performance of Critical Infrastructure Systems* - Little

*Thursday, 18 January*

Using the System: Peripheral Actors and the Social License to Operate  
*The Social License to Operate: A Critical Review* - Moffat et al.

Assignment: Notice of team memberships for project (not graded) - Due 29 January

### Week 3 -

*Tuesday, 23 January*

The Economic Pillar of Sustainability  
*Thirty Years of Economics at the Environmental Protection Agency* - McGartland

*Thursday, 25 January*

Commodity Chains  
*A Framework for Sustainable Materials Management* - Fiksel

Assignment: Case study on the social license to operate (paper 2) - Due 5 February

### Week 4 -

*Tuesday, 30 January*

Whose Resources? The Tragedy of the Commons and the Free-Rider Problem  
*The Tragedy of the Commons* - Hardin

*Thursday, 1 February*

Energy Transitions for Sustainability  
*Stocks, Flows, and Prospects of Energy* - Löschel et al.

Assignment: None

**Week 5 -**

*Tuesday, 6 February*

What Resources? Energy Poverty  
*Energy and Social Issues* - Reddy

*Thursday, 8 February*

Managing Water and Waste  
*Groundwater in Peril* - Jones

Assignment: Case study on the tragedy of the commons (paper 3) - Due 19 February

**Week 6 -**

*Tuesday, 13 February*

Who Has a Voice? Environmental Justice  
*Environmental Justice* - Mohai et al.

*Thursday, 15 February*

Growing the Network: Human Demographics  
*Global Population Growth and Sustainable Development* - United Nations

Assignment: Notice of tentative project topic (not graded) - Due 26 February

**Week 7 -**

*Tuesday, 20 February*

Growing the Network: Patterns of Development  
*Electric Vehicles and Psychology* - Viola

*Thursday, 22 February*

Moving People and Freight  
*Public Transport and Sustainability: A Review* - Miller et al.

Assignment: Case study on environmental justice (paper 4) - Due 4 March

**Week 8 -**

*Tuesday, 27 February*

Who Benefits? Who Pays? Transport Service  
*Do Artifacts Have Politics?* - Winner

*Thursday, 29 February*

System Risk and Resilience

*A Methodological Approach to Political Risk*

Assignment: Project literature report (not graded) - Due 18 March

**Week 9 -**

*Tuesday, 5 March*

Access to Information in an Era of Hyper-Connectivity

*The Digital Divide: A Review and Future Research Agenda - Lythreatis et al.*

*Thursday, 7 March*

Communications and Data: Digital Infrastructure and Sustainability

*Green Data: A 4-Pillar Approach for Green Data Centers - Deloitte*

Assignment: Case study on transportation service (paper 5) - Due 25 March

## **SPRING BREAK**

**Week 10 -**

*Tuesday, 19 March*

Getting Things Built

*Sustainable Project Management Through Project Control in Infrastructure Projects  
- Kivila et al.*

*Thursday, 21 March*

The Permitting Process: The Role of Government

*Engaging Overburdened Communities in Permitting Actions:  
US Environmental Protection Agency's "Promising Practices" to Promote  
Environmental Justice - Forrest*

Assignment: None

**Week 11 -**

*Tuesday, 26 March*

Smart Communities

*Smart Growth: A Prescription for Livable Cities - Geller*

*Thursday, 28 March*

Sustainability Metrics

*Sustainability Indicators and Indices: An Overview - Jianguo Wu and Tong Wu*

Assignment: Case study on urban sustainability (paper 6) - Due 8 April

**Week 12 -**

*Tuesday, 2 April*

Social Media

*Green Sustainability and New Social Media - Williams et al.*

*Thursday, 4 April*

Distributing Risk: Microgrids and Microsystems

*Possibilities, Challenges, and Future Opportunities of Microgrids: A Review - Sharzad*

**Assignment: Project progress report (not graded) - Due 16 April**

**Week 13 -**

*Tuesday, 9 April*

Gamification

*Gamification: The Intersection Between Behavior Analysis and Game Design*

*Thursday, 11 April*

Documentaries and Film

*Green Shooting: Media Sustainability, A New Trend - Lopara-Mármol et al.*

**Assignment: None**

**Week 14 -**

*Tuesday, 16 April*

Social Movements for Change

*Sustainability Community Movement Organizations - Foro et al.*

*Thursday, 18 April*

Going Green and Getting Regulation Right

*Engaging with the Politics of Sustainability Transitions - Meadowcroft*

**Assignment: None**

**Week 15**

Student Project Presentations

**Final Exam:** Refer to the final exam schedule in the USC *Schedule of Classes* at [classes.usc.edu](http://classes.usc.edu).

## Statement on Academic Conduct and Support Systems

### Academic Integrity:

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, compromises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see [the student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

### Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. [The Office of Student Accessibility Services](#) (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at [osas.usc.edu](http://osas.usc.edu). You may contact OSAS at (213) 740-0776 or via email at [osasfrontdesk@usc.edu](mailto:osasfrontdesk@usc.edu).

### Support Systems:

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis



centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-5086 or (213) 821-8298

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or [otfp@med.usc.edu](mailto:otfp@med.usc.edu)

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.