Energy and Resources

Minor

The Energy and Resources Group (ERG) is an academic unit within the University of California, Berkeley. Our vision is a future in which the twin goals of human well-being and a healthy environment are mutually and sustainably satisfied. ERG’s mission is to develop and transmit the critical knowledge needed to make such a future possible. We view society and the environment as an inextricably coupled system. ERG research, therefore, emphasizes (1) science-based knowledge of the environmental consequences of resource use; (2) analytical tools that promote efficiency, conservation, affordability and equity in energy and resource use patterns; and (3) a deep understanding of the social and institutional contexts in which resource and environmental problems arise, and in which creative and ethical solutions can be sustained. It is this synthesis of basic science, practical problem-solving and constructive social critique that defines ERG.

The ERG Minor offers undergraduates the opportunity to develop basic knowledge and skills to help them address the complex and interdependent issues associated with the interaction of social, economic, political, technical, and environmental factors. Though it is primarily designed to complement majors in the natural sciences and engineering, students in any major with the appropriate prerequisites may pursue the ERG minor. Based on a six-course set of prerequisites in mathematics and natural sciences, the minor is satisfied by completing five upper division courses, including two core courses and three electives.

The Energy and Resources Group is responsible for monitoring the minor program and will designate one faculty member as the head ERG minor adviser. It is the undergraduate academic adviser who will be charged with certifying completion of the minor. All core faculty members will participate in advising students in the minor, just as they do graduate students.

Declaring the Minor

Students interested in pursuing the ERG minor should submit an Intent to Declare the ERG Minor form the semester in which upper division ERG minor coursework is started. The department maintains a list of students pursuing the minor to keep students informed about any ERG-related opportunities or course offerings that arise. Students completing the ERG minor are also given a special mention during the ERG commencement ceremony in May.

For information on how to submit your intent to pursue the minor, review how the lower division prerequisites may be completed with AP, IB, or A-Level exams, and declare the minor once completed, please visit the ERG website (http://erg.berkeley.edu/academics/program/#undergrad).

Students who have a strong interest in an area of study outside their major often decide to complete a minor program. These programs have set requirements and are noted officially on the transcript in the memoranda section, but they are not noted on diplomas.

General Guidelines

1. All courses taken to fulfill the minor requirements below must be taken for graded credit.

2. A minimum grade point average (GPA) of 2.0 is required for courses used to fulfill the minor requirements.

3. No more than one upper division course may be used to simultaneously fulfill requirements for a student’s major and minor programs.

Lower Division Prerequisites

Some of the lower division prerequisites for the ERG minor can be satisfied with Advanced Placement, International Baccalaureate and other transfer credit. Please visit the ERG Minor Website (http://erg.berkeley.edu/academics/program/#undergrad) for more information.

Lower division prerequisites (six courses):

<table>
<thead>
<tr>
<th>Course</th>
<th>Prerequisite/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1A</td>
<td>General Chemistry Chem 1AL not required</td>
</tr>
<tr>
<td>or CHEM 4A</td>
<td>General Chemistry and Quantitative Analysis</td>
</tr>
<tr>
<td>BIOLOGY 1B</td>
<td>General Biology Lecture and Laboratory</td>
</tr>
</tbody>
</table>

Select one math sequence from the following:

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 16A &amp; MATH 16B</td>
<td>Analytic Geometry and Calculus</td>
</tr>
<tr>
<td>&amp; MATH 1A &amp; MATH 1B</td>
<td>Calculus</td>
</tr>
</tbody>
</table>

Select one physics sequence from the following:

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICS 8A</td>
<td>Introductory Physics</td>
</tr>
<tr>
<td>&amp; PHYSICS 8Band</td>
<td>Introductory Physics</td>
</tr>
<tr>
<td>PHYSICS 7A</td>
<td>Physics for Scientists and Engineers</td>
</tr>
<tr>
<td>&amp; PHYSICS 7Band</td>
<td>Physics for Scientists and Engineers</td>
</tr>
</tbody>
</table>

Upper Division Requirements

Upper division requirements (five courses):

Two core courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENE.RES C100/184</td>
<td>Energy and Society</td>
</tr>
<tr>
<td>PUB POL C184</td>
<td>Quantitative Aspects of Global Environmental Problems</td>
</tr>
</tbody>
</table>

Three upper division electives, approved by the ERG faculty (see below):

- At least one course must be in the social sciences.
- At least one course must be in the natural sciences or engineering.
- At least one course must be from the ERG department.

Electives

The choice of electives should be made with two goals in mind: exploring the range of approaches available to address energy and resource issues and complementing the student’s major. The latter can be achieved by adding relevant depth in closely related areas or by exploring methods and approaches that contrast with the tools and knowledge base employed in the major. Students are encouraged to discuss their program with the ERG faculty.

The following courses have been approved, but students should contact the head ERG minor adviser to request approval of alternate courses. At least four upper division courses must be taken at Berkeley.

Social science electives
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENE,RES/ENVECON C176</td>
<td>Climate Change Economics</td>
<td>4</td>
</tr>
<tr>
<td>ENE,RES 175</td>
<td>Water and Development</td>
<td>4</td>
</tr>
<tr>
<td>ENE,RES 180</td>
<td>Ecological Economics in Historical Context</td>
<td>3</td>
</tr>
<tr>
<td>ECON/ENVECON C102</td>
<td>Natural Resource Economics</td>
<td>4</td>
</tr>
<tr>
<td>ECON C171/ENVECON C151</td>
<td>Economic Development</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 102D</td>
<td>Climate and Energy Policy</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 155AC</td>
<td>Sociology and Political Ecology of Agro-Food Systems</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 160AC/HISTORY 120AC</td>
<td>American Environmental and Cultural History</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 161</td>
<td>Environmental Philosophy and Ethics</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 168</td>
<td>Political Ecology</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 169</td>
<td>International Environmental Politics</td>
<td>4</td>
</tr>
</tbody>
</table>

**Natural science and engineering electives**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENE,RES 101</td>
<td>Ecology and Society</td>
<td>3</td>
</tr>
<tr>
<td>CIV ENG 103</td>
<td>Introduction to Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CIV ENG 107</td>
<td>Climate Change Mitigation</td>
<td>3</td>
</tr>
<tr>
<td>CIV ENG 111</td>
<td>Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIV ENG 114</td>
<td>Environmental Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>CIV ENG 115</td>
<td>Water Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>EPS 117</td>
<td>Geomorphology</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 111</td>
<td>Ecosystem Ecology</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 112</td>
<td>Microbial Ecology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 120</td>
<td>Soil Characteristics</td>
<td>3</td>
</tr>
<tr>
<td>ESPM/EPS C129</td>
<td>Biometeorology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 131</td>
<td>Soil Microbial Ecology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 140</td>
<td>General Entomology</td>
<td>4</td>
</tr>
<tr>
<td>ESPM/CIV ENG C106</td>
<td>Air Pollution</td>
<td>3</td>
</tr>
<tr>
<td>INTEGBI 106A</td>
<td>Physical and Chemical Environment of the Ocean</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 152</td>
<td>Environmental Toxicology</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 153</td>
<td>Ecology</td>
<td>3</td>
</tr>
<tr>
<td>INTEGBI 157LF</td>
<td>Ecosystems of California</td>
<td>4</td>
</tr>
</tbody>
</table>

**Other electives**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENE,RES 190</td>
<td>Seminar in Energy and Resources Issues</td>
<td>3</td>
</tr>
<tr>
<td>CY PLAN 119</td>
<td>Planning for Sustainability</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 118</td>
<td>Agricultural Ecology</td>
<td>3</td>
</tr>
</tbody>
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**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 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; epidemics.
Quantitative Aspects of Global Environmental Problems: Read More [+]
Rules & Requirements
Prerequisites: Upper division standing; calculus (Math 1A-1B or 16A-16B); physics (7A-7B or 8A-8B), chemistry (1A or 4A), biology (1B or 11), 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. Final exam required.
Instructor: Harte
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. Final exam required.
Instructor: Anthoff
Also listed as: ENVECON C176/IAS C176
Climate Change Economics: 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: 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. 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.
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: 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 [-]