

# Energy and Resources Group

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## Overview

The Energy and Resources Group (ERG) is an interdisciplinary academic unit of UC Berkeley, conducting programs of graduate teaching and research that treat issues of energy, resources, development, human and biological diversity, environmental justice, governance, global climate change, and new approaches to thinking about economics and consumption. Established in 1973, ERG offers two-year MA and MS degrees in Energy and Resources, as well as a PhD and an undergraduate minor.

The faculty of ERG consists of eight professors of energy and resources plus 100 affiliated faculty members whose main appointments span all five colleges and four of the schools of the Berkeley campus, as well as the University's Lawrence Berkeley and Lawrence Livermore National Laboratories. The chair is normally drawn on a rotating basis from the affiliated faculty.

There are approximately 60 graduate students enrolled in ERG degree programs; about half of them are doctoral candidates. 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 course work 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

## Graduate Programs

Energy and Resources (<http://guide.berkeley.edu/graduate/degree-programs/energy-resources>): MA, MS, PhD

## Energy and Resources

### 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 as topic varies. 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:** The grading option will be decided by the instructor when the class is offered. Final exam required.

Freshman Seminar: [Read Less](#) [-]

### 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 not required.

**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 with consent of department. 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.

Directed Group Study for Lower Division Students: Read Less [-]

## ENE,RES 99 Supervised Independent Studies for Freshmen and Sophomores 1 - 4 Units

Terms offered: Fall 2017, Fall 2016, Spring 2016

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.

### 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 2017, Summer 2017 8 Week Session, Fall 2016

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

### 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 101 Ecology and Society 3 Units

Terms offered: Summer 2017 8 Week Session, Fall 2014, Fall 2012

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:** 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:** Harte

Ecology and Society: Read Less [-]

## ENE,RES 102 Quantitative Aspects of Global Environmental Problems 4 Units

Terms offered: Spring 2017, Spring 2016, Spring 2015

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 175 Water and Development 4 Units

Terms offered: Spring 2016, Spring 2014, Spring 2013

This course introduces students to water policy in developing countries.

It is a course motivated by the fact that over one billion people in developing countries have no access to safe drinking water, three billion do not 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 the assumptions behind some of today's popular "solutions."

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 [-]

## ENE,RES C176 Climate Change Economics 4 Units

Terms offered: Fall 2017, Fall 2016

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.

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:** 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.

**Formerly known as:** Energy and Resources Group C180/Environmental Economics and Policy C180

Ecological Economics in Historical Context: Read Less [-]

## ENE,RES 190 Seminar in Energy and Resources Issues 3 Units

Terms offered: Spring 2017, Fall 2016, Summer 2016 Second 6 Week Session

Critical, cross disciplinary analysis of specific issues or general problems of how people interact with environmental and resource systems.

More than one section may be given each semester on different topics depending on faculty and student interest.

Seminar in Energy and Resources Issues: Read More [+]

### Rules & Requirements

**Prerequisites:** Upper division standing and consent of instructor

**Repeat rules:** Course may be repeated for credit.

### Hours & Format

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

**Summer:**

6 weeks - 7.5 hours of lecture per week

8 weeks - 2-6 hours of lecture per week

### Additional Details

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

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

Seminar in Energy and Resources Issues: Read Less [-]

## ENE,RES 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units

Terms offered: Spring 2016, Fall 2015, Fall 2014

Group studies of selected topics.

Directed Group Studies for Advanced Undergraduates: [Read More](#) [+]

### Rules & Requirements

**Prerequisites:** Upper division standing, plus particular courses to be specified by instructor

**Repeat rules:** Course may be repeated for credit.

### 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.

Directed Group Studies for Advanced Undergraduates: [Read Less](#) [-]

## ENE,RES 199 Supervised Independent Study and Research 1 - 4 Units

Terms offered: Fall 2017, Summer 2017 8 Week Session, Spring 2017  
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.

### 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 2017, Summer 2017 8 Week Session, Fall 2016

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 201 Interdisciplinary Analysis in Energy and Resources 3 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015

Introduction to interdisciplinary analysis as it is practiced in the ERG. Most of the course consists of important perspectives on energy and resource issues, introduced through a particularly influential book or set of papers. The course also provides an introduction to the current research activities of the ERG faculty as well as practical knowledge and skills necessary to successfully complete graduate school in an interdisciplinary program.

Interdisciplinary Analysis in Energy and Resources: [Read More](#) [+]

### Rules & Requirements

**Prerequisites:** Open to ERG graduate students only 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.

**Instructors:** Harte, Kammen, Ray

Interdisciplinary Analysis in Energy and Resources: [Read Less](#) [-]

## 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

Modeling Ecological and Meteorological Phenomena: Read Less [-]

## 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/INTEG BI C205

Quantitative Methods for Ecological and Environmental Modeling: Read Less [-]

## ENE,RES C221 Climate, Energy and Development 3 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015, Fall 2014

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.

Climate, Energy and Development: Read More [+]

### 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 [-]

## 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 254 Electric Power Systems 3 Units

Terms offered: Spring 2017, Fall 2015, Fall 2014

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 per week

### Additional Details

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

**Grading:** Letter grade.

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<BR/>Energy and Resources ENE,RES 102<BR/>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 2017, Fall 2015, Spring 2014

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 2016, Spring 2014, Spring 2013

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 2017, Fall 2016

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.

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 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.

### 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/Graduate

**Grading:** Letter grade.

**Instructor:** David Anthoff

Climate Change Economics: Read Less [-]



## 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

### 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:** Norgaard

Energy Economics: Read Less [-]

## ENE,RES 290 Seminar in Energy and Resources 1 - 4 Units

Terms offered: Spring 2016, Fall 2015, Spring 2015

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.

### Hours & 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 2017, Spring 2017

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 [+]

### 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.

Seminar in Energy and Resources: Read Less [-]

## 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 interdisciplinary 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.

### 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.

Special Topics in Energy and Resources: Read Less [-]

## **ENE,RES 292A Tools of the Trade 2 Units**

Terms offered: Fall 2017, Fall 2016, Fall 2015

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 [-]

## **ENE,RES 292B Master's Project Seminar 2 Units**

Terms offered: Spring 2017, Spring 2016, Spring 2015

Required of second-semester Energy and Resources Master's candidates. Topics include the adoption of a research project, research design, presentation of work, and statistical analyses. Introduction to research skills, including Human Subject Research Protocols, research ethics and methodologies. Critical reading and analysis of research papers; development and discussion of project ideas. Students begin to identify and solicit faculty readers for their projects. Students will apply the interdisciplinary methods, approaches, and perspectives learned in the core curriculum.

Master's Project Seminar: Read More [+]

### **Rules & Requirements**

**Prerequisites:** Energy and Resources 201

### **Hours & Format**

**Fall and/or spring:** 15 weeks - 1.5 hours of seminar per week

### **Additional Details**

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

**Grading:** Letter grade.

**Instructor:** ERG Faculty

Master's Project Seminar: Read Less [-]

## **ENE,RES 292C Master's Project Seminar 2 Units**

Terms offered: Fall 2017, Fall 2016, Fall 2015

Required for ERG Master's students in the semester previous to the one in which they plan to file their Project. Development of Master's Project outline and research plan. Identification and solicitation of faculty readers. Evaluation and integration of critical feedback from readers and cohort on project. Topics include the adoption of a research project, research design, presentation of work, and statistical analyses. Students will apply the interdisciplinary methods, approaches, and perspectives learned in the core curriculum. Course requirements include:

Attendance and active participation in the sharing and critique of the cohort's final master's projects (50%); draft project outline and final readers confirmed by end of term (50%).

Master's Project Seminar: Read More [+]

### **Rules & Requirements**

**Prerequisites:** Energy and Resources 201 and Energy and Resources 292B

### **Hours & Format**

**Fall and/or spring:** 15 weeks - 1.5 hours of seminar per week

### **Additional Details**

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

**Grading:** Letter grade.

**Instructor:** ERG Faculty

Master's Project Seminar: Read Less [-]

## **ENE,RES 292D Master's Project Seminar 2 Units**

Terms offered: Spring 2017, Spring 2016, Spring 2015

Required of all ERG Master's students in the semester during which they plan to file their Final Master's Project. This course is intended to assist students in completing their required Master's Projects, and to provide constructive feedback to students on their Final Master's Project oral presentations. The goal is to improve the quality of the research for the ERG Master's Projects and to learn and refine presentation skills for an academic/professional audience.

Master's Project Seminar: Read More [+]

### **Rules & Requirements**

**Prerequisites:** Energy and Resources 201, 292B, and 292C

### **Hours & Format**

**Fall and/or spring:** 15 weeks - 1.5 hours of seminar per week

### **Additional Details**

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

**Grading:** Letter grade.

**Instructor:** ERG Faculty

Master's Project Seminar: Read Less [-]

## ENE,RES 295 Special Topics in Energy and Resources 1 Unit

Terms offered: Fall 2017, Spring 2017, Fall 2016

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.

### 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 2017, Spring 2017, Fall 2016

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.

### 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 2017, Spring 2016, Spring 2015

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.

### 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.

Doctoral Seminar: Read Less [-]

## 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.

### 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.

Directed Group Study: Read Less [-]

## **ENE,RES 299 Individual Research in Energy and Resources 1 - 12 Units**

Terms offered: Fall 2017, Spring 2017, Fall 2016

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.

### **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.

Individual Research in Energy and Resources: [Read Less](#) [-]

## **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.

### **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](#) [-]