

**University of Southern California
Systems Architecting and Engineering Program**

**SAE 515 - Sustainable Infrastructure Systems
Course Syllabus - Spring 2023**

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 12:30 - 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.

The last day to drop the class without a W grade is 24 February, and the last day to drop the class with a W grade is 7 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.	

SAE 515 Schedule - Spring 2023

Black - Lecture Topic

Blue - Required Reading Prior to Class Discussion

Red - Assignments

Green - Recommended Supplementary Readings

Textbook Cited:

Thinking in Systems, Donella Meadows (Required)

Week 1 -

Tuesday, 10 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, 12 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, 13 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 20 January

Week 2 -

Tuesday, 17 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, 19 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, 20 January

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

[Meadows: Chapters 1 and 2](#)

Assignment: Notice of Team Memberships - Due 3 February

Week 3 -

Tuesday, 24 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*

Thursday, 26 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*

Friday, 27 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 3 February

Week 4 -

Tuesday, 31 January

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)

Thursday, 2 February

Whose Impact? Energy, Environment, and Social Consequences (Albright)

Energy and Social Issues - Reddy

Infrastructure and the Environment - Doyle and Havlik

Climate Change and Social Inequality - Islam and Winkel

Friday, 3 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 10 February

Week 5 -

Tuesday, 7 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

Thursday, 9 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

Friday, 10 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 17 February

Week 6 -

Tuesday, 14 February

Growing the Network: Human Demographics (Maby)

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

Thursday, 16 February

Growing the Network: Patterns of Development (Maby)

*Forecasting Electric Demand of Distribution System Planning in Rural and
Sparsely Populated Regions - Willis*

The Dynamics of Brownfield Redevelopment - BenDor et al.

Friday, 17 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 24 February

Week 7 -

Tuesday, 21 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

Thursday, 23 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.*

Friday, 24 February

System Dynamics: Estimating Model Parameters (Maby)

Mistakes and Misunderstandings: Examining Dimensional Inconsistency - Gary

Assignment: Project Literature Report - Due 3 March

Week 8 -

Tuesday, 28 February

Green Data: Sustainability and Digital Infrastructure (Bill Kleyman)

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

Thursday, 2 March

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

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

Friday, 3 March

System Dynamics: Model Evaluation (Maby)

Assignment: System Dynamics Exercise 3 - Due 10 March

Week 9 -

Tuesday, 7 March

Risk and Resilience (Richard Little)

A Methodological Approach to Political Risk - Little

Thursday, 9 March

Strategies for Risk Management (Richard Little)

Improving Healthcare Supply Chain Resilience During Extreme Weather Events - Little

What to Do While the Water Rises - Little

Reengineering Cities: A Framework for Adaptation to Global Change - Dawson

Friday, 10 March

No Class

Assignment: Risk Assessment (Paper 3) - Due 24 March

14 March - 17 March SPRING BREAK

Week 10 -

Tuesday, 21 March

The Permitting Process: The Role of Government (TBD)

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

Thursday, 23 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*

Friday, 24 March

System Dynamics: Sustainia - The Environmental Model

Assignment: Project Status Report - Due 31 March

Week 11 -

Tuesday, 28 March

Getting Things Built (Wayne Kalayjian)

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

Thursday, 30 March

Sustainability Metrics (Maby)

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

The Sustainability Metrics - Institution of Chemical Engineers

Friday, 31 March

System Dynamics: Sustainia - The Social Model

Week 12 -

Tuesday, 4 April

Sustainable Financing (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, 6 April

Sustainable Management (TBD)

Readings TBD

Friday, 7 April

System Dynamics: Sustainia - The Economic Model

Week 13 -

Tuesday, 11 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

Preparing for Smart-Grid Technologies: A Behavioral Decision Research Approach to Understanding Consumer Expectations About Smart Meters - Krishnamurti et al.

Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems - Vermesan and Fries

On Micro-Transactions in Urban Informatics - McCullough

Thursday, 13 April

Gamification (Albright)

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

Friday, 14 April

System Dynamics: Sustainia - Resilience Assessment

Week 14 -

Tuesday, 18 April

Artificial Intelligence for Sustainable Cities (TBD)

Thursday, 20 April

Going Green and Getting It Right (Charles Cicchetti)

Friday, 21 April

No Class

Week 15

Student Presentations