EMMETT INTERDISCIPLINARY PROGRAM IN ENVIRONMENT AND RESOURCES (E-IPER)

Courses offered by the Emmett Interdisciplinary Program in Environment and Resources are listed under the subject code ENVRES on the Stanford Bulletin's ExploreCourses web site (http://explorecourses.stanford.edu/search;jsessionid=75B13D9BD401BF4435773811DC678716/?view=catalog&catalog=&page=0&q=ENVRES&filter-catalognumber-ENVRES=on&filter-coursestatus-Active=on).

Mission of the Program

The Emmett Interdisciplinary Program in Environment and Resources develops the knowledge, skills, perspectives, and ways of thinking needed to understand and help solve the world's most significant environmental and resources sustainability challenges. E-IPER strives to be a model for interdisciplinary graduate education. E-IPER offers a Ph.D. in Environment and Resources, a Joint M.S. exclusively for students in Stanford's Graduate School of Business or Stanford Law School, and a Dual M.S. for students in the Ford Dorsey Master's in International Policy program, School of Medicine, or a Ph.D. program in another department. E-IPER's home is the School of Earth, Energy & Environmental Sciences; affiliated faculty come from all seven Stanford schools.

Graduate Programs in Environment and Resources

The University's basic requirements for the M.S. and Ph.D. degrees are discussed in the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees/)" section of this bulletin. The E-IPER Ph.D. and M.S. degrees are guided by comprehensive requirements created with faculty and student input and approved by E-IPER's Executive Committee. To access the current Ph.D. and M.S. degree requirement documents, see the E-IPER web site (https://earth.stanford.edu/eiper/).

Learning Outcomes (Graduate)

Completion of the Ph.D. and M.S. degrees in Environment and Resources provides students with the knowledge, skills, perspectives, and ways of thinking needed to understand and help solve the world's most significant environmental and resources sustainability challenges.

Master of Science in Environment and Resources

For information on the University's basic requirements for the master's degree, see the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees/)" section of this bulletin.

Joint Master's Degree

Students enrolled in a professional degree program in Stanford's Graduate School of Business or the Stanford Law School are eligible to apply for admission to the joint M.S. in Environment and Resources Degree program. Enrollment in the joint M.S. program allows students to pursue an M.S. degree concurrently with their professional degree and to count a defined number of units toward both degrees, resulting in the award of joint M.B.A. and M.S. in Environment and Resources degree or a joint J.D. and M.S. in Environment and Resources degree.

The joint M.S.-M.B.A. degree program requires a total of 129 units: 84 units for the M.B.A. and 45 units for the M.S. (compared to 98 units for the M.B.A. plus 45 units for the M.S. as separate degrees) to be completed over approximately eight academic quarters.

The joint M.S.-J.D. degree program requires a minimum of 113 units; additional units may be necessary to satisfy all requirements. The J.D. degree requires 111 units (minimum of 80 Law units and 31 non-Law units) and the M.S. degree requires 45 units. The joint degree allows up to 43 overlapping units: 31 non-Law units allowed within the J.D. degree, plus 12 professional school units allowed within the M.S. degree. The joint M.S.-J.D. may be completed in three years.

Each student's program of study focuses on a specific track (see "Joint M.S. and Dual M.S. Course Tracks" below) and is subject to the approval by the student's faculty adviser and E-IPER staff. The joint degree is conferred when the requirements for both the E-IPER M.S. and the professional degree program have been met.

In addition to requirements for the professional degree, all joint M.S. students are required to complete 45 units within the parameters outlined below. Students must achieve at least a cumulative 3.0 grade point average (GPA) for all letter-graded courses taken toward the M.S. degree. Professional school letter-graded courses are not included in the E-IPER GPA calculation, but is included in the professional school GPA calculation. The student must complete at least 23 units at the 200 level or above. Courses numbered 1 to 99 are not allowable. For application information, see the Admissions (https://earth.stanford.edu/eiper/joint-ms-admissions/) page on the E-IPER website (https://earth.stanford.edu/eiper/).

1. *Required Courses:* An introductory core course and a capstone project seminar:

		Units
ENVRES 280	Topics in Environment and Resources	2
ENVRES 290	Capstone Project Seminar in Environment and Resources	3

2. *Track Courses:* A minimum of four letter-graded courses from one M.S. course track at the 100-level or higher. Track courses must be taken for a minimum of 3 units. Specific track courses are listed below in the "Joint M.S. and Dual M.S. Course Tracks" section.
   a. Cleantech
   b. Climate and Atmosphere
   c. Energy
   d. Freshwater
   e. Global, Community, and Environmental Health
   f. Land Use and Agriculture
   g. Oceans and Estuaries
   h. Sustainable Built Environment
   i. Sustainable Design [Submit a customized course track proposal]
3. *Elective Courses:* At least four 3-5 unit letter-graded elective courses at the 100-level or higher. Elective courses may be taken from the student's selected course track, another course track, or elsewhere in the University, provided that they are relevant to the student's environment and resources course of study.

There are additional restrictions on course work used to fulfill the joint M.S. degree requirements:

- A maximum of 5 units from courses that are identified as primarily consisting of guest lectures, such as the Energy Seminar, may be counted toward the joint M.S. degree.
- A maximum of 5 units of individual study courses, independent research units (such as ENVRES 399 Directed Research in Environment and Resources) may be counted toward the joint M.S. degree. One individual study course, if taken for 3-5 letter-graded units, may be counted as one of the four elective courses.

- A maximum of 12 units of approved courses (https://explorecourses.stanford.edu/search/?view=catalog&filter-coursestatus-Active=on&page=0&catalog=&academicYear=&q=EIPER%3A%3Ams_profschool&collapse=) related to environmental and resource fields, from any professional school, may be counted toward the joint M.S. degree. One approved professional school course may be counted as one of the four electives.

Dual Master's Degree

M.A. students in the Ford Dorsey Master's in International Policy program (MIP), M.D. students in the School of Medicine (SoM), or students pursuing a Ph.D. in another Stanford department may apply to the M.S. in Environment and Resources dual degree program. For the dual degree, students must meet the University's minimum requirements for their M.A., M.D., or Ph.D. degree and also complete an additional 45 units for the M.S. in Environment and Resources. Completion of the M.S. typically requires at least three quarters of study in addition to the time required for the student's other degree. For additional information, see the E-IPER website (https://pangea.stanford.edu/eiper/).

Each student's program of study focuses on a specific track (see "Joint M.S. and Dual M.S. Course Tracks" below) and is subject to the approval of the student's faculty adviser and E-IPER staff. The two degrees are conferred when the requirements for both the E-IPER M.S. and the other degree program have been met. For application information, see the Admissions (https://earth.stanford.edu/eiper/joint-ms-admissions/) page on the E-IPER website (https://earth.stanford.edu/eiper/).

In addition to requirements for the M.A., M.D., or Ph.D. degree, students are required to complete 45 units within the parameters outlined below. Students must achieve at least a cumulative 3.0 grade point average for all letter-graded courses taken toward the M.S. degree. The student must complete at least 23 units at the 200-level or above. Courses numbered 1 to 99 are not allowable.

1. *Required Courses:* An introductory core course and a capstone project seminar.

		Units
ENVRES 280	Topics in Environment and Resources	2
ENVRES 290	Capstone Project Seminar in Environment and Resources	3

2. *Track Courses:* A minimum of four letter-graded courses from one M.S. Course Track at the 100-level or higher. Track courses must be taken for a minimum of 3 units. Specific track courses are listed below under Joint M.S. and Dual M.S. Course Tracks.
    - Cleantech
    - Climate and Atmosphere
    - Energy
    - Freshwater
    - Global, Community, and Environmental Health
    - Land Use and Agriculture
    - Oceans and Estuaries
    - Sustainable Built Environment
    - Sustainable Design [Submit a customized course track proposal]
3. *Elective Courses:* At least four additional 3-5 unit letter-graded elective courses at the 100 level or higher. Elective courses may be taken from the student's selected course track, another course track, or elsewhere in the University, provided that they are relevant to the student's environment and resources course of study.

There are additional restrictions on course work used to fulfill the dual M.S. degree requirements:

- A maximum of 5 units from courses that are identified as primarily consisting of guest lectures, such as the Energy Seminar may be counted toward the dual M.S. degree.
- A maximum of 5 units of individual study courses, independent research (such as ENVRES 399 Directed Research in Environment and Resources) may be counted toward the dual M.S. degree. One individual study course, if taken for 3-5 letter-graded units, may be counted as one of the four elective courses.
- A maximum of 12 units of approved courses (https://explorecourses.stanford.edu/search/?view=catalog&filter-coursestatus-Active=on&page=0&catalog=&academicYear=&q=EIPER%3A%3Ams_profschool&collapse=) related to the environmental and resource fields, from any professional school, may be counted toward the dual M.S. degree. One approved professional school course may be counted as one of the four electives.

Joint M.S. and Dual M.S. Course Tracks

Students should consult the Stanford Bulletin's ExploreCourses (http://explorecourses.stanford.edu/) web site to view the course description, class schedule, location, eligibility, and prerequisites for all courses. Course track information and other recommended courses are also available on the E-IPER website (https://pangea.stanford.edu/eiper/).

Cleantech

		Units
APPPHYS 219	Solid State Physics Problems in Energy Technology	3
BIOE 355	Advanced Biochemical Engineering	3
CEE 176A	Energy Efficient Buildings	3
CEE 176B	100% Clean, Renewable Energy and Storage for Everything	3-4
CEE 207A	Understanding Energy	3-5
CEE 207R	E^3: Extreme Energy Efficiency	3
CEE 226	Life Cycle Assessment for Complex Systems	3-4
CEE 272R	Modern Power Systems Engineering	3
CEE 274A	Environmental Microbiology I	3
CEE 274B	Microbial Bioenergy Systems	3
CEE 276B	100% Clean, Renewable Energy and Storage for Everything	3-4
CEE 277L	Smart Cities & Communities	3
CEE 330	Racial Equity in Energy	2-3
ECON 155	Environmental Economics and Policy	5
ENERGY 253	Carbon Capture and Sequestration	3-4
ENERGY 267	Engineering Valuation and Appraisal of Energy Assets and Projects	3
ENERGY 269	Geothermal Reservoir Engineering	3
ENERGY 293C	Energy from Wind and Water Currents	3
MATSCI 256	Solar Cells, Fuel Cells, and Batteries: Materials for the Energy Solution	3-4
MATSCI 302	Solar Cells	3
MATSCI 303	Principles, Materials and Devices of Batteries	3
MATSCI 316	Nanoscale Science, Engineering, and Technology	3
ME 182	Electric Transportation	3
ME 267	Ethics and Equity in Transportation Systems	3

Climate and Atmosphere

		Units
BIO 117	Biology and Global Change	4
BIO 238	Ecosystem Services: Frontiers in the Science of Valuing Nature	3
CEE 172	Air Quality Management	3
CEE 226	Life Cycle Assessment for Complex Systems	3-4
CEE 263A	Air Pollution Modeling	3-4
CEE 263B	Numerical Weather Prediction	3-4
CEE 263C	Weather and Storms	3
CEE 263D	Air Pollution and Global Warming: History, Science, and Solutions	3
CEE 265E	Adaptation to Sea Level Rise and Extreme Weather Events	3
CEE 265F	Environmental Governance and Climate Resilience	3
CEE 276B	100% Clean, Renewable Energy and Storage for Everything	3-4
CEE 278A	Air Pollution Fundamentals	3
CEE 278C	Indoor Air Quality	2-3
ECON 155	Environmental Economics and Policy	5
ENERGY 253	Carbon Capture and Sequestration	3-4
ESS 202	Scientific Basis of Climate Change	3
ESS 246A	Atmosphere, Ocean, and Climate Dynamics: The Atmospheric Circulation	3
ESS 246B	Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation	3
ESS 271	Climate Models and Data	3
MS&E 394	Advanced Methods in Modeling for Climate and Energy Policy	3
PHYSICS 199	The Physics of Energy and Climate Change	3

Energy

		Units
APPPHYS 219	Solid State Physics Problems in Energy Technology	3
CEE 176A	Energy Efficient Buildings	3
CEE 176B	100% Clean, Renewable Energy and Storage for Everything	3-4
CEE 207A	Understanding Energy	3-5
CEE 207R	E^3: Extreme Energy Efficiency	3
CEE 226	Life Cycle Assessment for Complex Systems	3-4
CEE 226E	Techniques and Methods for Decarbonized and Energy Efficient Building Design	2-3
CEE 255	Introduction to Sensing Networks for CEE	3-4
CEE 256	Building Systems Design & Analysis	3-4
CEE 272R	Modern Power Systems Engineering	3
CEE 273S	Electricity Economics	3
CEE 276B	100% Clean, Renewable Energy and Storage for Everything	3-4
CEE 330	Racial Equity in Energy	2-3
ECON 155	Environmental Economics and Policy	5
EE 237	Solar Energy Conversion	3
ENERGY 101	Energy and the Environment	3
ENERGY 102	Fundamentals of Renewable Power	3
ENERGY 104	Sustainable Energy for 9 Billion	3
ENERGY 120	Fundamentals of Petroleum Engineering	3
ENERGY 226	Thermal Recovery Methods	3
ENERGY 227	Enhanced Oil Recovery	3
ENERGY 253	Carbon Capture and Sequestration	3-4
ENERGY 263	Introduction to Quantitative Methods for Energy Decisions	3
ENERGY 267	Engineering Valuation and Appraisal of Energy Assets and Projects	3
ENERGY 269	Geothermal Reservoir Engineering	3
ENERGY 271	Energy Infrastructure, Technology and Economics	3
ENERGY 291	Optimization of Energy Systems	3-4
ENERGY 293B	Fundamentals of Energy Processes	3
ENERGY 293C	Energy from Wind and Water Currents	3
GEOPHYS 208	Unconventional Reservoir Geomechanics	3
MATSCI 256	Solar Cells, Fuel Cells, and Batteries: Materials for the Energy Solution	3-4
MATSCI 302	Solar Cells	3
MATSCI 303	Principles, Materials and Devices of Batteries	3
MATSCI 316	Nanoscale Science, Engineering, and Technology	3
ME 182	Electric Transportation	3
ME 370A	Energy Systems I: Thermodynamics	3
ME 370B	Energy Systems II: Modeling and Advanced Concepts	4
ME 370C	Energy Systems III: Projects	3-5
MS&E 243	Energy and Environmental Policy Analysis	3
MS&E 394	Advanced Methods in Modeling for Climate and Energy Policy	3
PHYSICS 199	The Physics of Energy and Climate Change	3

Freshwater

		Units
BIO 238	Ecosystem Services: Frontiers in the Science of Valuing Nature	3
CEE 101B	Mechanics of Fluids	4
CEE 174A	Providing Safe Water for the Developing and Developed World	3
CEE 174B	Wastewater Treatment: From Disposal to Resource Recovery	3
CEE 177	Aquatic Chemistry and Biology	4
CEE 226	Life Cycle Assessment for Complex Systems	3-4
CEE 260A	Physical Hydrogeology	4
CEE 260C	Contaminant Hydrogeology and Reactive Transport	3
CEE 262A	Hydrodynamics	3-4
CEE 262B	Transport and Mixing in Surface Water Flows	3-4
CEE 262E	Rivers, Streams, and Canals	3
CEE 265A	Resilience, Sustainability and Water Resources Development	3
CEE 265C	Water Resources Management	3
CEE 265D	Water and Sanitation in Developing Countries	1-3
CEE 266A	Watershed Hydrologic Processes and Models	3
CEE 266B	Water Resources and Hazards	3
CEE 266C	Dams, Reservoirs, and their Sustainability	3

CEE 270	Movement and Fate of Organic Contaminants in Waters	3
CEE 271A	Physical and Chemical Treatment Processes	3
CEE 271B	Environmental Biotechnology	4
CEE 273A	Water Chemistry Laboratory	3
ECON 155	Environmental Economics and Policy	5
GEOPHYS 206	Sustainable and Equitable Water Management	3-4

Global, Community, and Environmental Health

		Units
ANTHRO 262	Indigenous Peoples and Environmental Problems	3-5
ANTHRO 266	Political Ecology of Tropical Land Use: Conservation, Natural Resource Extraction, and Agribusiness	3-5
ANTHRO 282	Medical Anthropology	5
BIO 117	Biology and Global Change	4
BIO 238	Ecosystem Services: Frontiers in the Science of Valuing Nature	3
CEE 174A	Providing Safe Water for the Developing and Developed World	3
CEE 174B	Wastewater Treatment: From Disposal to Resource Recovery	3
CEE 226	Life Cycle Assessment for Complex Systems	3-4
CEE 260C	Contaminant Hydrogeology and Reactive Transport	3
CEE 263A	Air Pollution Modeling	3-4
CEE 263D	Air Pollution and Global Warming: History, Science, and Solutions	3
CEE 265A	Resilience, Sustainability and Water Resources Development	3
CEE 265C	Water Resources Management	3
CEE 265D	Water and Sanitation in Developing Countries	1-3
CEE 270	Movement and Fate of Organic Contaminants in Waters	3
CEE 272	Coastal Contaminants	3-4
CEE 274D	Pathogens and Disinfection	3
CEE 276	Introduction to Human Exposure Analysis	3
CEE 277S	Engineering and Sustainable Development	1-3
CEE 278A	Air Pollution Fundamentals	3
CEE 278C	Indoor Air Quality	2-3
ECON 155	Environmental Economics and Policy	5
HUMBIO 153	Parasites and Pestilence: Infectious Public Health Challenges	4
HUMBIO 166	Food and Society: Exploring Eating Behaviors in Social, Environmental, and Policy Context	4
INTLPOL 291	Theories of Change in Global Health	3-4

Land Use and Agriculture

		Units
ANTHRO 266	Political Ecology of Tropical Land Use: Conservation, Natural Resource Extraction, and Agribusiness	3-5
BIO 117	Biology and Global Change	4
BIO 234	Conservation Biology: A Latin American Perspective	3
BIO 238	Ecosystem Services: Frontiers in the Science of Valuing Nature	3
BIO 279	Integrated Valuation of Ecosystem Services and Tradeoffs	1-3
CEE 226	Life Cycle Assessment for Complex Systems	3-4
CEE 236	Planning Calif: the Intersection of Climate, Land Use, Transportation & the Economy	3
CEE 275A	California Coast: Science, Policy, and Law	3-4
EARTHSYS 155	Science of Soils	3-4
EARTHSYS 185	Feeding Nine Billion	4-5
EARTHSYS 187	FEED the Change: Redesigning Food Systems	2-3
EARTHSYS 205	Food and Community: Food Security, Resilience and Equity	2-3
EARTHSYS 206	World Food Economy	5
EARTHSYS 276	Open Space Management Practicum	4-5
EARTHSYS 281	Urban Agroecology	3
EARTHSYS 289	FEED Lab: Food System Design & Innovation	3-4
EARTHSYS 289A	FEED Lab: Food System Design & Innovation	3-4
ECON 155	Environmental Economics and Policy	5
ECON 206	World Food Economy	5
ESS 155	Science of Soils	3-4
ESS 164	Fundamentals of Geographic Information Science (GIS)	1-4
ESS 206	World Food Economy	5
ESS 256	Soil and Water Chemistry	3
ESS 262	Remote Sensing of Land	4
ESS 270	Analyzing land use in a globalized world	3
ESS 280	Principles and Practices of Sustainable Agriculture	3-4
ESS 281	Urban Agroecology	3
HUMBIO 166	Food and Society: Exploring Eating Behaviors in Social, Environmental, and Policy Context	4
SUST 210	Pursuing Sustainability: Managing Complex Social Environmental Systems	3
URBANST 163	Land Use: Planning for Equitable and Sustainable Cities	3

Oceans and Estuaries

		Units
BIO 238	Ecosystem Services: Frontiers in the Science of Valuing Nature	3
BIOHOPK 263H	Oceanic Biology	4
BIOHOPK 273H	Marine Conservation Biology	4
BIOHOPK 274	Hopkins Microbiology Course	3-12
BIOHOPK 285H	Ecology and Conservation of Kelp Forest Communities	5
CEE 226	Life Cycle Assessment for Complex Systems	3-4
CEE 262D	Introduction to Physical Oceanography	4
CEE 272	Coastal Contaminants	3-4
CEE 274S	Hopkins Microbiology Course	3-12
CEE 275A	California Coast: Science, Policy, and Law	3-4
ECON 155	Environmental Economics and Policy	5

ESS 241	Remote Sensing of the Oceans	3-4
ESS 244	Marine Ecosystem Modeling	3
ESS 246A	Atmosphere, Ocean, and Climate Dynamics: The Atmospheric Circulation	3
ESS 246B	Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation	3
ESS 251	Biological Oceanography	3-4
ESS 252	Marine Chemistry	3-4
ESS 258	Geomicrobiology	3

Sustainable Built Environment

		Units
CEE 100	Managing Sustainable Building Projects	4
CEE 174A	Providing Safe Water for the Developing and Developed World	3
CEE 174B	Wastewater Treatment: From Disposal to Resource Recovery	3
CEE 176A	Energy Efficient Buildings	3
CEE 176B	100% Clean, Renewable Energy and Storage for Everything	3-4
CEE 207R	E^3: Extreme Energy Efficiency	3
CEE 218X	Shaping the Future of the Bay Area	3-5
CEE 226	Life Cycle Assessment for Complex Systems	3-4
CEE 226E	Techniques and Methods for Decarbonized and Energy Efficient Building Design	2-3
CEE 236	Planning Calif: the Intersection of Climate, Land Use, Transportation & the Economy	3
CEE 241A	Infrastructure Project Development	3
CEE 243	Intro to Urban Sys Engrg	3
CEE 255	Introduction to Sensing Networks for CEE	3-4
CEE 256	Building Systems Design & Analysis	3-4
CEE 265A	Resilience, Sustainability and Water Resources Development	3
CEE 265E	Adaptation to Sea Level Rise and Extreme Weather Events	3
CEE 276B	100% Clean, Renewable Energy and Storage for Everything	3-4
CEE 277L	Smart Cities & Communities	3
CEE 330	Racial Equity in Energy	2-3
ECON 155	Environmental Economics and Policy	5
ME 267	Ethics and Equity in Transportation Systems	3
URBANST 163	Land Use: Planning for Equitable and Sustainable Cities	3

Sustainable Design

Submit customized course track proposal prior to pursuing the Sustainable Design track. Submission of the customized course track proposal is not a guarantee of its approval. See E-IPER website (https://pangea.stanford.edu/eiper/) for detailed information about this track.

Master of Science

In exceptional circumstances, students in E-IPER's Ph.D. program may opt to complete their training with a M.S. degree. There is no direct admission to the M.S. degree program. Requirements for the M.S. include:

1. Completion of a minimum of 45 units at or above the 100-level, of which 23 units must be at or above the 200-level. Courses numbered 1 to 99 are not allowable.
2. Completion of the E-IPER Ph.D. core curriculum, with a letter grade of 'B' or higher in each course:

		Units
ENVRES 300	Introduction to Resource, Energy and Environmental Economics	3
ENVRES 315	Environmental Research Design Seminar	1
ENVRES 320	Designing Environmental Research	3-4
ENVRES 330 & ENVRES 398	Research Approaches for Environmental Problem Solving and Directed Reading in Environment and Resources	4-13

Additional courses may be chosen in consultation with the student's lead advisers. Students must maintain at least a 3.0 grade point average in all courses taken for the M.S. degree. The M.S. degree does not have an M.S. with thesis option. Students may write a M.S. thesis, but it is not formally recognized by the University.

Doctor of Philosophy in Environment and Resources

For information on the University's basic requirements for the Ph.D. degree, see the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees/)" section of this bulletin.

E-IPER updates the Ph.D. requirements annually, laying out the structure of advising meetings, core courses, program activities, and milestones that guide students' progress. Each student works with a faculty advising team from different research areas to design a course of study that allows the student to develop and exhibit:

1. understanding of analytical tools and research approaches for interdisciplinary problem solving, and a mastery of those tools and approaches central to the student's thesis work
2. depth of knowledge in at least two distinct fields of inquiry; and
3. interdisciplinary breadth as determined by faculty, advising team, and student.

Program-specific Ph.D. requirements, including a timeline to achieve milestones, are outlined in detail in the current year requirements and are summarized below:

1. In the first year, completion of the Ph.D. core course sequence:

		Units
ENVRES 300	Introduction to Resource, Energy and Environmental Economics	3
ENVRES 315	Environmental Research Design Seminar	1
ENVRES 320	Designing Environmental Research	3-4
ENVRES 330	Research Approaches for Environmental Problem Solving	3
ENVRES 398	Directed Reading in Environment and Resources	1-10

2. *Fields of Inquiry:* Fulfillment of depth of knowledge in the student's two chosen fields of inquiry through courses, research, and/or independent studies as determined by the student and their two lead advisers and committee members. Fields of inquiry are central to the student's dissertation research. Students have the freedom to define and choose the two fields of inquiry in which they develop depth of understanding throughout their Ph.D. program; the fields must be distinct from one another to ensure that the student's research is interdisciplinary. Each field of inquiry is associated with a specific lead adviser.

As part of the qualifying exam, each student is required to submit a detailed essay describing:

- the two fields of inquiry, explaining the development of these fields, and their relationship to the larger disciplines from which they are drawn;
- how rigor is understood and achieved in these fields;
- the importance and applicability of these fields to the student's research questions; and
- how the student's work will combine these two fields of inquiry to produce an interdisciplinary research project that demonstrates scholarly rigor.

1. Demonstration of an interdisciplinary breadth of knowledge that is more broadly related to environment and resources; this may be in the form of courses, independent study, and/or evidence of proficiency through prior course work or other experience. Fulfillment of the interdisciplinary breadth requirement must be certified by the student's lead faculty advisers and committee members.
2. Completion of quarterly meetings with advisers during the first year, and at minimum, two annual meetings thereafter.
3. Submission of a candidacy plan for review at the second-year committee meeting and subject to the approval of that plan by the student's committee and E-IPER's faculty director. The candidacy plan documents how the student has fulfilled the program requirements to date and includes a summary of research ideas and a list of faculty who might serve as qualifying exam committee members.
4. Completion of the oral qualifying examination and completion of the requirements for candidacy, including at least 25 letter-graded graduate course units (200 level and above) with at least a 'B' (3.0) average. The qualifying exam committee must include the student's two lead advisers and two to three other faculty members with expertise in the student's research area. The majority of the qualifying exam committee should be members of the Stanford Academic Council; the chair of the committee must be a Stanford Academic Council member and may not be one of the student's two lead advisers. In exceptional cases, the committee may include a member-at-large who is not a Stanford faculty member as a fourth or fifth member.
5. Completion of a written dissertation, approved by the student's dissertation reading committee consisting of the student's lead advisers and at least one other member and passage of the University oral examination in defense of the dissertation following the guidelines outlined in the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees/)" section of this bulletin. The University oral examination committee comprises the student's two lead advisers, at least two additional members, and a chair whose academic appointment is in a department outside that of the lead advisers. Normally, all committee members are Academic Council members; appointment of a non-Academic Council member must be petitioned and approved by the faculty director.

In addition to the requirements listed above, all Ph.D. students must:

1. Serve as a teaching assistant (TA) for at least one quarter, as a discussion section leader or with an opportunity to lecture in at least two class sessions, in any department or program, including but not limited to ENVRES 300 Introduction to Resource, Energy and Environmental Economics, ENVRES 320 Designing Environmental Research, or ENVRES 330 Research Approaches for Environmental Problem Solving. Seminars, including Introductory Seminars, may not be used to fulfill this requirement. Students should fulfill the teaching requirement by the end of the third year unless they obtain a firm commitment from a faculty member to TA a future course.
2. On an ongoing basis, submit grant proposals for external funding, defined as fellowship and/or research funds provided by a government agency, a private foundation, or a University entity other than E-IPER or the School of Earth, Energy and Environmental Sciences.
3. Participate each year in a Spring Quarter Annual Review in which the student and lead advisers submit progress reports for review by the E-IPER Academic Guidance Committee.

COVID-19 Policies

On July 30, the Academic Senate adopted grading policies effective for all undergraduate and graduate programs, excepting the professional Graduate School of Business, School of Law, and the School of Medicine M.D. Program. For a complete list of those and other academic policies relating to the pandemic, see the "COVID-19 and Academic Continuity (http://exploredegrees.stanford.edu/covid-19-policy-changes/#tempdepttemplatetabtext)" section of this bulletin.

The Senate decided that all undergraduate and graduate courses offered for a letter grade must also offer students the option of taking the course for a “credit” or “no credit” grade and recommended that deans, departments, and programs consider adopting local policies to count courses taken for a “credit” or “satisfactory” grade toward the fulfillment of degree-program requirements and/or alter program requirements as appropriate.

Graduate Degree Requirements

Grading

E-IPER policy requires some courses credited to the M.S. and Ph.D. degrees to be taken for a letter grade. However, due to the special circumstances arising from the COVID-19 pandemic, these requirements are being adjusted for the 2020-21 academic year. Courses can be credited towards the degree requirements either if they have been taken for a letter grade OR with a grade of 'CR' (credit) or 'S' (satisfactory).

Graduate Advising Expectations

The Emmett Interdisciplinary Program in Environment and Resources is committed to providing academic advising in support of graduate student scholarly and professional development. Through the open discussions of scholarly ideas during regular interactions with their advisers, graduate students identify areas of focus, and more generally develop their creative and intellectual potential.

Faculty advisers guide students in designing and conducting research, selecting courses, exploring academic opportunities and professional pathways, developing teaching skills, and navigating policies and degree requirements. At the same time, they are aware and respectful of work-life balance and wellness considerations. Graduate students are proactive in seeking academic and professional guidance, and take responsibility for learning about their program's policies and degree requirements.

Incoming students are assigned faculty adviser(s) in advance of their matriculation to the program; after further development of their research and professional interests, students may select different advisers.

As a best practice, adviser and advisee should agree upon advising expectations and then, periodically, discuss and review them in order to ensure mutual understanding.

Students should also take advantage of the larger advising network, consulting such resources as the E-IPER program staff, Stanford's institutional resources (VPGE, Office of Graduate Life, CAPS, etc.), and individuals and networks in the broader community of scholars. While student academic progress is reviewed annually, students are expected to be active in tracking their own progress, and raising concerns in a timely manner.

The E-IPER website provides more detailed information about E-IPER advising procedures and expectations in the Joint- and Dual-M.S. programs (https://pangea.stanford.edu/eiper/curriculum/) and in the Ph.D. program (https://pangea.stanford.edu/eiper/phd-requirements/).

In the event that a student has a formal concern or complaint about their advising experience, they are encouraged to contact the E-IPER Associate Director, the E-IPER Faculty Director, the School Associate Dean for Educational Affairs, or the School Associate Dean for Human Resources and Faculty Affairs.

For a statement of University policy on graduate advising, see the "Graduate Advising (http://exploredegrees.stanford.edu/graduatedegrees/#advisingandcredentialstext)" section of this bulletin.

Faculty Director: Nicole M. Ardoin

Director of Graduate Studies: Nicole M. Ardoin

Associate Co-Directors: Ann Marie Pettigrew and Anjana Richards

Anthropology: Lisa Curran, William H. Durham, James Ferguson, Lynn Meskell, Krish Seetah

Biology: Barbara Block, Larry B. Crowder, Gretchen C. Daily, Giulio De Leo, Rodolfo Dirzo, Anne Ehrlich (emerita), Paul Ehrlich (emeritus), Tadashi Fukami, Elizabeth Hadly, Fiorenza Micheli, Harold Mooney (emeritus), Erin Mordecai, Stephen Palumbi, Kabir Peay, Robert Sapolsky, Shripad Tuljapurkar, Peter Vitousek

Business: William Barnett, Jonathan Bendor, Steve Comello, Dan Iancu, Hau Lee, Dale T. Miller, Erica Plambeck, Hayagreeva Rao, Stefan J. Reichelstein, Dan Reicher, Baba Shiv, Itamar Simonson, Sarah A. Soule

Center for Comparative Studies in Race and Ethnicity: Michael Wilcox

Chemical Engineering: William Tarpeh

Civil and Environmental Engineering: Sarah L. Billington, Alexandria Boehm, Craig S. Criddle, John Dabiri, Jennifer Davis, Martin Fischer, David Freyberg, Olivier Fringer, Mark Jacobson, Rishee Jain, Jeffrey Koseff, Michael Lepech, Raymond Levitt (emertius), Richard Luthy, Gilbert M. Masters (emeritus), Stephen Monismith, Leonard Ortolano, Ram Rajagopal

Communications: Jon A. Krosnick

Earth System Science: Kevin Arrigo, Marshall Burke, Karen Casciotti, Page Chamberlain, Noah Diffenbaugh, Robert B. Dunbar, Scott Fendorf, Christopher Field, Christopher Francis, Steven Gorelick, Rob Jackson, James Holland Jones, Julie Kennedy (emerita), Eric Lambin, David Lobell, Pamela Matson, Anna Michalak, Rosamond Naylor, Morgan O'Neill, Leif Thomas, Gabrielle Wong-Parodi

Earth Systems Program: Patrick Archie, Sibyl Diver, Tom Hayden, Suki Hoagland, Richard Nevle

Economics: Lawrence Goulder, Charles Kolstad

Education: Nicole M. Ardoin, Daniel McFarland, Walter W. Powell

Energy Resources Engineering: Ines M. Azevedo, Sally M. Benson, Adam Brandt, Jef Caers, Margot Gerritsen, Anthony Kovscek

English: Mark Algee-Hewitt

Freeman Spogli Institute for International Studies: Walter Falcon (emeritus), Francis Fukuyama, Stephen Stedman

Geological Sciences: Gary Ernst (emeritus), Stephan Graham

Geophysics: Jenny Suckale, Mark Zoback

History: Zephyr Frank, David Kennedy, Richard White, Mikael Wolfe

Law: Michelle Anderson, Jeffrey Ball, Margaret Caldwell, Janet Martinez, Deborah Sivas, Barton Thompson, Alicia Seiger

Management Science and Engineering: Dariush Rafinejad, James Sweeney, John Weyant

Materials Science and Engineering: Michael D. McGehee

Mechanical Engineering: Arun Majumdar

Medicine: Jason Andrews, Michele Barry, Eran Bendavid, Mark Cullen, Christopher Gardner, Jeremy D Goldhaber-Fiebert, Desiree LaBeaud, Stephen P. Luby, Grant Miller, David Rehkopf, Thomas N. Robinson, Gary Schoolnik, Gary Shaw

Philosophy: Debra Satz

Physics: Leo Hollberg

Political Science: Bruce E. Cain, Terry Karl, Clayton Nall, Kenneth Schultz, Jeremy Weinstein

Program in Writing and Rhetoric: Emily Polk

Psychology: Brian Knutson

Sociology: Mark Granovetter, Douglas McAdam, Richard Scott (emeritus), Robb Willer

Statistics: Susan Holmes

Woods Institute for the Environment: Newsha Ajami, Shilajeet Banerjee, Jim Leape, Katharine Mach, Michael Wara

Outside Stanford:

Carnegie Institution: Greg Asner**,** Ken Caldeira

University of Virginia: Leon Szeptycki

Courses

ENVRES 199. Independent study. 1-5 Unit.

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Same as: ENVRES 299

ENVRES 201. Designing and Evaluating Community Engagement Programs for Social and Environmental Change. 3 Units.
Non-profit organizations seeking to achieve social and environmental change often run outreach and education programs to engage community members in their cause. Effective application of social science theory and methods may improve the design and evaluation of such community engagement programs. In this class, we partner with environmental and social justice organizations in the Bay Area to explore two questions: 1) How can recent findings from the social sciences be applied to design more effective community engagement programs ? 2) How can we rigorously evaluate outreach and education programs to ensure they are achieving the desired objectives? The course will include an overview of key theories from psychology, sociology, and education, field trips to partnering organizations, and a term-long community-engaged research project focused on designing and/or evaluating a local outreach or educational program that is meant to achieve social and environmental change.
Same as: EARTHSYS 130

ENVRES 215A. Topics in International Justice, Rights, and the Environment. 1-3 Unit.
As the effects of environmental change are increasingly felt by people around the globe--whether point-source pollution from factories, livelihood deterioration from overfishing, or exposure to climate change impacts--it is more urgent than ever that we engage critically and creatively with the justice, ethics, and rights implications of these changes. Topics that will be addressed in this survey course include marine justice, climate justice and ethics, environmental racism, social movements, resource degradation, and neoliberal conservation. Through guest lectures, student-led discussions, readings, and creative writing, students will engage with cutting-edge research on these topics. The course offers two enrollment options: a 1-unit seminar-only option that meets once a week, and a 3-unit seminar + discussion option that meets twice a week. The 3-unit option of the course requires instructor approval. Please submit an application by March 17th at 11:59 PM Pacific Time. Application is available at https://tinyurl.com/TIJREapplication.
Same as: HUMRTS 118

ENVRES 220. The Social Ocean: Human Dimensions of Coastal and Marine Ecosystems. 1-2 Unit.
This interdisciplinary seminar examines human dimensions of current ocean issues through a series of readings, discussions, and guest lecturer presentations. Through the lenses offered by multiple disciplines and fields, we will examine and reinterpret the challenges of fisheries management, climate change, conservation/restoration, and human rights. We will welcome specialists in industry, academia, law, and the nonprofit sector to discuss theories of change for ocean issues, with a particular emphasis on marine justice. We invite students to create and share their own ¿Social Ocean Project¿ synthesizing course themes and personal reflections.

ENVRES 221. New Frontiers and Opportunities in Sustainability. 1 Unit.
Interdisciplinary exploration of how companies, government and non-profit organizations address some of the world's most significant environmental & resource sustainability challenges. Each week we will explore with an experienced sustainability practitioner new frontiers and opportunities in clean tech, policy, energy, transportation, consumer goods, agriculture, food, and sustainable built environments.

ENVRES 222. Climate Law and Policy. 3 Units.
This course offers an interdisciplinary, graduate-level survey of historical and current efforts to regulate emissions of greenhouse gases in the United States. Students will read primary legal documents, including statutes, regulations, and court cases in order to evaluate the forces and institutions shaping American climate policy. Although the class will focus on the intersection of climate policy and the legal system, no specific background in law is necessary. Elements used in grading: Grades will be based on class attendance, class participation, and either written assignments and an exam. Cross-listed with LAW 2520.

ENVRES 223. Topics in Writing & Rhetoric: Introduction to Environmental Justice: Race, Class, Gender and Place. 4 Units.
This course examines the rhetoric, history and key case studies of environmental justice while encouraging critical and collaborative thinking, reading and researching about diversity in environmental movements within the global community and at Stanford, including the ways race, class and gender have shaped environmental battles still being fought today. We center diverse voices by bringing leaders, particularly from marginalized communities on the frontlines to our classroom to communicate experiences, insights and best practices. Together we will develop and present original research projects which may serve a particular organizational or community need, such as racialized dispossession, toxic pollution and human health, or indigenous land and water rights, among many others. Prerequisite: PWR 2.
Same as: EARTHSYS 194, PWR 194EP

ENVRES 225. E-IPER Current Topics Seminar. 1 Unit.
For E-IPER Ph.D and Joint M.S. students only. Weekly presentations of E-IPER students' research and other program-related projects. Occasional guest speakers. Individual or team presentation, active participation, and regular attendance required for credit. May be taken for credit a maximum of two times. Enrollment by department consent only. Contact instructor for permission to enroll.

ENVRES 226. Energy Law. 3 Units.
Modern energy systems aim to deliver a supply of reliable, low-cost, and clean energy; in turn, they require massive capital investments in infrastructure projects, some of which have the features of a natural monopoly and therefore require ongoing economic regulation. The U.S. energy system today is subject to a complex regime of state and federal laws. We will examine the historical role of state-level electric utility regulation, tracing its evolution into the various forms of regulated and deregulated energy markets now in use in the U.S. electricity and natural gas sectors. Contemporary energy law increasingly involves a delicate federalist balance where state and federal regulators share overlapping authority in contested policy areas that are subject to major technological and economic change, as changes in the supply and costs of renewable and fossil energy resources alike transform the U.S. energy sector. Finally, we will interrogate the contested ideals of regulation and competition, which private, non-profit, and governmental stakeholders all deploy in legal and political fora to advance private gain and public goods¿most recently in a series of transformative proposals to use federal emergency powers to provide financial bailouts to legacy fossil and nuclear power plants. Students who complete the class will gain a historical understanding of how economic regulation of the energy sector has evolved since the early 20th century, a durable conceptual framework for understanding modern energy law and policy debates, and a practical understanding of energy law designed for future practitioners. Non-law students interested in energy issues are highly encouraged to take this course, as energy law literacy is essential to careers in the sector. Elements used in grading: class participation, short written assignments, and a one-day take-home final exam. Cross-listed with LAW 2503.

ENVRES 228. Private Environmental Governance. 2-3 Units.
The tools of private environmental regulation (e.g., eco-certifications, CSR initiatives, supplier contracts) have become an increasingly important source of governance. But how do they work? How do they arise--why and how can corporations participate in these voluntary measures? How do they regulate firm behavior and how can regulators police the tools themselves? This interdisciplinary seminar examines these questions and more, with readings from traditional legal sources (cases, agreements), as well as from economics, political science, and social psychology. Guest speakers and case studies will add real-world context to our exploration of theory. Elements used in grading: Students may take the course for 2 units (Option 1) or 3 units (Option 2). Attendance, class participation, and short written assignments will factor into grades for both sections. Option 1 students will also prepare a private governance proposal and presentation. Option 2 students will write a research paper meeting the Law School's R paper requirements. Please note that the last two class sessions (May 21 and 28) will have to be rescheduled. Cross-listed with the Law School (LAW 2522).

ENVRES 229A. Policy Practicum: Smoke. 3 Units.
Client: Various legislative and executive branch decision makers. Wildfire smoke has emerged as one of the most pressing air pollution and public health threats in the Western United States. Last year, despite decades of progress in reducing air pollution from transport, industry, and electric power, wildfires caused the highest number of "spare the air" declarations ever called by local Air Quality Management Districts in California. Oregon, Washington and Colorado all suffered similar "airpocalypse" fire seasons. Recent model-based estimates of mortality from wildfire smoke-derived particulate matter suggest that between 1200 and 3000 seniors likely died from the fires this summer. Current law and regulation not only doesn't consider particulate matter derived from wildfire smoke to be a target for regulation, it also imposes burdensome permitting requirements on one of the most effective risk-mitigation strategies: prescribed fire. In this course, we will both learn about the science and regulatory framework governing smoke and develop new research and briefing materials for the California legislature and executive branches focused on informing a new approach. The course is intended for students interested in multi-disciplinary approaches to public policy problems. No background in either the Clean Air Act or wildfire policy is required. Students will work in multi-disciplinary teams focused on current policy problems including (1) mapping policies regarding prescribed fire at local Air Quality Management Districts; (2) developing a policy proposal to facilitate coordinated permitting of much greater prescribed fire under the Clean Air Act; and (3) deploying a simplified air quality health benefits model (EPA COBRA) to estimate the potential public health and economic benefits of better fuels management. Students will engage in a once per week lecture/discussion of wildfire smoke science and policy, including student presentations. Class will also meet additionally once per week in a working session to discuss progress on team projects. Students will be expected to present the results of their team projects to California legislative and executive branch staff engaged in developing new approaches to wildfire policy. Elements used in grading: Attendance, Performance, Class Participation, Written Assignments, Final Paper. CONSENT APPLICATION: To apply for this course, students must complete and submit a Consent Application Form available on the SLS website: https://law.stanford.edu/education/courses/consent-of-instructor-forms/#slsnav-spring-quarter. See Consent Application Form for instructions and submission deadline. Course is cross-listed with LAW 808D.

ENVRES 230. Field Survey Data Collection & Analysis. 3 Units.
In this course we will examine a range of issues related to the collection and analysis of survey data. Topics will include initiating a survey, designing an instrument, conducting enumeration, converting data from questionnaires to digital files, data analysis, empirical modeling and presenting results. Technical components will also be highly focused on application and implementation, and while prior training in econometrics would be useful, it will not be a prerequisite. The course will be tailored so that some of the specific topics covered will be based on the needs and interests of the students.

ENVRES 231. Qualitative Interviewing. 3 Units.
Addressing the theoretical underpinnings of qualitative interviews as well as the application of theory to practice, this course considers different approaches to interviewing. Interview types covered will range from group interviews to individual interviews, and from unstructured, ethnographically oriented interviews to highly structured interviews. Working with community partners to facilitate application to practice, the students will move from theory to interview design, implementation, and initial stages of analysis, with an emphasis on consistency in approach and utility in graduate-level research.
Same as: EDUC 450C

ENVRES 240. Environmental Decision-Making and Risk Perception. 1-3 Unit.
Mobilizing successful conservation efforts to mitigate climate change and preserve both local and global ecosystems requires a new way of thinking. This course will investigate the barriers to pro-environmental behavior and the heuristics and biases that cloud our ability to respond effectively to environmental problems, using insights from behavioral economics, neuroeconomics, and environmental risk perception. Emphasis on interdisciplinary applications of recent research, and implications for environmental policymaking and persuasive messaging.

ENVRES 245. Psychological Insights for Science Communication. 2-3 Units.
This course integrates lessons learned from psychology, behavioral economics, marketing, and sociology to the practice of science communication, with practical experience working to create and test new messaging for partner environmental organizations. Students learn about innate biases and heuristics that influence the communication of scientific ideas and data and the public¿s receptiveness to environmental messaging. Topics covered include information framing, attention and salience, public science literacy and numeracy, simplifying complexity and dealing with uncertainty, cultural and political contexts and social norms, and methods to motivate science engagement, evidence-based decision-making, and behavior change. Students will learn how to design new messaging strategies based on social science research and how to analyze their efficacy using basic statistical analyses in R (no prior programming knowledge is required). The course culminates in a project developing and testing new messaging strategies for real-world environmental organizations.

ENVRES 246. Measuring Success in Environmental Messaging. 1-2 Unit.
How do we understand the impacts of environmental messaging on its target audience, and ensure that it provides compelling and informative content for education, outreach, and behavior change? Once different messaging campaigns have been attempted, how do we evaluate their success? This course teaches students practical social science approaches to assess the efficacy of environmental messaging campaigns by real environmental nonprofit organizations. As a continuation of ENVRES 245, students will work with partner nonprofit organizations to analyze the performance of campaigns designed in the previous quarter, and identify the most salient and motivational aspects of the campaigns that best predicted successful and meaningful outcomes. The course will also focus on how to evaluate outcomes across heterogeneous populations, to better understand how messaging may impact a diverse audience. The statistical computing language R will be used in the course, but prior programming experience is not required. Prerequisite: ENVRES 245 : Psychological Insights for Science Communication or consent of instructor required.

ENVRES 247. Navigating Complexity: Design, Strategy, and Decision Making for Systemic Challenges. 1 Unit.
Environmental issues fall in a class of challenge that demand a systems perspective and the ability to navigate complexity at many levels. Inter-related multi-outcome challenges not only require systems approaches in understanding the problem, but also dealing with the complexities of how to transform them in the real world. This class will introduce students to concepts regarding new mindsets, toolsets, and skillsets that are going to be increasingly pertinent as we move into an era marked by growing levels of complexity, uncertainty, and urgency. This is a hands-on class where the students will experience the act of unraveling complexity, co-creating interventions, and making decisions to transform systems at scale. ENROLLMENT: Course enrollment priority given to E-IPER graduate students. Please contact program staff at mkuida@stanford.edu for permission code.

ENVRES 250. Environmental Governance. 3 Units.
How do we work together to solve environmental problems? Across the globe, who has a voice, and who ultimately decides how to balance conservation and development? How do we build governance institutions that facilitate both environmental sustainability and social equity? This seminar on environmental governance will focus on the challenges and opportunities for managing common-pool resources, like fisheries, forests, and water. Because managing environmental resources is often about managing people, we will explore the motivations underlying human behavior towards the environment. We will discuss how institutions encode our cultural values and beliefs, and how we can reshape these institutions to achieve more sustainable outcomes. Coursework includes foundational readings and a pragmatic exploration of case studies. Teaching cases address topics in community-based conservation, international protected areas, market-based approaches, coping with environmental risk, and other themes. Interested undergraduate and graduate students from any discipline are welcome.
Same as: EARTHSYS 254

ENVRES 255. Moral, Civic, and Environmental Education. 3 Units.
An examination of the conceptual foundations that underlie moral, civic, and environmental action in contemporary society, and the social, cognitive, and motivational capacities that make possible constructive participation. The course will discuss both in-school and beyond-schools ways in which young people can be educated for informed and constructive participation. Among the educational methods to be considered will be narrative treatments of exemplary figures in the moral, civic, and environmental domains.
Same as: EDUC 379

ENVRES 260. Implementing & Financing a Decarbonized Economy. 3 Units.
In the forthcoming decades, the transition to a global low-carbon economy will require tens of trillions of dollars worth of capital investment. Much of that capital investment will directed towards new builds, or retrofits, of major capital projects. This course aims to give students a very practical and detailed introduction to the opportunities and challenges of developing and financing such major capital projects. Each of the instructors has decades of hands-on experience in developing and financing major capital projects. The process of developing and financing major capital projects is inherently very multidisciplinary--including engineering, business, finance, legal and (often) international relations principles. The course will start at a high level, covering the emissions landscape, policy framework, markets, and main technologies. Then we will dive much deeper into such key tasks as permitting; engineering and resource studies; project pro forma models; successfully negotiating project construction contracts and output sales contracts; arranging the financial terms and legal provisions of bank or bond debt financing; maximizing returns to equity; and monetizing tax and other governmental incentives. Students should be eager to engage in a multi-disciplinary approach both in terms of how to think about the subject matter and in terms of interacting with fellow students who bring a different academic and or work experience than their own. Class preparation for the bi-weekly sessions will require watching a pre-recorded lecture, literature review or case reading, and homework assignments designed to reinforce principles learned. A four-part case study encompassing the development of a 500 MW solar project will be used early on in the class to acquaint students with the tools and issues of project development. We plan to reserve the 1.5 hour class sessions for homework review, student case study analysis, reinforcement of technical concepts, and free-form discussion. Finally, we will divide the class into small teams to do final group projects that will be presented during the last few class sessions. The instructors do not require prior coursework in finance; and we will provide basic background materials and additional tutorials, as needed, to bring students up to the technical level required to do the coursework successfully. CONSENT OF PROGRAM FORM: In order to be considered for enrollment, please complete the Consent of Program Form: nhttps://forms.gle/U3gbzjcSgD7vpayf8 by Sunday, January 3rd at 11:59pm PST. Successful applicants will be notified when permission has been granted and will receive a permission number to register for the course in Axess by Wednesday, January 6th. Forms received after the deadline will be reviewed on a rolling basis until the class is full. ENVRES 260 is capped at 20 students. Some priority will be given to E-IPER graduate students.

ENVRES 270. Graduate Practicum in Environment and Resources. 1-5 Unit.
Opportunity for E-IPER students to pursue areas of specialization in an institutional setting such as a laboratory, clinic, research institute, governmental agency, non-governmental organization, or multilateral organization. Meets US CIS requirements for off-campus employment with endorsement from designated school official.

ENVRES 280. Topics in Environment and Resources. 2 Units.
Required core course restricted to E-IPER Joint M.S. and Dual M.S. students. This course functions as a gateway to fundamental concepts in environment, energy and sustainability. Topics include climate change, ecosystem services, life cycle assessment, energy systems, food systems, and others. Students engage with affiliated faculty, and begin to develop ways to integrate science and technology with business, law and other professional skills to solve environment and resource problems.

ENVRES 290. Capstone Project Seminar in Environment and Resources. 3 Units.
Required for and limited to E-IPER Joint M.S. and Dual M.S. students. Propose, conduct and publicly present final individual or team projects demonstrating the integration of professional (M.B.A., J.D., M.D., M.I.P., or Ph.D.) and M.S. in Environment and Resources degrees. Presentation and submission of final product required.

ENVRES 295. Carbon Dioxide and Methane Removal, Utilization, and Sequestration. 1 Unit.
This is a seminar on carbon dioxide and methane removal, utilization, and sequestration options, and their role in decarbonizing the global energy system. This course will cover topics including the global carbon balance, utilizing atmospheric carbon in engineered solutions, recycling and sequestering fossil-based carbon, and enhancing natural carbon sinks. The multidisciplinary lectures and discussions will cover elements of technology, economics, policy and social acceptance, and will be led by a series of guest lecturers. Short group project on carbon solutions.
Same as: EARTHSYS 308, ENERGY 308, ESS 308, ME 308

ENVRES 299. Independent study. 1-5 Unit.
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Same as: ENVRES 199

ENVRES 300. Introduction to Resource, Energy and Environmental Economics. 3 Units.
Required core course restricted to first year E-IPER Ph.D. students. Examination of environmental, energy and natural resource management problems through the lens of economics, with an emphasis on hands-on practical problem-solving. Topics include market failure, cost-benefit analysis, finance, risk & uncertainty, non-market valuation, regulation, green accounting, rent, renewable resources, exhaustible resources, including energy, and biodiversity. Prerequisite: proficiency in multivariate calculus. Knowledge of basic microeconomics helpful but not essential.

ENVRES 315. Environmental Research Design Seminar. 1 Unit.
Required core course restricted to first year E-IPER Ph.D. students. Series of faculty presentations and student-led discussions on interdisciplinary research design as exemplars of the research design theories discussed in ENVRES 320. Designing Environmental Research. Topics parallel the ENVRES 320 syllabus. Corequisite: ENVRES 320.

ENVRES 320. Designing Environmental Research. 3-4 Units.
Required core course restricted to first year E-IPER Ph.D. students. Research design options for causal inference in environmentally related research. Major philosophies of knowledge and how they relate to research objectives and design choices. Identification of critical elements within a broad range of research designs. Evaluation of the types of research questions for which different designs are suited, emphasizing fit between objectives, design, methods, and argument. Development of individual research design proposals, including description and justification understandable to a non-specialist. Enrollment by permission number only. Contact instructor for enrollment in course.

ENVRES 320A. Interdisciplinary Environmental Research Epistemology. 1 Unit.
Required introductory core course to ENVRES 320 restricted to first year E-IPER Ph.D. students. Research design options for causal inference in environmentally related research. Major philosophies of knowledge and how they relate to research objectives and design choices. Identification of critical elements within a broad range of research designs. Evaluation of the types of research questions for which different designs are suited, emphasizing fit between objectives, design, methods, and argument. Development of individual research design proposals, including description and justification understandable to a non-specialist.

ENVRES 330. Research Approaches for Environmental Problem Solving. 3 Units.
Required core course restricted to first year E-IPER Ph.D. students. How to develop and implement interdisciplinary research in environment and resources. Assignments include development of research questions, a preliminary literature review, and a summer funding proposal. Course is structured on peer critique and student presentations of work in progress. Corequisite: ENVRES 398 with a faculty member chosen to explore a possible dissertation topic.

ENVRES 340. E-IPER PhD Writing Seminar. 1-2 Unit.
Required core course restricted to second-year E-IPER PhD students. Actively pursue one or more writing goals relevant to this stage in their graduate studies in a structured setting. Set specific writing goals, create and follow a plan for reaching these goals, and receive substantive feedback on their written products from their peers. Examples of writing products include, but are not limited to, the student's dissertation proposal, E-IPER Fields of Inquiry essay, a literature review, or a grant or fellowship application. By the end of the course, students are expected to have completed or have made substantial progress toward their writing goal.

ENVRES 341. Theoretical Underpinnings of Environmental Behavior: Exploration and reflection. 1-3 Unit.
Human behavior is studied in many fields and disciplines at a range of scales, from the micro to the macro, with some focusing on the individual as the core, while others take a more critical approach. Theories and approaches from each can be considered in context with implications for the environment, resources, and sustainability-related issues. Using interdisciplinary frames, students in this doctoral-level seminar will apply various perspectives and lenses to advance their own empirical work through intensive, focused writing sessions. The intention is to provide a supportive structure such that students may advance their own in-progress research and ongoing writing grounded in behavioral science and social-ecological systems theories.

ENVRES 380. Innovating Large Scale Sustainable Transformations/ Collaborating for the Future. 3-4 Units.
The capacity to innovate system-level transformations is a crucial leadership modality in the face of complex systemic challenges. This class gives students the mindsets, theoretical framework, and hands-on experience in shaping innovative interventions that bring about scaled and profound transformations in the face of complex multi-factorial challenges. Students are immersed in the System Acupuncture Methodology, which combines systems thinking, strategy, design thinking, behavioral sciences, resilience theory, diffusion theory, decision theory, and a theoretical framework around scaled multi-stakeholder interventions. Tools and theories introduced in class will be used to structure large-scale transformations that simultaneously create sustainability and resilience on environmental, societal, and economic fronts. This project-based team-based class challenges students to find solutions for complex real-world challenges. Class meets in the spring quarter on Fridays 9:30am-4:20pm, weeks 1-9. Lunch will be provided. Final presentations on Friday of week 9, 3-7:30pm. Consent of instructor required. To be considered, please apply on the d.school website.
Same as: SUST 230

ENVRES 391. Curricular Practical Training. 1-3 Unit.
Educational opportunities in research and development labs in industry. Qualified students engage in internship work and integrate that work into their academic program. Students register during the quarter they are employed and complete a research report outlining their work activity, problems investigated, results, and follow-on projects they expect to perform. Course may be repeated for credit.

ENVRES 398. Directed Reading in Environment and Resources. 1-10 Unit.
Under supervision of an E-IPER affiliated faculty member on a subject of mutual interest. Joint M.S. students must submit an Independent Study Agreement for approval. May be repeat for credit.

ENVRES 399. Directed Research in Environment and Resources. 1-15 Unit.
For advanced graduate students. Under supervision of an E-IPER affiliated faculty member. Joint M.S. students must submit an Independent Study Agreement for approval.

ENVRES 801. TGR Project. 0 Units.
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ENVRES 802. TGR Dissertation. 0 Units.
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