Energy and Resources Group

Overview
The Energy and Resources Group (ERG) is an interdisciplinary academic unit of UC Berkeley, offering Minor, M.A., M.S., and Ph.D. degrees in Energy and Resources, and a Minor/Certificate in Sustainability. Established in 1973, ERG addresses issues of energy, climate change, resources, development, human and biological diversity, environmental justice, governance, and new approaches to economics, food, waste, and consumption.

The mission of the Energy and Resources Group is a sustainable environment and a just society.

The faculty of ERG consists of 11 core professors of energy and resources, plus 150 affiliated faculty and researchers from across the Berkeley campus, Lawrence Berkeley National Laboratory, and elsewhere.

There are approximately 65 graduate students enrolled in ERG degree programs, about half doctoral students. The students come from a wide variety of backgrounds — engineering, natural sciences, social sciences, and humanities. The characteristics they have in common are an interest in interdisciplinary approaches to energy and resource issues and the intellectual credentials to succeed in a rigorous academic program. All receive training at ERG in the technological, environmental, economic, and sociopolitical dimensions of energy and resource issues while pursuing additional coursework and individual research tailored to their interest and backgrounds.

ERG graduates are employed across the U.S. and around the world in universities, governmental and international agencies, legislative staff positions, national laboratories, public and private utilities, other energy and resource companies, consulting firms, and public-interest organizations.

Undergraduate Program
Energy and Resources (http://guide.berkeley.edu/undergraduate/degree-programs/energy-resources/): Minor
Sustainability (http://guide.berkeley.edu/undergraduate/degree-programs/energy-resources/#summerminorrequirementstext): Summer Minor and Certificate

Graduate Programs
Energy and Resources (http://guide.berkeley.edu/graduate/degree-programs/energy-resources/): MA, MS, PhD, Concurrent ERG/Public Policy MA-MS, Concurrent ERG/Law School MA-MS/JD

Energy and Resources
Expand all course descriptions [+]
Collapse all course descriptions [-]

ENE,RES 24 Freshman Seminar 1 Unit
Terms offered: Fall 2015, Spring 2012, Spring 2011
The Freshman Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Freshman Seminars are offered in all campus departments, and topics may vary from department to department and semester to semester.
Freshman Seminar: Read More [+]

Rules & Requirements

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Final Exam To be decided by the instructor when the class is offered.
Instructor: John Harte

ENE,RES 39A Freshman and Sophomore Seminar: Complex Systems, Information Theory, and Big Data 2 Units
Terms offered: Fall 2016
Freshman and sophomore seminars offer lower division students the opportunity to explore an intellectual topic with a faculty member and a group of peers in a small-seminar setting. These seminars are offered in all campus departments; topics vary from department to department and from semester to semester. Enrollment limits are set by the faculty, but the suggested limit is 25.
Freshman and Sophomore Seminar: Complex Systems, Information Theory, and Big Data: Read More [+]

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Final Exam To be decided by the instructor when the class is offered.
Instructor: John Harte

Freshman and Sophomore Seminar: Complex Systems, Information Theory, and Big Data: Read Less [-]
ENE,RES 98 Directed Group Study for Lower Division Students 1 - 4 Units
Terms offered: Fall 2017, Fall 2016, Spring 2016
Lectures and small group discussions focusing on topics of interest that vary from semester to semester.
Directed Group Study for Lower Division Students: Read More [+]

Rules & Requirements
Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.
Repeat rules: Course may be repeated for credit under special circumstances: Course may be repeated with consent of department.

Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week
Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

ENE,RES 99 Supervised Independent Studies for Freshmen and Sophomores 1 - 4 Units
Terms offered: Spring 2023, Spring 2022, Fall 2021
Supervised research on specific topics related to energy and resources.
Supervised Independent Studies for Freshmen and Sophomores: Read More [+]

Rules & Requirements
Prerequisites: Consent of faculty adviser directing research; lower division standing (3.3 GPA or better)
Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of independent study per week
Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Supervised Independent Studies for Freshmen and Sophomores: Read Less [-]

ENE,RES C100 Energy and Society 4 Units
Terms offered: Fall 2023, Fall 2022, Fall 2021
Energy sources, uses, and impacts: an introduction to the technology, politics, economics, and environmental effects of energy in contemporary society. Energy and well-being; energy in international perspective, origins, and character of energy crisis.
Energy and Society: Read More [+]

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Summer:
8 weeks - 6 hours of lecture and 1.5 hours of discussion per week
10 weeks - 6 hours of lecture and 1.5 hours of discussion per week
Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Kammen
Also listed as: PUB POL C184
Energy and Society: Read Less [-]

ENE,RES W100 Energy and Society 4 Units
Terms offered: Summer 2023 8 Week Session, Summer 2022 8 Week Session, Summer 2021 8 Week Session
Energy sources, uses, and impacts: an introduction to the technology, politics, economics, and environmental effects of energy in contemporary society. Energy and well-being; energy in international perspective, origins, and character of energy crisis.
Energy and Society: Read More [+]

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of web-based lecture and 1 hour of web-based discussion per week
Summer:
8 weeks - 6 hours of web-based lecture and 1.5 hours of web-based discussion per week
Online: This is an online course.
Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Kammen
Also listed as: PUB POL W184
Energy and Society: Read Less [-]
ENE,RES 101 Ecology and Society 3 Units
Terms offered: Summer 2023 8 Week Session, Summer 2022 8 Week Session, Summer 2021 8 Week Session
This course introduces students to the many ways in which our lives are intertwined with the ecosystems around us. Topics will include ecological limits to growth, climate change and other threats to biodiversity, the value of ecosystem goods and services, the ecology of disease, ecotoxicology, the evolution of cooperation in ecosystems, industrial ecology, and the epistemology of ecology.
Ecology and Society: Read More [+]

Rules & Requirements
Prerequisites: One college level course, or high school Advanced Placement, in either physics or biology; introductory calculus

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer:
6 weeks - 7.5 hours of lecture per week
8 weeks - 6 hours of lecture per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: TBA

Ecology and Society: Read Less [-]

ENE,RES 102 Quantitative Aspects of Global Environmental Problems 4 Units
Terms offered: Spring 2023, Spring 2022, Spring 2021
Human disruption of biogeochemical and hydrological cycles; causes and consequences of climate change and acid deposition; transport and health impacts of pollutants; loss of species; radioactivity in the environment; and quantitative models to understand these environmental problems.
Quantitative Aspects of Global Environmental Problems: Read More [+]

Objectives & Outcomes
Course Objectives: Application of basic principles of natural science to the analysis of human influence on environmental conditions and processes at continental to global scale. Topics covered include dimensions of the physical world and of human modifications of it; techniques of estimation and back of the envelope calculation; box models of environmental stocks and flows; equilibrium and feedback; chemical equilibria in the environment; nutrient cycles and their disruptions; acid deposition and its consequences; climate change and its consequences; stratospheric ozone depletion; sources, fate and effects of toxic substances in the global environment; radioactivity and radiation; macroecology; carrying capacity and human population growth; biodiversity and its diminution; epidemics.

Student Learning Outcomes: Students will also have gained insight into the multi-disciplinary nature of environmental science, having used physical, chemical, and biological principles to create and solve analytical models. Students will be familiar with and able to apply a diverse set of quantitative tools for understanding and analyzing environmental problems.

Rules & Requirements
Prerequisites: Upper division standing; calculus (Mathematics 1A-1B or 16A-16B); Physics (7A-7B or 8A-8B), Chemistry (1A or 4A), Biology (1B), or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week
Summer:
8 weeks - 6 hours of lecture and 4 hours of laboratory per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Kueppers

Quantitative Aspects of Global Environmental Problems: Read Less [-]
ENE,RES C124 Gender and Environment 4 Units
Terms offered: Fall 2023, Spring 2023, Fall 2022
This course examines the centrality of gender and intersectionality in understanding nature-society relations across time and space. During the first half of the semester, students will become familiar with key feminist theoretical approaches to studying environmental problems, including ecofeminism, feminist environmentalism, feminist critiques of science, feminist political ecology, and queer and more-than-human ecologies. In the remainder of the semester, students will apply the theories learned to explore contemporary feminist environmental movements and analyze key topics, such as resource politics, pollution and toxins, environmental and reproductive justice, climate change, and the ethics of care.

Objectives & Outcomes
Student Learning Outcomes: Upon taking this course, students will be able to: 1) explain different approaches to theorizing the gender-environment nexus; and 2) apply theoretical and conceptual tools to engage with, reflect on, and critique contemporary local and global environmental issues from an intersectional feminist perspective.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Alternate method of final assessment during regularly scheduled final exam group (e.g., presentation, final project, etc.).
Instructor: Chung
Also listed as: ESPM C124

ENE,RES 131 Data, Environment and Society 4 Units
Terms offered: Fall 2023, Fall 2022, Fall 2021
This course will teach students to build, estimate and interpret models that describe phenomena in the broad area of energy and environmental decision-making. Students leave the course as both critical consumers and responsible producers of data-driven analysis. The effort will be divided between (i) learning a suite of data-driven modeling and prediction tools (including linear model selection methods, classification and regression trees, and support vector machines) (ii) building programming and computing expertise and (iii) developing capacity to formulate and answer resource allocation questions within energy and environment contexts.

Rules & Requirements
Prerequisites: Required: Foundations of Data Science (Computer Science C8/Information Systems C8/Statistics C8) and high school or college calculus Recommended: An introductory computer programming course (Computer Science 61A or Computer Science 88) and Linear Algebra (Mathematics 54, Electrical Engineering and Computer Science 16A, or Statistics 89A)

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Callaway
Data, Environment and Society: Read Less [-]
ENE,RES C160 CLIMATE JUSTICE 4 Units
Terms offered: Fall 2023, Fall 2022
Climate change is transforming our world in ways we are only beginning to understand, and in many ways we cannot yet imagine. The emerging theoretical and practical lenses of social and environmental justice (EJ) provide tools with which to examine and understand this new world. Using literature, media, and engaged field experiences, this course brings together the scholarship, scientific and engineering innovation, policy, literature and media, and activism around the interacting themes of climate change and social justice.

CLIMATE JUSTICE: Read More [+]

Rules & Requirements
Credit Restrictions: Students will receive no credit for ENE,RES C160 after completing ENE,RES 160, or ARCH 153. A deficient grade in ENE,RES C160 may be removed by taking ENE,RES 160, or ARCH 153.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Mills-Novoa
Also listed as: ESPM C176
CLIMATE JUSTICE: Read Less [-]

ENE,RES 170 Environmental Classics 3 Units
Terms offered: Summer 2023 8 Week Session, Summer 2022 8 Week Session, Summer 2021 8 Week Session
What is the history and evolution of environmental thinking and writing in the USA? How have certain ‘environmental classics’ shaped the way in which we think about nature, society and progress? Why did these become ‘classics’ and why/how did they influence environmental thought and policy? What is their relevance today? This course includes substantial reading assignments.

Environmental Classics: Read More [+]

Objectives & Outcomes
Course Objectives: This course will use a selection of books and papers from the last 6 decades that have had a profound impact on academic and wider public thinking -- primarily in the USA -- about the environment and society to probe these issues. In class, we will situate the key reading in its historical context and discuss its contributions, critiques and consequences. Through these classics the class will explore: the evolution of environmental thought; the connections between environment, perception and policy; and the links between scientific thought and public perception.

Hours & Format
Summer: 8 weeks - 4 hours of seminar per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Environmental Classics: Read Less [-]
ENE,RES 171 California Water 3 Units
Terms offered: Summer 2023 First 6 Week Session, Summer 2022 First 6 Week Session, Summer 2021 8 Week Session
The story of water development in California provides compelling examples of water politics, the social and environmental consequences of redistributing water, and the relationships between water uses, energy, and climate. This course provides the historical, scientific, legal, institutional, and economic background needed to understand the social and ecological challenges of providing water for California’s growing population, agricultural economy, and other uses - all of which are made more complex by climate change.

California Water: Read More [+]

Objectives & Outcomes
Course Objectives: Students will grasp the historical, scientific, legal, institutional, and economic background needed to understand the social and ecological challenges of providing water for California’s growing population, agricultural economy, and other uses - all of which are made more complex by climate change.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer:
6 weeks - 6 hours of lecture per week
8 weeks - 4 hours of lecture per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.

California Water: Read Less [-]

ENE,RES W174 Water and Sanitation Justice 3 Units
Terms offered: Summer 2023 8 Week Session, Summer 2022 8 Week Session, Summer 2021 8 Week Session
This course will explore the many manifestations of water and sanitation justice and injustice on interlocking scales (i.e. local, national, transnational) while illustrating analytical ideas connecting to a range of social processes including claims for human rights, deprivation and exclusion, urbanization and infrastructure development, and privatization of land and water. We will look at various case studies in high-income and low-income countries and use key technical and social concepts to examine rights, equity, and justice with respect to water and sanitation. This course partially satisfies requirements for the ERG Summer Minor/ Certificate in Sustainability.

Water and Sanitation Justice: Read More [+]

Objectives & Outcomes
Course Objectives: This course will acquaint you with theoretical and practical knowledge about water and sanitation justice.

Student Learning Outcomes: Analyze water and sanitation through a variety of disciplinary perspectives: Arts, Engineering, Humanities, and in the social sciences of Sociology, Geography, Environmental Studies, Politics, Economics, Anthropology
Compare issues at local to global scales
Explain key issues of water and sanitation justice
Explain water and sanitation policy and governance historical examples, locally and globally
Identify factors influencing water and sanitation justice and injustice
Seriously consider strategies for addressing water and sanitation injustice
Understand impacts of water and sanitation injustice on quality of life

Hours & Format
Summer: 8 weeks - 6 hours of web-based lecture and 2.5 hours of web-based discussion per week
Online: This is an online course.

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Ray

Water and Sanitation Justice: Read Less [-]
Water and Development: Read More [+]

Rules & Requirements

Prerequisites: Upper division standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Energy and Resources Group/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: ERG Faculty

Water and Development: Read Less [-]

Climate Change Economics: Read More [+]

Objectives & Outcomes

Course Objectives: The course will start with a brief review of the science of climate change, discuss scenarios of economic growth and the greenhouse gas emissions caused by economic activities and investigate various emission reduction opportunities and their economic costs. A significant amount of time will be spent on studying the impacts of climate change, their economic evaluation and how adaptation can lower the costs of climate damages.

We will then study various theoretical frameworks economists have developed that answer the question how estimates about the costs and benefits of climate policy can be combined to find “good” climate policies. We then study three more specialized topics that turn out to be of great importance when analyzing climate change policy: first, how do we compare costs and benefits of generations that live many centuries apart? Second, how do we design climate policy when our projections of both the costs and the benefits of climate policy are highly uncertain? And third, how can equity considerations be accounted for in an economic assessment of climate change policy? The course will close with a look at international cooperation on climate policy and why it has been so difficult to agree on effective treaties that implement climate change policy.

Student Learning Outcomes: Students will also have gained insight into the practical aspects of modeling the economics of climate change by building a simple integrated assessment model in Excel. They will be able to use that model to do simple analysis of climate change policy themselves.

Students will be familiar with the tools economists use to analyze climate change policy. They will have studied empirical estimates of the costs and benefits of climate policy and have an understanding of the analytical issues that drive research on the economics of climate change.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Energy and Resources Group/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Anthoff

Also listed as: ENVECON C176/IAS C176

Climate Change Economics: Read Less [-]
ENE,RES 180 Ecological Economics in Historical Context 3 Units
Terms offered: Fall 2016
Economists through history have explored economic and environmental interactions, physical limits to growth, what constitutes the good life, and how economic justice can be assured. Yet economists continue to use measures and models that simplify these issues and promote bad outcomes. Ecological economics responds to this tension between the desire for simplicity and the multiple perspectives needed to understand complexity in order to move toward sustainable, fulfilling, and just economies.
Ecological Economics in Historical Context: Read More [+]

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer:
6 weeks - 7.5 hours of lecture per week
8 weeks - 6 hours of lecture per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.

ENE,RES 190B Energy and Environmental Issues 4 Units
Terms offered: Spring 2022, Spring 2021
Critical, data-driven analysis of specific issues or general problems of how people interact with environmental and resource systems. This course will teach students to build, estimate and interpret models that describe phenomena in the broad area of energy and environmental decision-making. More than one section may be given each semester on different topics depending on faculty and student interest.
Energy and Environmental Issues: Read More [+]

Rules & Requirements
Repeat rules: Course may be repeated for credit when topic changes. Students may enroll in multiple sections of this course within the same semester.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

ENE,RES 190C Energy and Environmental Issues 4 Units
Terms offered: Fall 2020, Fall 2018
Critical, data-driven analysis of specific issues or general problems of how people interact with environmental and resource systems. This course will teach students to build, estimate and interpret models that describe phenomena in the broad area of energy and environmental decision-making. More than one section may be given each semester on different topics depending on faculty and student interest.
Energy and Environmental Issues: Read More [+]

Rules & Requirements
Prerequisites: 1. Foundations of Comp Sci: COMPSCI C8 or STAT C8 or INFO C8: Foundations of Data Science 2. Computing: COMPSCI 61A: The Structure and Interpretation of Computer Programs or COMPSCI 88: Computational Structures in Data Science 3. Math: MATH 54: Linear Algebra and Differential Equations or ELENG 16A: Designing Information Devices and Systems I or STAT 89A: Linear Algebra for Data Science

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
ENE,RES C192 Business, Sustainability, and Society 3 Units
Terms offered: Summer 2022 8 Week Session, Summer 2021 8 Week Session
As corporations have grown in influence, concerns over their impact on people and the planet have also grown, pushing sustainability, corporate social responsibility, and the wider impact of business into the spotlight. This course focuses on business ethics, supply chains, resource constraints, labor issues, innovation, and environmental externalities, as well as the internal challenges, competitive pressures, external stakeholders, and other issues that businesses must consider while trying to act responsibly.
Business, Sustainability, and Society: Read More [+]

Hours & Format
Summer: 8 weeks - 6 hours of lecture per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Letter grade. Final exam required, with common exam group.
Instructor: Rochlin
Also listed as: UGBA C192R

ENE,RES 199 Supervised Independent Study and Research 1 - 4 Units
Terms offered: Fall 2023, Spring 2023, Summer 2022 8 Week Session
Individual conferences.
Supervised Independent Study and Research: Read More [+]

Rules & Requirements
Prerequisites: Enrollment restricted by regulations in General Catalog
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of independent study per week
Summer: 8 weeks - 1.5-15 hours of independent study per week

Additional Details
Subject/Course Level: Energy and Resources Group/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Supervised Independent Study and Research: Read Less [-]

ENE,RES C200 Energy and Society 4 Units
Terms offered: Fall 2023, Fall 2022, Fall 2021
Energy sources, uses, and impacts; an introduction to the technology, politics, economics, and environmental effects of energy in contemporary society. Energy and well-being; energy international perspective, origins, and character of energy crisis.
Energy and Society: Read More [+]

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Summer:
8 weeks - 6 hours of lecture and 1.5 hours of discussion per week
10 weeks - 6 hours of lecture and 1.5 hours of discussion per week

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructor: Kammen
Also listed as: PUB POL C284
Energy and Society: Read Less [-]
ENE,RES W200 Energy and Society 4 Units
Terms offered: Summer 2023 8 Week Session, Summer 2022 8 Week Session, Summer 2021 8 Week Session, Fall 2020
Energy sources, uses, and impacts: an introduction to the technology, politics, economics, and environmental effects of energy in contemporary society. Energy and well-being; energy in international perspective, origins, and character of energy crisis.

Energy and Society: Read More [+]

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of web-based lecture and 1 hour of web-based discussion per week
Summer: 8 weeks - 6 hours of web-based lecture and 1.5 hours of web-based discussion per week

Online: This is an online course.

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructor: Kammen
Also listed as: PUB POL W284

ENE,RES C202 Modeling Ecological and Meteorological Phenomena 3 Units
Terms offered: Fall 2015, Fall 2014, Fall 2013
Modeling methods in ecology and meteorology; stability analysis; effects of anthropogenic stress on natural systems. Offered alternate years.

Modeling Ecological and Meteorological Phenomena: Read More [+]

Rules & Requirements
Prerequisites: Integrative Biology 102 or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructor: Harte
Also listed as: ESPM C211

ENE,RES C205 Quantitative Methods for Ecological and Environmental Modeling 3 Units
Terms offered: Fall 2015, Fall 2013, Fall 2012, Fall 2011, Fall 2009
This course will review the background mathematical and statistical tools necessary for students interested in pursuing ecological and environmental modeling. Topics include linear algebra; difference equation, ordinary differential equation, and partial differential equation models; stochastic processes; parameter estimation; and a number of statistical techniques. This course will be recommended as a prerequisite for advanced modeling courses in Integrative Biology, Energy and Resources Group, and Environmental Science, Policy, and Management.

Quantitative Methods for Ecological and Environmental Modeling: Read More [+]

Rules & Requirements
Prerequisites: Consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Also listed as: ESPM C205/INTEGBI C205

Quantitative Methods for Ecological and Environmental Modeling: Read Less [-]
**ENE,RES C221 Climate, Energy and Development 3 Units**

Terms offered: Fall 2019, Fall 2018, Fall 2017
Graduate seminar examining the role of energy science, technology, and policy in international development. The course will look at how changes in the theory and practice of energy systems and of international development have co-evolved over the past half-century, and what opportunities exist going forward. A focus will be on rural and decentralized energy use, and the issues of technology, culture, and politics that are raised by both current trajectories, and potential alternative energy choices. We will explore the frequently divergent ideas about energy and development that have emerged from civil society, academia, multinational development agencies, and the private and industrial sector.

**Rules & Requirements**

**Prerequisites:** Graduate student standing or consent of instructor

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Energy and Resources Group/Graduate

**Grading:** Letter grade.

**Instructor:** Kammen

**Also listed as:** DEVP C221/PUB POL C221

Climate, Energy and Development: Read Less [-]

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**ENE,RES C223 Agrarian Questions 4 Units**

Terms offered: Not yet offered

The seminar offers an introduction to the interdisciplinary field of critical agrarian and food studies, which brings together Marxian agrarian political economy, historical and political sociology, postcolonial and subaltern studies, post structural feminist theory, critical development studies, and political ecology. Students should come out of this class with a genealogical understanding of key debates and emergent issues in the field. Our goal is to think theoretically and empirically about the social relations of land, labor, and livelihoods and how these relations articulate with broader political economic processes.

**Rules & Requirements**

**Credit Restrictions:** Students will receive no credit for ENE,RES C223 after completing ESPM 223. A deficient grade in ENE,RES C223 may be removed by taking ESPM 223.

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of seminar per week

**Additional Details**

**Subject/Course Level:** Energy and Resources Group/Graduate

**Grading:** Letter grade.

**Instructor:** Chung

**Also listed as:** ESPM C223

Agrarian Questions: Read Less [-]
ENE,RES C226 Photovoltaic Materials; Modern Technologies in the Context of a Growing Renewable Energy Market 3 Units
Terms offered: Fall 2015, Spring 2013, Spring 2011
This technical course focuses on the fundamentals of photovoltaic energy conversion with respect to the physical principals of operation and design of efficient semiconductor solar cell devices. This course aims to equip students with the concepts and analytical skills necessary to assess the utility and viability of various modern photovoltaic technologies in the context of a growing global renewable energy market.
Photovoltaic Materials; Modern Technologies in the Context of a Growing Renewable Energy Market: Read More [+]

Rules & Requirements

Prerequisites: Material Science and Mineral Engineering 111 or 123 or equivalent. Should have a firm foundation in electronic and optical props of semiconductors and basic semiconductor device physics

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Also listed as: MAT SCI C226
Photovoltaic Materials; Modern Technologies in the Context of a Growing Renewable Energy Market: Read Less [-]

ENE,RES C266 Political Ecologies of Climate Change Adaptation 3 Units
Terms offered: Fall 2023
As the climate crisis escalates and mitigation efforts stagnate, adaptation has come to the forefront of public debates and funding priorities. This course will explore the varied political ecologies of climate change adaptation. By drawing on political ecology, this course will include both foundational and emerging scholarship that explores how climate change adaptation is shaping and being shaped by the material impacts of climate change, the political economy of climate governance and finance, and the agency of experts, funders, promoters, and the individuals and collectives adapting to climate change. We will examine the history of climate change adaptation concepts and governance while also exploring emerging frontiers in the field.
Political Ecologies of Climate Change Adaptation: Read More [+]

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of seminar per week

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructor: Mills-Novoa
Also listed as: ESPM C266
Political Ecologies of Climate Change Adaptation: Read Less [-]

ENE,RES 254 Electric Power Systems 4 Units
Terms offered: Spring 2023, Spring 2020, Spring 2019
Provides an understanding of concepts in the design and operation of electric power systems, including generation, transmission, and consumption. Covers basic electromechanical physics, reactive power, circuit and load analysis, reliability, planning, dispatch, organizational design, regulations, environment, end-use efficiency, and new technologies.
Electric Power Systems: Read More [+]

Rules & Requirements

Prerequisites: Physics 7B or 8B or equivalent

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructor: Callaway
Electric Power Systems: Read Less [-]

ENE,RES 270 Environmental Classics 3 Units
Terms offered: Fall 2013, Fall 2011, Fall 2009
Motivation: What is the history and evolution of environmental thinking and writing? How have certain "environmental classics" shaped the way in which we think about nature, society, and development? This course will use a selection of 20th-century books and papers that have had a major impact on academic and wider public thinking about the environment and development to probe these issues. The selection includes works and commentaries related to these works that have influenced environmental politics and policy in the U.S. as well as in the developing world. Through the classics and their critiques, reviews, and commentaries, the class will explore the evolution of thought on these transforming ideas.
Environmental Classics: Read More [+]

Rules & Requirements

Prerequisites: Graduate standing

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of seminar per week

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructors: Kammen, Ray
Environmental Classics: Read Less [-]
ENE,RES C271 Energy and Development 3 Units
Terms offered: Spring 2016
This advanced graduate seminar will examine the theoretical frames and models used to examine the linkages between energy and development, and the impacts of one on the other.

Energy and Development: Read More [+]

Rules & Requirements

Prerequisites: Energy and Resources ENE,RES C100 or C200 or Public Policy PUB POL C184 or C284 Energy and Resources ENE,RES 102 Environmental Economics and Policy ENVECON C151 or ECON C171 or equivalent Economics course

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of seminar per week

Additional Details

Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructor: Kammen
Also listed as: PUB POL C271
Energy and Development: Read Less [-]

ENE,RES 273 Research Methods in Social Sciences 3 Units
Terms offered: Fall 2023, Fall 2021, Fall 2019
This course aims to introduce graduate students to the rich diversity of research methods that social scientists have developed for the empirical aspects of their work. Its primary goal is to encourage critical thinking about the research process: how we "know," how we match research methods to research questions, how we design and conduct our information/data collection, what we assume explicitly and implicitly, and the ethical dilemmas raised by fieldwork-oriented studies.

Research Methods in Social Sciences: Read More [+]

Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructor: Ray
Research Methods in Social Sciences: Read Less [-]

ENE,RES 275 Water and Development 4 Units
Terms offered: Spring 2023, Spring 2022, Spring 2020
This class is an interdisciplinary graduate seminar for students of water policy in developing countries. It is not a seminar on theories and practices of development through the "lens" of water. Rather, it is a seminar motivated by the fact that over 1 billion people in developing countries have no access to safe drinking water, 3 billion don't have sanitation facilities and many millions of small farmers do not have reliable water supplies to ensure a healthy crop. Readings and discussions will cover: the problems of water access and use in developing countries; the potential for technological, social, and economic solutions to these problems; the role of institutions in access to water and sanitation; and the pitfalls of and assumptions behind some of today's popular "solutions."

Water and Development: Read More [+]

Hours & Format

Fall and/or spring: 15 weeks - 4 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructor: Ray
Water and Development: Read Less [-]
ENE,RES 276 Climate Change Economics 4 Units
Terms offered: Fall 2023, Fall 2022, Fall 2021
This course is a self-contained introduction to the economics of climate change. Climate change is caused by a large variety of economic activities, and many of its impacts will have economic consequences. Economists have studied climate change for more than two decades, and economic arguments are often powerful in policy decisions. The course will familiarize students with these arguments and equip them with the tools to participate in discussions of climate change policy through an economic lens.

Objectives & Outcomes

Course Objectives: The course will start with a brief review of the science of climate change, discuss scenarios of economic growth and the greenhouse gas emissions caused by economic activities and investigate various emission reduction opportunities and their economic costs. A significant amount of time will be spent on studying the impacts of climate change, their economic evaluation and how adaptation can lower the costs of climate damages. We will then study various theoretical frameworks economists have developed that answer the question how estimates about the costs and benefits of climate policy can be combined to find “good” climate policies. We then study three more specialized topics that turn out to be of great importance when analyzing climate change policy: first, how do we compare costs and benefits of generations that live many centuries apart? Second, how do we design climate policy when our projections of both the costs and the benefits of climate policy are highly uncertain? And third, how can equity considerations be accounted for in an economic assessment of climate change policy? The course will close with a look at international cooperation on climate policy and why it has been so difficult to agree on effective treatises that implement climate change policy.

Student Learning Outcomes: Students will also have gained insight into the practical aspects of modeling the economics of climate change by building a simple integrated assessment model in a scientific programming language of their choice. They will be able to use that model to do simple analysis of climate change policy themselves. Students will be familiar with the tools economists use to analyze climate change policy. They will have studied empirical estimates of the costs and benefits of climate policy and have an understanding of the analytical issues that drive research on the economics of climate change.

Hour & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week
Summer: 8 weeks - 6 hours of lecture and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructor: David Anthoff

Climate Change Economics: Read More [+]

ENE,RES 280 Energy Economics 3 Units
Terms offered: Fall 2016, Fall 2015, Spring 2015
Input-output and cost benefit analysis applied to energy; exhaustion theory and economics of energy supply; patterns of energy use; trade-offs in energy conservation; the effect of energy policy on supply and demand; projecting future energy and resource supply and use.

Energy Economics: Read More [+]

Rules & Requirements

Prerequisites: Economics 100A or equivalent; basic calculus or linear algebra

Hour & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 6 weeks - 7.5 hours of lecture per week

Additional Details

Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.

Energy Economics: Read Less [-]

ENE,RES 290 Seminar in Energy and Resources 1 - 4 Units
Terms offered: Fall 2023, Spring 2023, Fall 2022
Graduate student presentations and faculty-student discussions of advanced topics in energy and resources. Specific topics vary according to faculty and student interest.

Seminar in Energy and Resources: Read More [+]

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hour & Format

Fall and/or spring: 15 weeks - 2-3 hours of seminar and 0-1 hours of discussion per week

Additional Details

Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.

Seminar in Energy and Resources: Read Less [-]
ENE,RES 290A Seminar in Energy and Resources 3 Units
Terms offered: Fall 2021, Spring 2021, Fall 2020
Graduate student presentations and faculty-student discussions of advanced topics in energy and resources. Specific topics vary according to faculty and student interest.
Seminar in Energy and Resources: Read More [+]

Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of seminar per week
Summer: 8 weeks - 6 hours of seminar per week

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.

ENE,RES 291 Special Topics in Energy and Resources 1 - 3 Units
Terms offered: Fall 2016, Spring 2012, Spring 2011
Study and critical analysis of advanced topics in energy and resources using interdisciplinatory approaches. Specific topics vary according to faculty and student interest.
Special Topics in Energy and Resources: Read More [+]

Rules & Requirements
Prerequisites: Graduate standing or consent of instructor
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-3 hours of lecture per week

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.

ENE,RES 292A Tools of the Trade 2 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016
Quantitative methods for energy and resource analysis. Topics include linear algebra, differential equations, statistical methods, chemical equilibrium theory, and thermodynamics.
Tools of the Trade: Read More [+]

Rules & Requirements
Prerequisites: Consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Offered for satisfactory/unsatisfactory grade only.

Tools of the Trade: Read Less [-]

Special Topics in Energy and Resources: Read Less [-]
ENE,RES 293A Master's Seminar I: Interdisciplinary Analysis and the Environment 3 Units
Terms offered: Fall 2023, Fall 2022, Fall 2021
ENERES 293A is the first of 4 required seminars of the ERG Masters’ sequence. It provides an intellectual and practical orientation to the Energy and Resources Group and to what makes us “ERG”. It's at once an understanding interdisciplinary approaches class and a cohort-building class. ERG is a community of scholars and researchers who are actively engaged in academic research, policy design, and engagement with civil society. ENERES 293A provides a space in which interdisciplinary approaches to domains, methods / tools and worldviews are explored, individually and collaboratively, for the fields that comprise energy and resources research.
Master's Seminar I: Interdisciplinary Analysis and the Environment: Read More [+]
Objectives & Outcomes
Course Objectives: 1. Develop a cohort among incoming students and connect with the larger ERG community.
2. Explore the foundations of the environmental field by reading seminal papers and books in the space.
3. Introduce interdisciplinary thinking and problem-solving frameworks through a unifying topic throughout the semester.
Rules & Requirements
Prerequisites: Open to ERG graduate students only
Hours & Format
Fall and/or spring: 15 weeks - 2 hours of seminar per week
Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructor: Ray
Formerly known as: Energy and Resources Group 201
Master's Seminar I: Interdisciplinary Analysis and the Environment: Read Less [-]

ENE,RES 293B Master's Seminar II: Methods for Interdisciplinary Analysis 3 Units
Terms offered: Spring 2023, Spring 2022
This is the second semester of the ENERES 293 sequence for all ERG Master’s Degree students. The primary purpose of the sequence is to support students in the process of doing independent interdisciplinary research. ENERES 293B is designed to help students learn to identify and develop tractable and impactful interdisciplinary research projects.
Master's Seminar II: Methods for Interdisciplinary Analysis: Read More [+]
Objectives & Outcomes
Course Objectives: 1. Discuss career paths and research with experts in students’ area(s) of interest – some of whom are eligible to be a reader of the students’ capstone Master’s Project.
2. Develop and refine an individual development plan.
3. Read and discuss several frameworks for the process of doing interdisciplinary research, and interpret existing research in the context of those frameworks.
4. Complete group activities to identify and argue for research in a new area.
5. Encourage students to think carefully about their mentoring needs and how they will fulfill those needs.
6. Develop a refined research question for the ERG capstone Master’s Project, as well as a supporting annotated bibliography, a list of anticipated methods and data to be used, and a plan for obtaining them.
Rules & Requirements
Prerequisites: Energy and Resources ENERES 293A
Credit Restrictions: Students will receive no credit for ENE,RES 293B after completing ENE,RES 292B. A deficient grade in ENE,RES 293B may be removed by taking ENE,RES 292B, or ENE,RES 292B.
Hours & Format
Fall and/or spring: 15 weeks - 2 hours of seminar per week
Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.
Instructors: ERG Faculty, Callaway
Formerly known as: Energy and Resources Group 292B
Master's Seminar II: Methods for Interdisciplinary Analysis: Read Less [-]
ENE,RES 293C Master's Seminar III - Master's Project Development for Interdisciplinary Analysis, Part 1 3 Units

Terms offered: Fall 2023, Fall 2022, Fall 2021
This is the third semester of the ERG master’s seminar series. This semester shifts from a focus on intellectual exploration to the design and execution of the master’s project. While some students may have already started their projects through summer research and/or fieldwork experiences, others may be starting fresh. This semester is designed to meet students wherever they are in the process of developing their research. It will also focus on building communication/translation skills and continuing the professional development work started in ENERES 293B.

Master's Seminar III - Master's Project Development for Interdisciplinary Analysis, Part 1:

Objectives & Outcomes

Course Objectives:
1. Develop verbal and written communication skills and techniques
   a. Project pitches
   b. Peer presentations
   c. Individual presentations
   d. Optional presentation to lab group
   e. Writing workshop
   f. Written outline of Master’s project
2. Network with people in and outside of the ERG community
   a. Determine the appropriate scope and focus for a Master’s project
   b. Begin to plan for a career beyond the Master’s degree
3. Develop project management and leadership skills
   a. Practice managing and executing a research plan
   b. Lead discussions on individual research
   c. Provide constructive feedback on peers’ research
   d. Ask for specific types of guidance and mentorship from advisors and readers
4. Define the scope of a Master’s project that can answer an interdisciplinary question
   a. Identify a gap in existing literature and/or a field of research
   b. Develop a question that is actionable under the timeline of the master’s project
   c. Bound the project with a defined literature search and analysis
5. Complete the initial steps of the Master’s project
   a. Read past Master’s projects and identify how to design a research thesis/
ENE,RES 295 Special Topics in Energy and Resources 1 Unit
Terms offered: Fall 2023, Spring 2023, Fall 2022
Presentations of research in energy issues by faculty, students, and visiting lecturers. Master's degree students required to enroll for two semesters.
Special Topics in Energy and Resources: Read More [+]
Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 1.5 hours of colloquium per week
Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Offered for satisfactory/unsatisfactory grade only.
Special Topics in Energy and Resources: Read Less [-]

ENE,RES 296 Doctoral Seminar 2 Units
Terms offered: Fall 2023, Spring 2023, Fall 2022
Lectures, reports, and discussions on current research in energy and resources. Particular emphasis on topics of research interest for current Ph.D. students in the Energy and Resources Group.
Doctoral Seminar: Read More [+]
Rules & Requirements
Prerequisites: Consent of instructor
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 2 hours of independent study per week
Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Offered for satisfactory/unsatisfactory grade only.
Formerly known as: 298
Doctoral Seminar: Read Less [-]

ENE,RES 298 Doctoral Seminar 2 Units
Terms offered: Fall 2023, Spring 2023, Fall 2022
Lectures, reports, and discussions on current research in energy and resources. Sections are operated independently and under direction of different staff.
Doctoral Seminar: Read More [+]
Rules & Requirements
Prerequisites: Consent of instructor
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 0 hours of independent study per week
Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Offered for satisfactory/unsatisfactory grade only.

ENE,RES 298N Directed Group Study 1 - 3 Units
Terms offered: Fall 2016, Spring 2016, Fall 2015
Informal group studies of special problems in energy and resources.
Directed Group Study: Read More [+]
Rules & Requirements
Prerequisites: Graduate standing and consent of instructor
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 1-3 hours of directed group study per week
Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Offered for satisfactory/unsatisfactory grade only.
Formerly known as: 298
Directed Group Study: Read Less [-]
ENE,RES 299 Individual Research in Energy and Resources 1 - 12 Units
Terms offered: Fall 2023, Summer 2023 10 Week Session, Spring 2023
Investigation of problems in energy and resources from an interdisciplinary perspective.
Individual Research in Energy and Resources: Read More [+]
Rules & Requirements
Prerequisites: Graduate standing
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 1-12 hours of independent study per week
Additional Details
Subject/Course Level: Energy and Resources Group/Graduate
Grading: Letter grade.

ENE,RES 301 Graduate Student Instructor Practicum 3 Units
Terms offered: Spring 2013, Fall 2012, Spring 2012
Course credit for experience gained in academic teaching through employment as a graduate student instructor.
Graduate Student Instructor Practicum: Read More [+]
Rules & Requirements
Prerequisites: Appointment as a graduate student instructor in the Group and permission of the graduate advisor
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 2 hours of seminar per week
Additional Details
Subject/Course Level: Energy and Resources Group/Professional course for teachers or prospective teachers
Grading: Offered for satisfactory/unsatisfactory grade only.
Graduate Student Instructor Practicum: Read Less [-]