The extraction, harnessing, or mining of that natural resource and resource transportation come next. The use of that natural resource as a material follows. Of course, short term and long climatic instability may play roles. The human elements (US & IL) involved in the trading and development of the resource lead to both armed interstate conflicts and intrastate disputes. Cultural questions might include how the digital age impact resource control and trade, how global resource distribution impacts energy security and utilization, and how international resource competition impacts the climate. Ultimately, the class is led to an understanding about how scarcity has impacted cultures throughout human history (US & IL). The tentative plan is that each lecture period consists of two parts starting with a moderator (the lead faculty member throughout the entire semester) who summarizes the resource under discussion in a 10-15 minute introduction. Then, appropriate EMS faculty will offer detailed accounts of their particular expertise. This format requires two 75-minute classes per week (30 per semester). The moderator shall be responsible for grading the class including the discussion and written responses in a large classroom format (50+ students) taught in one lecture hall. Active learning shall include discussion sessions with a wireless response pad technology for in-class interaction between student and instructor.

International Cultures (IL)
United States Cultures (US)

EMSC 121: Minerals and Modern Society
3 Credits
Production and use of mineral resources in modern society with an emphasis on the interrelationships and their effect on the Earth system.

Bachelor of Arts: Natural Sciences
General Education: Natural Sciences (GN)

EMSC 150: Out of the Fiery Furnace
3 Credits
A history of materials, energy and man, with emphasis on their interrelationships. For nontechnical students.

Cross-listed with: STS 150
Bachelor of Arts: Humanities
Bachelor of Arts: Natural Sciences
International Cultures (IL)
General Education: Natural Sciences (GN)

EMSC 240N: Energy and Sustainability in Contemporary Culture
3 Credits/Maximum of 3
In this course students are guided through an engaging exploration and the critical evaluation of selected media (e.g., books, film) in contemporary culture on topics related to energy and sustainability. Three selections are used each term, typically two books and one film. Students consider the subject matter in light of humanistic values, where the science, ideas and history presented in the selected media are critically evaluated relative to the viability of our planet's ability to support life. Opening lessons cover the foundational science of energy and sustainability, with a global perspective and consideration of the human dimension. The science is presented without technical jargon or
advanced mathematics, to promote a genuine and sound understanding of these essential concepts for college-level students of all academic backgrounds. Learning units are devoted to each media selection, with all content, activities and assessments within the unit contributing to this concentrated focus. After completing this course, students will possess the foundational science knowledge necessary to evaluate contemporary topics related to energy and sustainability, from the perspective of universal humanity on a planet of finite resources. This knowledge prepares students to develop observations, questions and opinions on topics related to energy and sustainability and to self-express them, in both written and oral presentations, to others with different backgrounds and points of view. Students will have the foundational knowledge necessary to be skilled critical readers of energy and sustainability subject matter, knowing how to raise (and answer) questions related to scientific clarity and soundness and how to test assumptions and scope of arguments, especially as related to inclusion of humanistic values and planetary limits. This knowledge prepares students to be willing and able to avoid entrenched ideology-based positions on issues related to energy and sustainability and to develop, instead, a personal position based in science and data with a humanistic perspective. Students will gain the knowledge of credible resources and organizations for ongoing research related to energy and sustainability and be prepared to participate in public dialogue on some of the most challenging and complicated issues of our time, including activities such as letters to the editor, online commenting, political engagement, and public advocacy.

Bachelor of Arts: Humanities
Bachelor of Arts: Natural Sciences
General Education: Humanities (GH)
General Education: Natural Sciences (GN)
General Education - Integrative: Interdomain
GenEd Learning Objective: Effective Communication
GenEd Learning Objective: Crit and Analytical Think
GenEd Learning Objective: Soc Resp and Ethic Reason

EMSC 296: Independent Studies
1-18 Credits/Maximum of 18

Creative projects, including research and design, which are supervised on an individual basis and which fall outside the scope of formal courses.

EMSC 302: Orientation to Energy and Sustainability Policy
1 Credits

Orientation to goals of the Energy and Sustainability Policy program and resources available to help students succeed. EM SC 302 Orientation to Energy and Sustainability Policy (1) EM SC 302 provides an orientation to the goals of the Energy and Sustainability Policy (ESP) degree program, helping students to successfully prepare for the five program learning outcomes. The course is conducted as a group seminar, with topics that are designed to provide an initial understanding of program outcomes: energy industry knowledge, global perspective, analytical skills, communication skills, and sustainability ethics. Students are expected to actively participate in discussions and work hands-on with online tools in activities that will allow them to gain an understanding of what it means to successfully participate as an ESP student in different educational and course contexts. Students are evaluated based on active class participation, written assignments, and class presentations. This course is intended to be taken during the first semester after being admitted to the ESP program.

EMSC 420: Energy and Modern Society
3 Credits

Technology and economics of energy resources, production, and consumption; environmental factors, exhaustion, new technology.

Prerequisite: 3 credits in Sociology
Cross-listed with: SOC 420, STS 420
Bachelor of Arts: Social and Behavioral Sciences

EMSC 440: Science Diving
4 Credits

Advanced scuba diving skills applied to underwater research. EM SC 440 Science Diving (4) EM SC 440 is a four credit intermediate science diving course for students already holding a basic open water scuba diving certification from an internationally recognized certification agency (e.g. PADI, NAUI, CMAS, YMCA, SSI etc.). Scientific diving is concerned with the observation of underwater phenomena and the acquisition of scientific data. This course introduces students to advanced scuba diving skills following the standards established by the American Academy of Underwater Sciences (AAUS) – with a significant emphasis on diver safety. The course covers theoretical aspects of the physics of diving, dive physiology, and underwater environments. There is a strong emphasis on diver safety with theoretical and practical training in cardiopulmonary resuscitation, diving-related first aid, accident management and dive rescue. The course will cover advanced recreational diving techniques, including deep diving and enriched air (nitrox) diving. A significant component of the course will involve scuba diving accident analysis, the focus of the course textbook. The course will also include an introduction of advanced underwater sign language. The course will include classroom sessions, pool sessions, and open water dives focusing on underwater skills development for eventual application in research settings. Each government or university underwater research program certifies its own divers based on standards that, at a minimum, conform to those of the AAUS. Successful completion of the course will allow the student diver in training to enroll in EM SC 441, Advanced Science Diving. Successful completion of EM SC 441 will allow the student diver in training to apply for science diver certification from the Penn State Science Diving Program. Certification is also dependant on a medical examination and is at the discretion of the University Dive Safety Officer; it is not automatically offered on completion of the course. The course is usually offered once a year in the spring semester and will involve several day trips (usually at weekends) to various river, lake, and quarry locations within the state. There will be an additional fee charged to cover the costs of the open water dives and administrative charges for recreational dive certifications.

Prerequisite: basic open water SCUBA certification and approval of program

EMSC 441: Advanced Science Diving
4 Credits

Advanced scuba diving skills applied to underwater data collection and research. EM SC 441 Advanced Science Diving (4) EM SC 441 is a four credit advanced science diving course for students who have completed EM SC 440 (Science Diving), an equivalent course at a recognized AAUS member institution, or have been approved by the University Dive Safety Officer based on acceptable demonstration of practical and academic dive experience. Students must have a minimum of 20
logged dives beyond their basic open water certification dives by the start of the course. Scientific diving is concerned with the observation of underwater phenomena and the acquisition of scientific data. This course introduces students to some of the basic skills and techniques used in scientific diving, following the standards established by the American Academy of Underwater Sciences (AAUS) – with a significant emphasis on diver safety. The course covers theoretical aspects of science diving techniques. The course will focus on advanced techniques in underwater ecology, geology, paleontology and archaeology, leveraging expertise from PSU faculty in these disciplines. The course will include classroom sessions, pool sessions, and open water dives. The classroom and pool sessions and the open water dives will involve skills development and their application in research settings. Research will involve a variety of projects (e.g. fish surveys, lake sediment sampling for climate reconstruction, underwater mapping) – the exact nature of which will vary depending on the areas of expertise of the faculty and students involved. Each government or university underwater research program certifies its own divers based on standards that, at a minimum, conform to those of the AAUS. Successful completion of the course will allow the student diver in training to apply for science diver certification from the Penn State Science Diving Program. Certification is also dependant on a medical examination and is at the discretion of the University Dive Safety Officer; it is not automatically offered on completion of the course. The course is usually offered once a year in the fall semester and will involve several day trips (usually at weekends) to various river, lake, and quarry locations within the northeastern United States. There will be an additional fee charged to cover the costs of the open water dives and administrative charges for recreational dive certifications.

**Prerequisite:** successful completion of EM SC440 or waiver by University Dive Safety Officer based on acceptable demonstration of practical and academic dive experience

EMSC 470: Undergraduate Collaborative Research in Earth and Materials Sciences

1-6 Credits/Maximum of 6

Interdisciplinary research seminar involving students in the process of discovery, writing, and debate on issues of broad interest to Earth and Materials Sciences.

Writing Across the Curriculum

EMSC 494: Research Project Courses

1-12 Credits/Maximum of 12

Supervised student activities on research projects identified on an individual or small-group basis.

EMSC 494H: Research Project Courses

1-12 Credits/Maximum of 12

Supervised student activities on research projects identified on an individual or small-group basis.

Honors