University of Southern California
Systems Architecting and Engineering Program

SAE 515 - Sustainable Infrastructure Systems

Course Syllabus - Fall 2018

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 Mondays and Wednesdays from 12:30 - 1:50 in OHE 100D.

The last day to drop the class without a W grade is 7 September, and the last day to drop the class with a W grade is 9 November. 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%	
Homework	(3)	15%	
Term Project		70%	(Paper 50%, Presentation 10%, Abstract, Prog. Report 10%)

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 Systems 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

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Office Hours: TBD

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Office Hours: MW 10:00 - 11:00

Tentative SAE 515 Schedule - Fall 2018

Black - Lecture Topic
Blue - Required (Strongly Recommended) Readings
Red - Assignments
Green - Recommended Supplementary Readings

Textbooks Cited

Curbing Catastrophe: Natural Hazards and Risk Reduction in the Modern World, Timothy Dixon (Required)
Pursuing Sustainability: A Guide to the Science and Practice, Pamela Matson, William C. Clark, and Krister Anderson (Required)
Thinking in Systems, Donella Meadows (Required)

Week 1 -

20 August

What is infrastructure? - What is sustainability? - What are systems? (Maby)

Matson: Chapters 1,2
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

22 August

The Tragedy of the Commons and Our Crumbling Infrastructure (Albright)

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

Infrastructure: A Field Guide to the Industrial Landscape - Hayes
Invaluable Resource, Highly Recommended!
Report Card for Los Angeles County Infrastructure: A Citizen's Guide (2012)

Assignment: Personal introduction and sustainability perspective paper 1 - Due 5 September

Week 2 -

27 August

System Thinking (Maby)

Meadows: Introduction, Chapter 1

29 August

System Dynamics: Theory and Interpreting Stories (Maby)

Meadows: Chapters 2, 3
A Skeptic's Guide to Computer Models - Sterman

Assignment: None

Week 3 - No class on 3 September - Labor Day

5 September

System Dynamics: The Modeling Process (Maby)

Meadows: Chapters 3 - 6
Mistakes and Misunderstandings: Examining Dimensional Inconsistency - Gary
Problems with Causal-Loop Diagrams - Richardson

Reflections on the Foundations of System Dynamics - Richardson
Daisyworld: A Review - Wood

Assignment: System dynamics exercise 1 - Due 17 September

Week 4 -

10 September

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

Global Hydrological Cycles and World Water Resources - Oki and Kanae
Groundwater in Peril - Jones
Water and Energy Interactions - McMahon and Price

12 September

Stocks and Flows II - 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)

Assignment: Team composition and tentative project title - Due 24 September

Week 5 -

17 September

Infrastructures as Complex Systems (Albright)

Matson: Chapters 3,4
The Social Requirements of Technical Systems - Whitworth
Guiding Principles for the Nation's Critical Infrastructure - ASCE

19 September

Actors in Complex Systems (Richard Little)

The Role of Organizational Structure and Values in the Performance of Critical Infrastructure Systems - Little
Dixon: Chapters 1 - 3

Assignment: Complex infrastructure and resilient systems paper 2 - Due 1 October

Week 6 -

24 September

Managing the Risk of Cascading Failure in Interdependent Infrastructures (Richard Little)

> *Toward More Robust Infrastructure: Observations on Improving the Resilience and Reliability of Critical Systems* - Little
> Dixon: Chapters 4 - 6

26 September

Adapting to Climate Change: Preparing the Flood-Resilient City (Richard Little)

> Dixon: Chapters 7 - 9
>
> *Reengineering Cities: A Framework for Adaptation to Global Change* - Dawson
> *What to Do While the Water Rises* - Little

Assignment: System dynamics exercise 2 - Due 8 October

Week 7 -

1 October

Social Pillar of Sustainability (Albright)

> *A Missing Pillar? Challenges in Theorizing and Practicing Social Sustainability* - Böstrom
> *Environmental Justice* - Mohai et al.

3 October

Model Development - Sustainia I (Growth Dynamics) (Maby)

> *Assessment of the Natural Environment: A Determinant of Natural Preferences* - Weichart
>
> *Forecasting Electric Demand of Distribution System Planning in Rural and Sparsely Populated Regions* - Willis

Assignment: Project abstract - Due 15 October

Week 8 -

8 October

Environmental Pillar of Sustainability (Tree People)

> *Infrastructure and the Environment* - Doyle and Havlik
> *Engaging Overburdened Communities in Permitting Actions:*
> *US Environmental Protection Agency's "Promising Practices" to Promote Environmental Justice* - Forrest

10 October

Model Development - Sustainia II (Environmental Issues) (Maby)

Assignment: System dynamics exercise 3 - Due 22 October

Week 9 -

15 October

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*

17 October

Conservation and the Gamification of Infrastructure Behavior (Albright)

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

Assignment: Sustainability paper 3 - Due 29 October

Week 10 -

22 October

Water Case Study -
Reclamation System Successes and Failures: Toilet to Tap vs. Orange County (Albright)

Domestic Wastewater Recycling: "Toilet-to-Toilet" and "Tap-to-Tap" Instead of "Toilet-to-Tap" - A New Approach - Antholz

24 October

Data-Center Infrastructure (Guest Speaker, TBD)

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

Assignment: None

Student projects and teams should be well underway. Changes to the scope of the team project must be submitted to the course instructors for approval no later than 5 November.

Week 11 -

29 October

Energy Case Study -
Gasland and Artists Against Fracking: Celebrity, Activism, and Non-Traditional Oil and Gas Extraction (Albright)

Organizational and Celebrity Activism - Collins

31 October

Energy Case Study -
The Smart Grid and Its Backlash (Albright)

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

Assignment: Project progress report - Due 19 November

Week 12 -

5 November

Blockchain for Clean Energy (Killian Tobin, Omega Grid)

> *Review of Blockchain Technology and Its Expectations: Case of the Energy Sector* - Chitchyan and Murkin

7 November

Linking Knowledge With Action and Unintended Consequences (Maby)

> Matson: Chapters 5,6

Assignment: None

Week 13 -

12 November

Transportation Case Study -
Electric Vehicles and the Charging Infrastructure (Albright)

> *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.

14 November

The Internet of Things and the Future of Infrastructure (Albright)

> *The Bright Future of the Internet of Things* - Campolargo
> *Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems* - Vermesan and Fries
> *On Micro-Transactions in Urban Informatics* - McCullough

Assignment: None

Week 14 -

19 November

Class Presentations (if necessary)

Week 15 -

Class Presentations

Recommended Texts --- One of them may be helpful for your project!

Sustainability

Simon Bell and Stephen Morse, *Measuring Sustainability: Learning from Doing* (Earthscan, 2006)

Simon Bell and Stephen Morse, *Sustainability Indicators: Measuring the Immeasurable* (Earthscan, 2008)

John Blewitt, *Understanding Sustainable Development* (Earthscan, 2008).

Jeremy L. Caradonna, *Sustainability: A History* (Oxford, 2014).

Robert Costanza, Lisa J. Graumlich, and Will Steffin, *Sustainability or Collapse: An Integrated History and Future of People on Earth* (MIT, 2007).

Stephen Cohen, *Sustainability Management: Lessons from and for New York City, America, and the Planet* (Columbia, 2011).

Randall Curren and Ellen Metzger, *Living Well Now and In the Future* (MIT, 2017).

Mark Denny, *Facing the Future: Making the Most of the Anthropocene* (Johns Hopkins, 2017).

Bert J. M. de Vries, *Sustainability Science* (Cambridge, 2013).

Jared Diamond, *Collapse: How Societies Choose to Fail or Succeed* (Viking, 2005).

Chris Goodall, *Sustainability: All That Matters* (Hodder and Stoughton, 2012).

Thomas Graedel and Ester van der Voet, *Linkages of Sustainability* (MIT, 2010).

John R. Ehrenfeld, *Sustainability by Design* (Yale, 2008).

Richard Heinberg and Daniel Lerch (eds.), *The Post Carbon Reader: Managing the 21st Century's Sustainability Crisis* (Watershed Media, 2010).

Rebecca Henn and Andrew Hoffman, *Constructing Green: The Social Structures of Sustainability* (MIT, 2013).

Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, and William W. Behrens III, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind* (Universe Books, 1972).

Donella H. Meadows, Jorgen Randers, and Dennis L. Meadows, *Limits to Growth: The 30-Year Update* (Chelsea Green, 2004).

Adrian Parr, *Hijacking Sustainability* (MIT, 2009)

Jorgen Randers, *2052: A Global Forecast for the Next Forty Years* (Chelsea Green, 2012).
Peter Rogers, Kazi Jalal, and John Boyd, *An Introduction to Sustainable Development* (Earthscan, 2008)

Andrew Ross, *Bird on Fire: Lessons from the World's Least Sustainable City* (Oxford, 2011).

Jeffrey D. Sachs, *The Age of Sustainable Development* (Columbia, 2015).

Carlos Arnaldo Schwantes, *Going Places: Transportation Redefines the Twentieth-Century American West* (Indiana, 2003).

Joseph A. Tainter, *The Collapse of Complex Societies* (Cambridge, 1988).

Robert W. Taylor, *Taking Sides: Clashing Views in Sustainability* (McGraw-Hill, 2012).

Brian Tilt, *The Struggle for Sustainability in Rural China: Environmental Values and Civil Society* (Columbia, 2010).

Derek Wall, *The Commons in History* (MIT, 2014).

Infrastructure (General)

Peter Ackroyd, *London Under: The Secret History Beneath the Streets* (Talese, 2011).

Kate Ascher, *The Works: Anatomy of a City* (Penguin, 2005).

Hillary Brown and Byron Stigge, *Infrastrucutural Ecologies: Alternative Development Models for Emerging Economies* (MIT, 2017).

Stephen Graham (ed.), *Disrupted Cities: When Infrastructure Fails* (Routledge, 2010).

Harry Granick, *Underneath New York* (Fordham, 1991).

Brian Hayes, *Infrastructure: A Field Guide to the Industrial Landscape* (Norton, 2005).

Alex Marshall, *Beneath the Metropolis: The Secret Lives of Cities* (Carroll and Graf, 2006).

Julia Solis, *New York Underground: The Anatomy of a City* (Routledge, 2005).

Kazys Varnelis (ed.), *The Infrastructural City: Networked Ecologies in Los Angeles* (Actar, 2009).

Electric Power

Charles Coleman, P. G. and E. of California: *The Centennial Story of Pacific Gas and Electric Company* (McGraw-Hill, 1952).

Julie A. Cohn, *The Grid: Biography of an American Technology* (MIT, 2017).

Peter Fox-Penner, *Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities* (Island Press, 2010).

Ernest Freeberg, *The Age of Edison: Electric Light and the Invention of Modern America* (Penguin, 2013).

Richard F. Hirsh, T*echnology and Transformation in the American Electric Utility Industry* (Cambridge, 1989).

Richard F. Hirsh, *Power Loss: The Origins of Deregulation and Restructuring in the American Electric Utility System* (MIT, 1999).

Thomas P. Hughes, *Networks of Power: Electrification in Western Society* (Johns Hopkins, 1983).

Maury Klein, *The Power Makers: Steam, Electricity, and the Men Who Invented America* (Bloomsbury, 2008).

Jeremiah D. Lambert, T*he Power Brokers: The Struggle to Shape and Control the Electric Power Industry* (MIT, 2015).

Richard Munson, *From Edison to Enron: The Business of Power and What It Means for the Future of Electricity* (Praeger, 2005).

William A. Myers, I*ron Men and Copper Wires: A Centennial History of the Southern California Edison Company* (Trans-Anglo Books, 1984).

David E. Nye, *When the Lights Went Out: A History of Blackouts in America* (MIT, 2010).

Harold L. Platt, *The Electric City: Energy and the Growth of the Chicago Area 1880 - 1930* (Chicago, 1991).

Mason Willrich, *Modernizing America's Electricity Infrastructure* (MIT, 2017).

Water

Tony Allan, *Virtual Water* (I. B. Taurus, 2011).

William M. Alley and Rosemarie Alley, *High and Dry: Meeting the Challenges of the World's Growing Dependence on Groundwater* (Yale, 2017).

Shimon C. Anisfeld, *Water Resources* (Island Press, 2010).

Cynthia Barnett, *Rain: A Natural and Cultural History* (Crown, 2015).

David P. Billington and Donald C. Jackson, *Big Dams of the New Deal Era* (Oklahoma, 2006).

Kevin Bone (ed.), *Water Works: The Architecture and Engineering of the New York City Water Supply* (Monacelli Press, 2006).

Peter Brown and Jeremy Schmidt, *Water Ethics: Foundational Readings for Students and Professionals* (Island Press, 2010).

David Carle, *Introduction to Water in California* (California, 2009).

David Carle, *Water and the California Dream: Historic Choices for Shaping the Future* (Counterpoint, 2016).

Brahma Chellaney, *Water: Asia's New Battleground* (Georgetown, 2011).

Juliet Christian-Smith and Peter H. Gleick, *A Twenty-First Century U. S. Water Policy* (Oxford, 2012).

William deBuys and Joan Myers, *Salt Dreams: Land and Water in Low-Down California* (New Mexico, 1999).

William Deverell and Tom Sitton, *Water and Los Angeles: A Tale of Three Rivers 1900-1941* (Univeristy of California, 2017).

Martin Doyle, *The Source: How Rivers Made America and America Remade Its Rivers* (Norton, 2018)

Malin Falkenmark and Johan Rockström, *Balancing Water for Humans and Nature: The New Approach in Ecohydrology* (Earthscan, 2005).

John Fleck, *Water is for Fighting Over and Other Myths About Water in the West* (Island Press, 2016).

Philip L. Fradkin, *A River No More: The Colorado River and the West* (Knopf, 1981).

Antoine Frérot, *Water: Towards a Culture of Responsibility* (New Hampshire, 2011).

Matthew Gandy, *The Fabric of Space: Water, Modernity, and the Urban Imagination* (MIT, 2014).

Diane Galusha: *Liquid Assets: A History of New York City's Water System* (Purple Mountain, 1999).

Philip Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley* (California, 2011).

Blake Gumprecht, *The Los Angeles River: Its Life, Death, and Possible Rebirth* (Johns Hopkins, 1999).

Gay Hawkins, Emily Potter, and Kane Race, *Plastic Water: The Social and Material Life of Bottled Water* (MIT, 2015).

Arjen Y. Hoekstra, *The Water Footprint of Modern Consumer Society* (Routledge, 2013).

Abraham Hoffman, *Mono Lake: From Dead Sea to Environmental Treasure* (New Mexico, 2014).

Norris Hundley, Jr., *The Great Thirst: Californians and Water, 1770s - 1990s* (California, 1992).

Norris Hundley Jr. and Donald C. Jackson, *Heavy Ground: William Mulholland and the St. Francis Dam Disaster* (California, 2015).

B. Lynn Ingram and Frances Malamud-Roam, *The West Without Water: What Past Floods, Droughts, and Other Climate Clues Tell Us About Tomorrow* (California, 2013).

William L. Kahrl, *The California Water Atlas* (State of California, 1978).

William L. Kahrl, *Water and Power* (California, 1982).

Gerard T. Koeppel, *Water for Gotham: A History* (Princeton, 2000).

George Kuffner (ed.), *The Power of Water* (DVA, 2006).

Allison Lassiter, *Sustainable Water; Challenges and Solutions from California* (California, 2015).

Victor Mallet, *River of Life, River of Death: The Ganges and India's Future* (Oxford, 2017).

Daniel McCool, River Republic: *The Fall and Rise of America's Rivers* (Columbia, 2012).

Patrick McCully, *Silenced Rivers: The Ecology and Politics of Large Dams* (Zed Books, 1996).

Steven Mithen, *Thirst: Water and Power in the Ancient World* (Harvard, 2012).

John Opie, Ogallala: *Water for a Dry Land* (Nebraska, 1993).

Jared Orsi, *Hazardous Metropolis: Flooding and Urban Ecology in Los Angeles* (California, 2004).

David Owen, *Where the Water Goes: Life and Death Along the Colorado River* (Riverhead Books, 2017).

Karen Piper, *The Price of Thirst: Global Water Inequality and the Coming Chaos* (Minnesota, 2014).

Sandra Postel, *Replenish: The Virtuous Cycle of Water and Prosperity* (Island Press, 2017).

James Powell, *Dead Pool: Lake Powell, Global Warming, and the Future of Water in the West* (California, 2008).

Brian Richter, *Chasing Water: A Guide for Moving from Scarcity to Sustainability* (Island Press, 2014).

Peter Rogers, *America's Water: Federal Roles and Responsibilities* (MIT, 1993).

James Salzman, *Drinking Water: A History* (Overlook Duckworth, 2012).

Andrew Sansom, *Water in Texas: An Introduction* (Texas, 2008).

Jeremy J. Schmidt, Water: *Abundance, Scarcity, and Security in the Age of Humanity* (New York University, 2017).

David Sedlak, *Water 4.0* (Yale, 2014).

David Soll, *Empire of Water: An Environmental and Political History of the New York Water Supply* (Cornell, 2013).

Steven Solomon, *Water: The Epic Struggle for Wealth, Power, and Civilization* (Harper Collins, 2010).

Michael E. Webber, *Thirst for Power: Energy, Water, and Human Survival* (Yale, 2016).

Leah J. Wilds, *Water Politics in Northern Nevada* (Nevada, 2014).
Jon Wilkman, *Floodpath: The Deadliest Man-Made Disaster of 20th-Century America and the Making of Modern Los Angeles* (Bloomsbury, 2016).

Ellen Wohl, *A World of Rivers: Environmental Change on Ten of the World's Great Rivers* (Chicago, 2011).

Donald Worster, *Rivers of Empire: Water, Aridity & the Growth of the American West* (Pantheon, 1985).

Paul L. Younger, *Water: All That Matters* (Hodder and Stoughton, 2012).

Waste Management

William M. Alley and Rosemarie Alley, Too Hot to Touch: The Problem of High-Level Nuclear Waste (Cambridge, 2013).

Assa Doron and Robin Jeffrey, *Waste of a Nation: Garbage and Growth in India* (Harvard, 2018).

Annie Leonard, *The Story of Stuff* (Free Press, 2010).

Samantha MacBride, *Recycling Reconsidered: The Present Failure and Future Promise of Environmental Action in the United States* (MIT, 2013).

Martin U. Melsoi, *The Sanitary City: Environmental Services in Urban America from Colonial Times to the Present* (Pittsburgh, 2008).

Adam Minter, *Junkyard Planet* (Bloomsbury, 2013).

Robin Nagle, *Picking Up: On the Streets and Behind the Trucks with the Sanitation Workers of New York City* (Farrar, Straus, and Giroux, 2013).

Heather Rogers, *Gone Tomorrow: The Hidden Life of Garbage* (New Press, 2005).

Anna Sklar, *Brown Acres: An Intimate History of the Los Angeles Sewers* (Angel City Press, 2008).

Transportation

Albert J. Churella, *The Pennsylvania Railroad: Building an Empire* (Pennsylvania, 2013).

Brian J. Cudahy, *Under the Sidewalks of New York: The Story of the Greatest Subway System in the World* (Fordham, 2010).

Joseph F. C. DiMento and Cliff Ellis, *Changing Lanes: Visions and Histories of Urban Freeways* (MIT, 2013).

Ethan N. Elkind, Railtown: *The Fight for the Los Angeles Metro Rail and the Future of the City* (California, 2014).

Robert E. Gallamore and John R. Meyer, *American Railroads: Decline and Renaissance in the Twentieth Century* (Harvard, 2014).

Mark Gerchick, *Full Upright and Locked Position: Not-So-Comfortable Truths About Air Travel Today* (Norton, 2013).

Roger Grant, *Railroads and the American People* (Indiana, 2012).

Charles P. Hobbs, *Hidden History of Transportation in Los Angeles* (History Press, 2014).

Clifton Hood, 722 Miles: *The Building of the Subways and How They Transformed New York* (Simon & Schuster, 1993).

Edward Humes, *Door to Door: The Magnificent Maddening, Mysterious World of Transportation* (Harper, 2016).

William Kaszynski, *The American Highway* (McFarland, 2000).

Albro Martin, *Enterprise Denied: Origins of the Decline of American Railroads* (Columbia, 1971).

Albro Martin, *Railroads Triumphant: The Growth, Rejection & Rebirth of a Vital American Force* (Oxford, 1992).

Henry Petroski, *The Road Taken: The History and Future of America's Infrastructure* (Bloomsbury, 2016).

Joseph B. Raskin, *The Routes Not Taken: A Trip Through New York City's Unbuilt Subway System* (Fordham, 2014).

Bill Sharpsteen, *The Docks* (California, 2011).

Brian Solomon, *North American Railroad Family Trees: An Infographic History of the Industry's Mergers and Evolution* (Voyager Press, 2013).

Richard Saunders, Jr., *Merging Lines: American Railroads, 1900-1970* (Northern Illinois, 2001).

Richard Saunders, Jr., *Main Lines: Rebirth of the North American Railroads, 1970-2002* (Northern Illinois, 2001).

Vaclav Smil, *Prime Movers of Globalization: The History and Impact of Diesel Engines and Gas Turbines* (MIT, 2010).

James E. Vance, Jr., *The North American Railroad: Its Origin, Evolution, and Geography* (Johns Hopkins, 1995).

Christian Wolmar, *The Great Railway Revolution: The Epic Story of the American Railroad* (Atlantic Books, 2012).

Telecommunications

Richard R. John, *Network Nation: Inventing American Telecommunications* (Harvard, 2010).

Jonathan E. Nuechterlein and Philip J. Weiser, *Digital Crossroads: American Telecommunications Policy in the Internet Age* (MIT, 2005).

Bill Tomlinson, *Greening Through IT: Information Technology for Environmental Sustainability* (MIT, 2010).

Kazys Varnelis (ed.), *Networked Publics* (MIT, 2008).

Lawrence Webber and Michael Wallace, *Green Tech: How to Plan and Implement Sustainable IT Solutions* (Amacom, 2009).

Brian Winston, *Media, Technology, and Society, a History: From the Telegraph to the Internet* (Routledge, 1998).

Tim Wu, *The Master Switch: The Rise and Fall of Information Empires* (Knopf, 2010).

Energy

Marsha E. Ackermann, *Cool Comfort: America's Romance With Air-Conditioning* (Smithsonian, 2002).

Stephen Ansolabehere and David M. Konisky, *Cheap and Clean: How Americans Think About Energy in the Age of Global Warming* (MIT, 2014).

Peter Asmus, *Introduction to Energy in California* (California, 2009).

Salvatore Basile, *Cool: How Air Conditioning Changed Everything* (Fordham, 2014).

Daniel B. Botkin, *Powering the Future: A Scientist's Guide to Energy Independence* (FT Press, 2010).

Robert Bryce, *Power Hungry, The Myths of "Green" Energy and the Real Fuels of the Future* (Public Affairs, 2010).

Robert Bryce, *Smaller, Faster, Lighter, Denser, Cheaper* (Public Affairs, 2014).

Alan R. Carroll, *Geofuels: Energy and the Earth* (Cambridge, 2015).

Charles Cicchetti, *Going Green and Getting Regulation Right: A Primer for Energy Efficiency* (Public Utilities Reports, 2009).

Francis F. Chen, *An Indispensable Truth: How Fusion Power Can Save the Planet* (Springer, 2011).

Guy Deutscher, *The Entropy Crisis* (World Scientific, 2008).

David Ginsley and David Cahen (eds.), *Fundamentals of Materials for Energy* (Cambridge, 2012).

Michael J. Graetz, *The End of Energy: The Unmaking of America's Environment, Security, and Independence* (MIT, 2011).

Agnia Grigas, *The New Geopolitics of Natural Gas* (Harvard, 2017).

Tyler Hamilton, Mad Like Tesla: Underdog Inventors and their Relentless Pursuit of Clean Energy (ECW Press, 2011).

Michael L. Jaffe and Washington Tayor, *The Physics of Energy* (Cambridge, 2018).

Christopher F. Jones, *Routes of Power: Energy and Modern America* (Harvard, 2014).

Bob Johnson, *Carbon Nation: Fossil Fuels in the Making of American Culture* (Kansas, 2014).

Astrid Kander et al., *Power to the People: Energy in Europe Over the Last Five Centuries* (Princeton, 2013).

Ingrid Kelley, *Energy in America: A Tour of Our Fossil Fuel Culture and Beyond* (Vermont, 2008).

Maggie Koerth-Baker, *Before the Lights Go Out: Conquering the Energy Crisis Before It Conquers Us* (Wiley, 2012).

Robert B. Laughlin, *Powering the Future: How We Will (Eventually) Solve the Energy Crisis and Fuel the Civilization of Tomorrow* (Basic Books, 2011).

Amory B. Lovins, *Reinventing Fire: Bold Business Solutions for the New Energy Era* (Chelsea Green, 2011).

David J. C. MacKay, *Sustainable Energy: Without the Hot Air* (UIT, 2009).

Alexis Madrigal, *Powering the Dream: The History and Promise of Green Technology* (Da Capo, 2011).

Efstathios E. Michaelides, Alternative Energy Sources (Springer, 2012).

Robin M. Mills, *Capturing Carbon: The New Weapon in the War Against Climate Change* (Columbia, 2011).

Scott L. Montgomery, *The Powers That Be: Global Energy for the Twenty-First Century and Beyond* (Chicago, 2010).

Andrew P. Morriss, William T. Bogart, Roger E. Meiners, and Andrew Dorchak, *The False Promise of Green Energy* (Cato, 2011).

Jim Motavalli, *High Voltage: The Fast Track to Plug In the Auto Industry* (Rodale, 2011).

David E. Nye, *Consuming Power: A Social History of American Energies* (MIT, 2001).

John Perlin, *Let It Shine: The 6000-Year Story of Solar Energy* (New World, 2013).

Richard Rhodes, *Energy: A Human History* (Simon and Schuster, 2018).

Eric W. Sanderson, *Terra Nova: The New World After Oil, Cars, and Suburbs* (Abrams, 2013).

Vaclav Smil, *Energies: An Illustrated Guide to the Biosphere and Civilization* (MIT, 1999).

Vaclav Smil, *Energy at the Crossroads: Global Perspectives and Uncertainties* (MIT, 2003).

Vaclav Smil, *Energy and Civilization* (MIT, 2017).

Vaclav Smil, *Power Density: A Key to Understanding Energy Sources and Uses* (MIT, 2003).

Peter F. Smith, *Sustainability at the Cutting Edge: Emerging Technologies for Low-Energy Buildings* (Architectural Press, 2003).

Jefferson W. Tester, Elisabeth M. Drake, Michael J. Driscoll, Michael W. Golay, and William A. Peters, *Sustainable Energy: Choosing Among Options* (MIT, 2005).

James C. Williams, *Energy and the Making of Modern California* (Akron, 1997).

Daniel Yergin, *The Quest: Energy, Security, and the Remaking of the Modern World* (Penguin, 2011).

Ozzie Zehner, Green Illusions: The Dirty Secrets of Clean Energy and the Future of Environmentalism (Nebraska, 2012).

Mining

David S. Abraham, The Elements of Power: Gadgets, Guns, and the Struggle for a Sustainable Future in the Rare Metal Age (Yale, 2015).

Andrew Scott Johnston, *Mercury and the Making of California: Mining, Landscape, and Race 1840-1890* (Colorado, 2013).

Ronald H. Limbaugh, *Tungsten: In Peace and War, 1918-1946* (Nevada, 2010).

Richard Martin, *Coal Wars: The Future of Energy and the Fate of the Planet* (Palgrave, 2015).

Mimi Sheller, Aluminum Dreams: The Making of Light Modernity (MIT, 2014).

Vaclav Smil, Making the Modern World: Materials and Dematerialization (Wiley, 2014).

Urban Systems

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