Minor in Energy

Program Description

The discovery, production, and use of energy has had and continues to have profound and far-reaching social, economic, political, and environmental effects. As energy is one of Mines core statutory missions, several Mines departments have come together to offer the Energy Minor and Area of Special Interest (ASI). The 18-credit Energy Minor adds value to any Mines undergraduate degree program by addressing the scientific and technical aspects of energy production and use as well as giving students an understanding of the broader social impacts and how policy and politics affect energy production and consumption. The Energy Minor is intended to provide engineering students with a deeper understanding of the complex role energy plays by meeting the following learning objectives:

1. Students will gain a broad understanding of the scientific, engineering, environmental, economic, political, policy, and societal aspects of the production, delivery, and use of energy in the United States and around the world.
2. Students will develop depth and breadth in their scientific and engineering understanding of energy.
3. Students will be able to apply their knowledge of energy to societal problems requiring economic, scientific, policy, and technical analysis and innovation while working in a multidisciplinary environment and be able to communicate effectively and professionally the outcomes of their analyses in written and oral form.

Primary Contact

Minor Director: Dr. Kathleen Hancock
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Minimum 18 credits required:

Required Courses (3 credits)

EBGN330	ENERGY ECONOMICS	3.0

Policy Course: Select at least one of the following (minimum 3 credits)

HASS490	ENERGY AND SOCIETY	3.0
HASS491	ENERGY TRANSITION: POLITICS AND POLICY	3.0

Select the remaining electives from the following:

Note: The Director may approve other courses with significant energy-related content. Email the Director for approval; include a copy of the syllabus.

Social Sciences and Law		
EBGN310	ENVIRONMENTAL AND RESOURCE ECONOMICS	3.0
EBGN340	ENERGY AND ENVIRONMENTAL POLICY	3.0
HASS419	ENVIRONMENTAL COMMUNICATION	3.0
HASS464	HISTORY OF ENERGY AND THE ENVIRONMENT	3.0
PEGN430	ENVIRONMENTAL LAW AND SUSTAINABILITY	3.0
All Energy Sources		
EBGN430	ECONOMICS OF INTERNATIONAL ENERGY MARKETS	3.0
ENGY200	INTRODUCTION TO ENERGY	3.0
CBEN469	FUEL CELL SCIENCE AND TECHNOLOGY	3.0
or MTGN469	FUEL CELL SCIENCE AND TECHNOLOGY	
or MEGN469	FUEL CELL SCIENCE AND TECHNOLOGY	
or MTGN469	FUEL CELL SCIENCE AND TECHNOLOGY	
CBEN472	INTRODUCTION TO ENERGY TECHNOLOGIES	3.0
EENG389	FUNDAMENTALS OF ELECTRIC MACHINERY	4.0
ENGY497	SUMMER PROGRAMS	1-6
ENGY498	SPECIAL TOPICS	1-6
GEOL315	SEDIMENTOLOGY AND STRATIGRAPHY	3.0
Nuclear Energy		
ENGY340	NUCLEAR ENERGY	3.0
ENGY475	INTRODUCTION TO NUCLEAR ENGINEERING	3.0
NUGN506	NUCLEAR FUEL CYCLE	3.0
NUGN510	INTRODUCTION TO NUCLEAR REACTOR PHYSICS	3.0
Sustainable Energy		
ENGY320	INTRO TO RENEWABLE ENERGY	3.0
ENGY350	GEOTHERMAL ENERGY	3.0
CEEN493	SUSTAINABLE ENGINEERING DESIGN	3.0
CHGN311	INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY	3.0
EENG475	INTERCONNECTION OF RENEWABLE ENERGY	3.0
EENG589	DESIGN AND CONTROL OF WIND ENERGY SYSTEMS	3.0
PHGN419	PRINCIPLES OF SOLAR ENERGY SYSTEMS	3.0
Fossil Fuels		
PEGN201	PETROLEUM ENGINEERING FUNDAMENTALS	
ENGY310	INTRO TO FOSSIL ENERGY	3.0
CBEN480	NATURAL GAS HYDRATES	3.0
MNGN438	GEOSTATISTICS	3.0
PEGN251	FLUID MECHANICS	3.0
PEGN305	COMPUTATIONAL METHODS IN PETROLEUM ENGINEERING	2.0
PEGN308	RESERVOIR ROCK PROPERTIES	3.0
PEGN450	ENERGY ENGINEERING	3.0

ENGY200. INTRODUCTION TO ENERGY. 3.0 Semester Hrs.
Introduction to Energy. Survey of human-produced energy technologies including steam, hydro, fossil (petroleum, coal, and unconventionals), geothermal, wind, solar, biofuels, nuclear, and fuel cells. Current and possible future energy transmission and efficiency. Evaluation of different energy sources in terms of a feasibility matrix of technical, economic, environmental, and political aspects. 3 hours lecture; 3 semester hours.
Course Learning Outcomes

- Compare energy generation, conversion, storage, transmission, and use.
- Explain the historical, technical, economic, environmental, ethical, and political context of energy systems.
- Apply scientific, engineering, and economic principles to energy challenges.

- Evaluate energy systems and portfolios using systems, social, environmental, and policy perspectives.
- Use qualitative and quantitative methods to analyze real-world energy problems and communicate recommendations.

ENGY310. INTRO TO FOSSIL ENERGY. 3.0 Semester Hrs.
Students will learn about conventional coal, oil, and gas energy sources across the full course of exploitation, from their geologic origin, through discovery, extraction, processing, processing, marketing, and finally to their end-use in society. Students will be introduced to the key technical concepts of flow through rock, the geothermal temperature and pressure gradients, hydrostatics, and structural statics as needed to understand the key technical challenges of mining, drilling, and production. Students will then be introduced to unconventional (emerging) fossil-based resources, noting the key drivers and hurdles associated with their development. Students will learn to quantify the societal cost and benefits of each fossil resource across the full course of exploitation and in a final project will propose or evaluate a national or global fossil energy strategy, supporting their arguments with quantitative technical analysis. 3 hours lecture; 3 semester hours.
Course Learning Outcomes

- no change

ENGY320. INTRO TO RENEWABLE ENERGY. 3.0 Semester Hrs.
Survey of renewable sources of energy. The basic science behind renewable forms of energy production, technologies for renewable energy storage, distribution, and utilization, production of alternative fuels, intermittency, natural resource utilization, efficiency and cost analysis and environmental impact. 3 hours lecture; 3 semester hours.
Course Learning Outcomes

- 1. have a broad scientific and technical understanding of key sources of renewable energy.
- 2. have an understanding of technical, economic, environmental, and political issues that influence the production, delivery and utilization of the various sources of renewable energy
- 3. be able to apply their knowledge of renewable energy to societal issues and effectively communicate their analysis

ENGY340. NUCLEAR ENERGY. 3.0 Semester Hrs.
Survey of nuclear energy and the nuclear fuel cycle including the basic principles of nuclear fission and an introduction to basic nuclear reactor design and operation. Nuclear fuel, uranium resources, distribution, and fuel fabrication, conversion and breeding. Nuclear safety, nuclear waste, nuclear weapons and proliferation as well economic, environmental and political impacts of nuclear energy. 3 hours lecture; 3 semester hours.
Course Learning Outcomes

- no change

ENGY350. GEOTHERMAL ENERGY. 3.0 Semester Hrs.
Geothermal energy resources and their utilization, based on geoscience and engineering perspectives. Geoscience topics include world wide occurrences of resources and their classification, heat and mass transfer, geothermal reservoirs, hydrothermal geochemistry, exploration methods, and resource assessment. Engineering topics include thermodynamics of water, power cycles, electricity generation, drilling and well measurements, reservoir-surface engineering, and direct utilization. Economic and environmental considerations and case studies are also presented. 3 hours lecture; 3 semester hours.
Course Learning Outcomes

- Analyze the applicability of geothermal energy to a geologic area
- Calculate the heat transfer between different components.
- Recommend an exploitation strategy for a geothermal field that satisfies relevant technical, professional and societal constraints.
- Understand and demonstrate hydrothermal and EGS design and economics.

ENGY450. FUNDAMENTALS OF SOLAR ENERGY ENGINEERING. 3.0 Semester Hrs.
This course will go over the solar resource and components of solar irradiance; principles of photovoltaic devices; wafer-based and thin film photovoltaic modules; photovoltaic system design; photovoltaic electrical energy production and cost analysis of photovoltaic systems relative to fossil fuel alternatives; integration into conventional energy systems; introduction to concentrated photovoltaic systems, solar water heating, solar ventilation air preheating, and passive solar building design. Case studies include net zero residential and commercial buildings and utility-scale solar plants. Prerequisites: PHGN200 and MATH225.
Course Learning Outcomes

- Derive relations based on key concepts of physics (quantum and spectral concepts; boundary layer theory; energy balance; heat exchanger effectiveness) to design and analysis of solar energy systems.
- Understand the operating principle of key solar energy technologies.
- Understand the function of each component of a solar energy system and how components are assembled into systems.
- Practice handbook and computer methods to estimate solar system energy delivery.
- Understand the life-cycle economics and financing strategies for solar energy systems and practice cost-estimating.
- Understand the financing and contracting process by which solar energy systems are delivered.
- Instill awareness of the effects of a solar energy system on the larger utility system and on the environment.

Professors

Andrew Herring, Chemical and Biological Engineering

Mark Jensen, Chemistry

Jennifer Shafer, Chemistry

Kathryn Johnson, Electrical Engineering

Carolyn Koh, Chemical and Biological Engineering

Associate professors

Kathleen Hancock, Director, Humanities, Arts and Social Sciences

Timothy R. Ohno, Physics

Neal Sullivan, Mechanical Engineering

Teaching Professors

Linda Battalora, Petroleum Engineering

Joe Horan, Humanities, Arts and Social Sciences

Teaching Associate Professors

Mark Miller, Petroleum

Mark Orrs, EDS

John Persichetti, Engineering, Design and Society

Visiting Professor

Angeline Letourneau, Humanities, Arts and Social Sciences