

Energy, Climate, and the Environment

The increasingly visible impacts of climate change, pollution, and biodiversity loss are driven to a large degree by economic growth and the world's increasing demands for energy. Other developments, including the proliferation of microplastics and forever chemicals, also threaten planetary health. Solutions to these challenges will require reimagining technologies, economic incentives, political relations, and social constructs. Those solutions will be created through the development of new science and engineering designs, innovation in policies and markets for decarbonizing economies and preserving ecosystems, mitigation of climatic impacts on public health and the natural world, renewed attention to ethical principles, and consideration of alternative ways of negotiating relations between humanity and our planet.

The concentration on Energy, Climate, and the Environment (ENCE) is focused on such solutions. It prepares the next generation of leaders to address these complex and multifaceted problems in the private sector, government, civil society, the arts, and academia. Students will develop field expertise, with a deep grounding in the methods and tools of a specific area of specialization, while gaining literacy and collaborative capacity in other relevant fields. For example, leaders in the development of low-carbon technologies should understand markets, social impacts, and stakeholder concerns, and government and business leaders should understand the science and engineering of climate change and low-carbon technologies. The students will learn the value of and be well prepared for working effectively with experts outside their own field.

To reflect this philosophy, ENCE takes a truly cross-School and cross-Divisional approach, spanning the School of Engineering and Applied Sciences (SEAS) and the FAS Divisions of Arts & Humanities, Social Science, and Science, and drawing on expertise across Harvard's professional Schools. All students share a common core of coursework, fostering a community where peers learn with and from one another across disciplines. Students will begin and end their programs with a shared introductory course (ENCE 10) and a shared, team-based capstone class in their senior year (ENCE 100), while focusing the remainder of their program on one of four tracks that will provide field depth and will also incorporate a distribution requirement for students to take two courses from other tracks. Each track has a braided structure to ensure coherence, proper scaffolding, and disciplinary depth, and students follow one of the pre-approved braids listed under each track. Students can propose other braids that meet the same standards; however, alternative braids need approval by the faculty advisor.

The four tracks:

- ***Markets, Politics, and Societies (Social Sciences)***: This track provides rigorous social-science training in economics, political science, and sociology through the lenses of energy, climate, and environmental challenges. Students use quantitative and qualitative methods to understand the systemic forces – from global markets to local governance to community life – that shape climate mitigation, sustainability finance, and social adaptation. Pre-approved Braids have emphasis in: Making Markets, Sustainable Business, or Justice & Law.
- ***Nature, Ethics, and the Human Imagination (Arts & Humanities)***: This track provides students with core competencies in understanding and addressing environmental challenges from historical, ethical, literary, artistic, and other value-sensitive perspectives. The curriculum covers diverse positions on the foundational causes and ultimate costs of human-caused climate change, biodiversity loss, and marine degradation, discussions of why we should care, and exploration of individual roles in the quality of all lives on the planet. It includes innovative design

strategies, morally persuasive literary and art forms, values and practices of different cultures, and historical cases of environmental care. Pre-approved Braids have emphasis in: Historical Study, Religion and Ethics, or Art and Media.

- **Science and Engineering for Sustainable Solutions (Engineering and Applied Sciences):** This track prepares students to be future inventors and drivers of technical solutions to the world's converging problems of growing energy needs, climate change, and environmental pollution. The students will gain depth and expertise in sciences and engineering, with a focus on decarbonization and electrification of the energy, chemical manufacturing, and transport sectors, design of state-of-the-art computing systems optimized for both compute performance and environmental impacts, and mitigation of human impacts on natural environmental systems with outcomes ranging from climate to public health. Pre-approved Braids have emphasis in: Energy Systems, Sustainable Computing, or Climate and Environmental Systems and Modeling.
- **Climate and Biodiversity (Sciences):** This track focuses on the interface of Earth system science and biology. Climate governs how ecosystems function, and ecosystems influence how carbon, water, and energy move through the Earth system. Topics covered in this track include climate–ecosystem interactions and physical drivers of biodiversity change. Students develop the tools to analyze and address questions such as how climate change reshapes species distributions and ecosystem services, when and how nature-based strategies can contribute to climate mitigation, and how to evaluate tradeoffs among emissions goals, ecosystem integrity, and land use needs across coupled human–natural systems.

LEARNING OBJECTIVES

Graduates of the Energy, Climate, and the Environment program achieve the following objectives as part of their program completion, and they are trained to become solutions focused and informed leaders prepared to address real-world challenges in energy and climate.

- **Disciplinary Depth with Multidisciplinary Literacy & Collaborative Leadership:** The ability to operate effectively within "T-shaped" professional environments, leveraging deep expertise in a specific track while communicating and collaborating fluently with experts across science and engineering, the social sciences, and the arts and humanities to address systemic societal challenges.
- **Integrated Problem-Solving & Design Thinking:** The capacity to translate complex, large-scale energy and environmental challenges into tractable problems through an iterative design process that incorporates stakeholder needs, real-world boundary conditions, and iterative experimentation.
- **Technical & Disciplinary Mastery for their Track:** A rigorous command of the quantitative and qualitative foundations, methods, and tools specific to their chosen track; ranging from energy systems and climate science to economic policy analysis and historical critique.
- **Synthesis of Theory and Real-World Application:** The proficiency to apply academic frameworks to real-world scenarios through experiential learning and team-based capstones, resulting in viable solutions that account for technical, social, and cultural dimensions of energy-climate issues.

REQUIREMENTS

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Concentration Requirements: 12–15 courses (48–60 credits)

1. *Required courses, ENCE Common Core for all Tracks (2 courses):*
 - a. Foundation (1 course): ENCE 10
 - b. Senior Team Project (1 course): ENCE 100
2. *Track requirements:*

Students must fulfill the requirements for one ENCE Track

 - a. **Markets, Politics, and Societies (MPS) Track (11 courses required, 12 for Honors)**
 - i. Methods (3 courses)
 1. MATH 1a
 2. Empirical methods: Statistics and econometrics at the level of ECON 1123, GOV 50, or STAT 111.
 3. One other course chosen to expand the methodological toolkit
 - a. Qualitative methods: SOCIOL 1107, SOCIOL 1157
 - b. Computational methods
 - c. Game Theory
 - d. Advanced probability or statistics
 - ii. Social Science Core (6 courses)
 1. Disciplinary courses (2 courses), select 2 from:
 - a. Environmental and climate economics (example: ECON 1661)
 - b. Politics of the environment and climate change (example: GOV 1722)
 - c. Sociology of climate change (example: SOCIOL 1284)
 2. Social Science Electives (3 courses). Select 3 from (e.g.):
 - a. ECON 1346, ECON 1661, ECON 2688, ECON 2689, FS42h
 - b. ESPP 77, ESPP 78, ESPP 160
 - c. GOV 94EN, GOV 1722
 - d. HKS API-165
 - e. HIST 15E, HIST 187
 - f. SOC 1284, SOC 2278
 3. Junior Tutorial (1 course)
 - a. ENCE 98
 - iii. Track Distribution (2 courses)
 - a. Select 2 other ENCE courses from outside of the MPS track, chosen with advisor. May include relevant GENED courses (e.g., GENED 1094, GENED 1015)
 - iv. Track Honors (0-1 courses)
 - a. Senior Tutorial (two semesters): Thesis and two-semester tutorial are required for Honors (including GOV 99, ECON 99R, SOCIOL 99A/B)
 - v. Track Braids: With their advisor, student should select a coherent set of courses to match their interests in a Track Braid. Example Braids within the MPS Track may include: Making Markets, Sustainable Business, Justice & Law.
 - b. **Nature, Ethics, and the Human Imagination (NEHI) Track (10 courses, or 11 courses for Honors)**
 - c. **Science and Engineering for Sustainable Solutions (SESS) Track (13 courses)**
 - d. **Climate and Biodiversity (CB) Track (12 courses, 13 for Honors)**