

## **SAE 515 - Sustainable Infrastructure Systems Course Syllabus - Spring 2024**

While open to many different interpretations, “sustainability” generally implies the optimization of economic, environmental, and social factors when developing complex infrastructure systems. SAE 515 shows students how to create dynamic infrastructure models, how to include economic, environmental, and social attributes, and how to assess behavior under disruptive perturbations. Students will use these skills to evaluate an infrastructure system of their choice.

### **Course Administration**

SAE 515 meets on Tuesdays and Thursdays from 12:00 - 1:50 for “flipped” class discussion. Students should view a posted 45-minute lecture and read a related paper before each class time. The course also has a Friday discussion from 9:00 to 9:50 that covers modeling issues.

**To get the most from this course, you should participate in class discussions.**

The last day to drop the class without a W grade is 23 February, and the last day to drop the class with a W grade is 6 April. Incomplete grades (IN) are rarely assigned. This grade may be justified only in exceptional cases such as student illness or a personally tragic event occurring after the twelfth week of the semester.

The SAE 515 grade is based on the following components:

Short Papers	(3)	15%
Exercises	(3)	15%
Term Project		70%
(Paper 40%, Presentation 15%, Abstract 5%, Literature Report 5%, Progress Report 5%)		

There are no midterm or final exams. The SAE 515 term project involves the simulation of a simple infrastructure system of interest to a team using standard system dynamics software. Up to four students per team is permitted. Teams are required to present their work to the class.

Once assigned, the SAE 515 letter grade is final except for grossly erroneous circumstances. Your grade cannot be changed via additional work --- don't even ask.

### **Instructor Information**

Julie Albright	albright@usc.edu
No regular office hours. Send e-mail to schedule consultation.	
Edward W. Maby	maby@usc.edu
No regular office hours. Send e-mail to schedule consultation.	

## Tentative SAE 515 Schedule - Spring 2024

Black - Lecture Topic

Red - Assignments

Textbook Cited:

Blue - Required Reading Prior to Class Discussion

Green - Recommended Supplementary Readings

*Thinking in Systems*, Donella Meadows (Required)

### Week 1 -

*Tuesday, 9 January*

Sustainable Infrastructure Systems (Maby)

*Sustainability: An Economist's Perspective* - Solow

*Creating the Future We Want* - Hecht et al.

*Response* - Stutz, *Rejoinder* - Hecht et al.

*Is Sustainability Sustainable?* - Bonevac

*The Limits to Growth and the Limits to Computer Modeling* - Hayes

*Environmental Alarmism, Then and Now* - Lomborg

*Transforming Our World: The 2030 Agenda for Sustainable Development*

- United Nations

*Infrastructure: A Field Guide to the Industrial Landscape* - Hayes

Invaluable Resource, Highly Recommended!

*Report Card for California's Infrastructure: 2019* - ASCE

*Thursday, 11 January*

Systems Thinking (Maby)

*Systems Thinking as a Paradigm Shift for Sustainability Transformation*

- Voulvoulis et al.

*Complexity, Problem Solving, Sustainability and Resilience* - Tainter and Taylor

*Resilience, Adaptability, and Transformability in Social-Ecological Systems*

- Walker et al.

*Infrastructure as a Complex Adaptive System* - Oughton et al.

*Infrastructure Ecology: An Evolving Paradigm for Sustainable Urban Development*

- Pandit et al.

*Integrated Infrastructure Systems—A Review* - Saidi et al.

*Friday, 12 January*

System Dynamics: The Modeling Process (Maby)

Why Model? - Epstein

*A Skeptic's Guide to Computer Models* - Sterman

*Boundary Matters: The Potential of System Dynamics to Support Sustainability*

- Nabavi et al.

*Reflections on the Foundations of System Dynamics* - Richardson

Assignment: Personal introduction and sustainability perspective (Paper 1) - Due 19 January

**Week 2 -**

*Tuesday, 16 January*

Running the System: Core Actors (Richard Little)

*The Role of Organizational Structure and Values in the Performance of Critical Infrastructure Systems* - Little

*The Social Requirements of Technical Systems* - Whitworth

*Thursday, 18 January*

Engaging the System: Peripheral Actors and the Social License to Operate (Albright)

*The Social License to Operate: A Critical Review* - Moffat et al.

*The Inner Dimension of Sustainability: Personal and Cultural Values* - Horlings

*The Politics of Sustainability and Development* - Scoones

*Sustainability and Regime Type: Do Democracies Perform Better in Promoting Sustainable Development than Autocracies?* - Wurster

*The Drivers of Greenwashing* - Delmas and Burbano

*Friday, 19 January*

System Dynamics: Stocks, Flows, and Links (Maby)

Meadows: Chapters 1 and 2

Assignment: Notice of Team Memberships (not graded) - Due 2 February

### **Week 3 -**

*Tuesday, 23 January*

The Economic Pillar of Sustainability (Charles Cicchetti)

*Thirty Years of Economics at the Environmental Protection Agency - McGartland*

*Assessing the Cost of Regulatory Proposals for Reducing Greenhouse  
Gas Emissions - Aldy*

*Duke's Fifth Fuel - Cicchetti*

*Thursday, 25 January*

Commodity Chains (Maby)

*A Framework for Sustainable Materials Management - Fiksel*

*Global Lithium Sources—Industrial Use and Future in the Electric Vehicle Industry:  
A Review - Kavanagh et al.*

*Energy-Critical Elements for Sustainable Development - Hurd et al.*

*Aluminum, Commodity Chains, and the Environmental History of the Second World War  
- Evenden*

*Friday, 26 January*

System Dynamics: Stories and Causal Diagrams (Maby)

*Meadows: Chapters 3 and 4*

*Problems with Causal-Loop Diagrams - Richardson*

*Problems in Causal Loop Diagrams Revisited - Richardson*

*Daisyworld: A Review - Wood*

**Assignment: System Dynamics Exercise 1 - Due 2 February**

## Week 4 -

*Tuesday, 30 January*

Whose Resources? The Tragedy of the Commons and the Free-Rider Problem (Albright)

*The Tragedy of the Commons - Hardin*

*Extensions of the "Tragedy of the Commons" - Hardin*

*Tending the Infrastructure Commons: Ensuring the Vitality of Our Public Systems - Little*

*The Struggle to Govern the Commons - Dietz*

*Nothing to Fear but a Lack of Fear: Climate Change and the Fear Deficit*

*- Lowenstein and Schwartz*

*Thursday, 1 February*

Stocks and Flows I - Energy (Water, Land Use, and Nonrenewable Resources) (Maby)

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

*On the Sustainability of Renewable Energy Sources - Edenhofer et al.*

*Stocks, Flows, and Prospects of Land - Seto et al.*

*Stocks, Flows, and Prospects of Mineral Resources - MacLean et al.*

*Linkages of Sustainability - Graedel and van der Voet (Highly recommended)*

*Friday, 2 February*

System Dynamics: Archetypes and Intervention Strategies (Maby)

*Meadows: Chapters 5 and 6*

*Eight Archetypes of Sustainable Development Goal (SDG) Synergies and Trade-Offs*

*- Moallemi et al.*

*Using Systems Thinking to Understand and Enlarge Mental Models: Helping the*

*Transition to a Sustainable World - Garrity*

**Assignment: Project Abstract - Due 9 February**

## **Week 5 -**

*Tuesday, 6 February*

What Resources? Energy Poverty (Albright)

*Energy and Social Issues - Reddy*

*Infrastructure and the Environment - Doyle and Havlik*

*Climate Change and Social Inequality - Islam and Winkel*

*Thursday, 8 February*

Stocks and Flows II - Water (Energy, Land Use, and Nonrenewable Resources) (Maby)

*Groundwater in Peril - Jones*

*Global Hydrological Cycles and World Water Resources - Oki and Kanae*

*Water and Energy Interactions - McMahon and Price*

*Water Scarcity: The Most Understated Global Security Risk - Stuckenberg and Contento*

*A System Dynamics Model to Facilitate Public Understanding of Water Management*

*Options in Las Vegas, Nevada - Stave*

*Friday, 9 February*

System Dynamics: Causal Diagram to Dynamic Model (Maby)

*Developing System Dynamics Models from Causal Loop Diagrams - Binder et al.*

*Causality and Diagrams for Systems Dynamics - Schaffernicht*

**Assignment: Social Analysis of a Water or Energy Infrastructure System (Paper 2)**

**- Due 16 February**

## **Week 6 -**

*Tuesday, 13 February*

Who Has a Voice? Environmental Justice (Albright)

*Environmental Justice - Mohai et al.*

*A Case Study of Environmental Injustice: The Failure in Flint - Campbell et al.*

*The Flint Water Crisis: What Happened and Why - Masten et al.*

*Toolkit for Assessing Potential Allegations of Environmental Injustice - EPA*

*Thursday, 15 February*

Growing the Network: Human Demographics (Maby)

*Assessment of the Natural Environment: A Determinant of Natural Preferences -  
Weichart*

*Friday, 16 February*

System Dynamics: The Spatial Dimension (Maby)

*Modeling Structural Change in Spatial System Dynamics: A Daisyworld Example  
- Neuwirth et al.*

**Assignment: System Dynamics Exercise 2 - Due 23 February**

## **Week 7 -**

*Tuesday, 20 February*

Growing the Network: Patterns of Development (Albright)

*Electric Vehicles and Psychology - Viola*

*The Dynamics of Brownfield Redevelopment - BenDor et al.*

*Thursday, 22 February*

Moving People and Freight (TBD)

*The Future of Transportation in Sustainable Energy Systems: Opportunities and Barriers in a Clean Energy Transition - Dominkovic et al.*

*A Review of System Dynamics Models Applied in Transportation - Shepherd*

*Friday, 23 February*

System Dynamics: Estimating Model Parameters (Maby)

*Mistakes and Misunderstandings: Examining Dimensional Inconsistency - Gary*

**Assignment: Project Literature Report - Due 1 March**

## **Week 8 -**

*Tuesday, 27 February*

Transport Service: Who Benefits? Who Pays? (Albright)

*Do Artifacts Have Politics? - Winner*

*Building Out The Electric Vehicle Charging Infrastructure - Forbes Magazine*  
*Charging Infrastructure Planning for Promoting Battery Electric Vehicles:  
An Activity-Based Approach Using Multiday Travel Data - Dong et al.*

*Thursday, 29 February*

Risk and Resilience (Richard Little)

*A Methodological Approach to Political Risk - Little*

*Friday, 1 March*

System Dynamics: Model Evaluation (Maby)

**Assignment: System Dynamics Exercise 3 - Due 8 March**

**Week 9 -**

*Tuesday, 5 March*

Left to Their Own Devices: The Digital Divide (Albright)

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

*Thursday, 7 March*

Green Data: Digital Infrastructure and Sustainability (Bill Kleyman)

*A New Methodology Toward Effectively Assessing Data Center Sustainability -  
Lykou et al.*

*Friday, 8 March - No Class*

**Assignment: Risk Assessment (Paper 3) - Due 22 March**

11 March - 15 March          SPRING BREAK

**Week 10 -**

*Tuesday, 19 March*

The Permitting Process: The Role of Media (Albright)

*Organizational and Celebrity Activism - Collins*

*“No Fracking Way!” Documentary Film, Discursive Opportunity, and Local Opposition  
against Hydraulic Fracking in the United States, 2010 to 2013 - Vasi et al.  
Domestic Wastewater Recycling: “Toilet-to-Toilet” and “Tap-to-Tap” Instead of*

*“Toilet-to-Tap” - A New Approach - Antholz*

*Thursday, 21 March*

Getting Things Built (Wayne Kalayjian)

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

*Friday, 22 March*

System Dynamics: Sustainia - The Environmental Model

**Assignment: Project Status Report - Due 29 March**

**Week 11 -**

*Tuesday, 26 March*

Smart Communities (TBD)

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

*Thursday, 28 March*

Sustainability Metrics (Maby)

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

*The Sustainability Metrics - Institution of Chemical Engineers*

*Friday, 29 March*

System Dynamics: Sustainia - The Social Model

**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

*Friday, 5 April*

System Dynamics: Sustainia - The Economic Model

**Week 13 -**

*Tuesday, 9 April*

Gamification (Albright)

*Gamification: The Intersection Between Behavior Analysis and Game Design Technologies* - Morford and Killingsworth

*Thursday, 11 April*

Documentaries and Film (TBA)

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

*Friday, 12 April*

System Dynamics: Sustainia - Resilience Assessment

**Week 14 -**

*Tuesday, 16 April*

The Smart Grid and the Internet of Things (Albright)

*The Big Smart-Grid Challenges* - Bullis  
*The Bright Future of the Internet of Things* - Campolargo

*Thursday, 18 April*

Going Green and Getting It Right (Charles Cicchetti)

*Engaging with the Politics of Sustainability Transitions* - Meadowcroft



*Friday, 19 April*

No Class

**Week 15**

Student Presentations