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Creating a Graduate Program in Energy and Sustainability Engineering: Lessons Learned

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Abstract

While many individual lessons and even semester-long courses related to energy and sustainability are available, there are relatively few technical degree programs in this area, and no published best practices on establishing such a program. In this work, we report on the construction and enactment of a new master's degree program in Energy and Sustainability Engineering (MESE) housed within the Chemical and Biomolecular Engineering department at the University of Pennsylvania, a research-focused university in the United States. We describe the details of our program as a resource to assist leaders at peer institutions in the development of similar offerings. Second, we use autoethnographic methods to describe the process of creating the program, using its launch as a window into the activity systems governing university decision-making.

Key words: autoethnography, professional master's programs, curriculum development, energy and sustainability

Introduction

Climate change is widely acknowledged to be one of the defining engineering challenges of our time. While many individual lessons and even semester-long courses related to energy and sustainability are available, there are relatively few technical degree programs in this area, and no published best practices on establishing such a program.

In this work, we report on the construction and enactment of a new master's degree program in Energy and Sustainability Engineering (MESE, https://energy-sustainability.seas.upenn.edu/) housed within the Chemical and Biomolecular Engineering department at the University of Pennsylvania (Penn), a research-focused university in the United States. First, we summarize our preliminary research on existing technical undergraduate minors and majors, professional and PhD degree programs, and graduate certificates in the area of energy and sustainability at peer institutions. We also describe the curriculum of our newly-developed program. We offer this background information as a resource to assist leaders at peer institutions in the development of similar offerings.

Second, we use autoethnographic methods to describe the process of creating the program, from initial ideation to curriculum development to final program approval. Based on field notes from student focus groups, faculty committee meetings, department faculty meetings, and meetings with upper administration, we use the launch of this program as a window into the activity systems governing university decision-making. Different actors within these systems acted according to different goals. For example, even decisions about the name of the program prompted extensive discussion, with students preferring straightforward degree titles that they felt would most effectively communicate their skills to employers, while faculty and administrators advocated for more distinctive titles that they felt would stand out in a competitive academic landscape. Administrators, who were also faculty, balanced goals of student learning with goals of maximizing marketability, which in turn led to tensions with intra-university political concerns regarding domain overlap and potential perceived competition for prospective students. The timeline and presentation of this program was also significantly impacted by shifting political and funding landscapes, which led some administrators to argue for the removal of "sustainability" from the program title while also prompting an increased focus on the growing the master's student population as a means of ensuring financial viability.

This paper offers a roadmap for leaders working towards new degree program offerings in energy and sustainability and simultaneously uses the launch of the authors' new master's program as a lens into more generalizable student, faculty, and administrative activity systems that impact the pursuit of a broad range of organizational change initiatives.

Theoretical Framework

We use cultural historical activity theory (CHAT) [1], [2], [3] as the theoretical foundation for understanding the engineering ecosystem at the University of Pennsylvania, which we study through the perturbation of creating the new master's program at the center of this. First-generation CHAT [3] conceives of systems as consisting of a subject and their goals and motives, termed objects, which, along with artifacts, or tools, mediates their action. In this case, the subject is the

first author, and her object was to create new curriculum and programming in energy and sustainability. Second-generation CHAT [1] expands the system to include the broader community in which the subject operates, the division of labor among that community, and the rules, both explicit and implied, that govern their activity. Different aspects of the system, such as the objects of different actors (for example, faculty, department chairs, and deans), are not necessarily in alignment; these tensions lead to contradictions, the resolution of which lead to evolutions in the system. In this work, we explore the contradictions that arose through the proposal, planning, and launch of the new program.

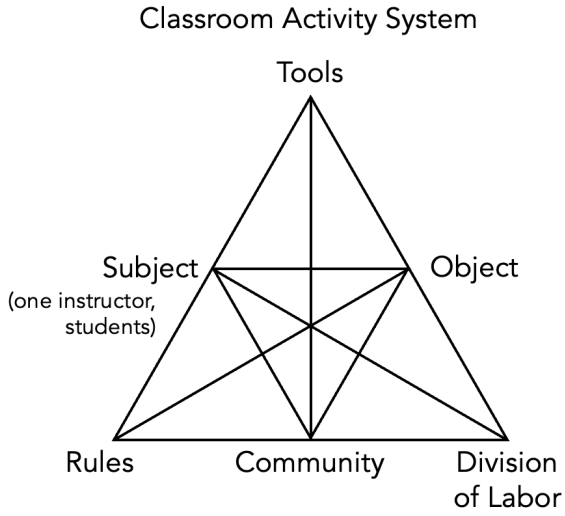


Figure 1. Second-generation cultural-historical activity theory (CHAT) [1]. Figure is adapted from [4].

Methods

This paper is part of a larger autoethnographic study [5] in which the first author characterizes the activity systems of the department, School of Engineering, and wider institutional context at the University of Pennsylvania through the lens of direct experience in the first years of a faculty position. As part of that study, she collected field notes in meetings and events within the regular course of her position and practiced periodic memo writing. These notes were coded according to the elements of a second-generation cultural-historical activity system (Figure 1), and themes are reported herein.

Because the aspect of the study reported here concerns only the experiences of the first author, the Institutional Review Board of the University of Pennsylvania determined that this work is not human subjects research and therefore did not need to undergo IRB review.

Positionality

The first author (hereafter writing in the first person) is a US-born white woman in a non-tenure track, teaching-focused role at a private research-focused institution in the United States. As a junior, contingent, new faculty member, I often found myself making program and teaching decisions based not only around my convictions about what would best serve students but also

around what would best preserve my job security in a tenuous academic funding environment. Exploration of those tensions is a key aspect of this work.

Results and Discussion

I was hired with the explicit mission of advancing curriculum and program in the energy and sustainability space within the Chemical Engineering department, and the broader School of Engineering, at the University of Pennsylvania.

Background Research on Existing Programs

As of the beginning of my appointment in fall 2024, the school had a minor in Energy and Sustainability that was poorly maintained (requiring at least one class that was no longer offered), enrolling five or fewer students per year. The Chemical and Biomolecular Engineering undergraduate major offered an optional concentration in Energy and the Environment. No graduate degree programs were offered. Several relevant graduate certificate programs existed, but none were technical or engineering-focused. While the school hoped to launch a new master's program, other options, such as establishing an undergraduate major, graduate certificate, or doctoral program, were also considered.

As such, the first stage of the project was to conduct a review of existing programs in this space at peer institutions. I assembled Table 1 during the summer prior to beginning my appointment (2024); for the sake of historical accuracy, it is presented here exactly as I presented it to department and school leaders at that time. I described it as follows:

"This is a starting point for learning what Penn's peer institutions are doing in this area. I began with the US News rankings of chemical engineering programs and added institutions that seemed relevant that were outside that list (e.g. several schools are outside the top 25 but have relevant offerings in energy and sustainability, and Boston University does not have a chemical engineering department, but does have a relevant master's program)... The below table [Table 1] is intended to help visualize what is available at different institutions. I have focused on energy and sustainability, excluding, for example, a major in environmental science and engineering, and have also focused on technical programs, excluding, for example, a humanities program in sustainability studies. Darker green indicates closeness to what I think we have in mind here at Penn, or potential for emulation. Grey indicates that I looked but did not find the offering."

The table was accompanied by 50 pages of descriptions of each program, including links to program webpages and curricula, where applicable. This detailed information has been included in Appendix 1.

It is important to emphasize that the color in the table does not indicate any form of assessment of the *quality* of the programs in question, but only the alignment with my perception of the target audience and subject focus that I perceived that Penn had in mind. For example, a world-class program that focused more on energy policy and less on technical engineering skills might not even have been included in the list due to its difference in focus. Additionally, there are several programs missing from the list: Duke University and Brown University have both relatively

recently launched programs in this field. The program at Brown had not yet been announced as of summer 2024, and the one at Duke was just beginning. The programs at Villanova [6] and the University of Michigan [7] have been described in previous ASEE papers, as have others from McGill University [8], St. Louis University [9], and Tennessee Technological University [10].

My notes from this phase describe feeling "icky" about searching schools based on their US News rankings. My personal convictions about how engineering education is assessed align with those of Riley [11], who argues that perceptions of rigor reproduce inequality and narrow our conceptions of knowledge. However, I was a new, contingent faculty member operating within a system heavily focused on competition between elite universities for prestige and for top students. This presented a contradiction between my own *Objects* of shifting the culture of higher education with the *Rules* of the system in which I found myself, along with the distribution of power within my *Community*.

Table 1. Compilation of energy and sustainability offerings found at peer institutions. Offerings are divided by category, including concentrations within the chemical engineering (or equivalent) undergraduate major, undergraduate minors, undergraduate majors, graduate non-degree minors or certificates, master's degree programs, and PhD programs. Colors indicate alignment with the target audience and goals of Penn Engineering: dark green indicates programs very similar in scope to our planned offering, lighter green and yellow indicate programs that existed but were less similar to our intended goals (for example, many were more policy-focused and less technical), and grey indicates that no program was found.

institution	Conc. in ChemE?	u.g. minor?	u.g. major?	grad cert?	master's?	PhD?
1. MIT						
2. CalTech						
2. Stanford					MS – Energy Sci. and Engr.	
2. Berkeley						
5. GA Tech						
6. Minnesota						
7. Princeton						
7. Delaware						
7. Michigan					MEng – Energy Systems Engr.	
7. Texas					MS – Sustainable Systems	
11. Wisc.					MEng – Sustainable Systems Engr.	
12. Illinois					MEng – Engr.: Energy Systems	
13. CMU					MS – Energy Sci., Tech., and Policy	
13. Cornell					MS – Enviro. Engr. (Sust. En. Syst.)	
13. UCSB						
16. NWestern					MS – Energy and Sustainability	
16. Purdue						
18. Colorado						
19. JHU					MS – Climate, En., & Enviro. Sust.	
19. Penn						
21. NC State						
21. TAMU					MS – Energy	

21. UCLA						
24. Rice						
24. Columbia					MS – Sustainability Science	
25. Ohio St						
25. Penn St					MS – Energy and Mineral Engr. MPS – Renewable En. & Sust. Syst.	
25. U. Wash.						
35. Yale					Joint MS + M Enviro. Sci.	
42. WUStL						
53. Lehigh					MEng – Chemical Energy Engr. MEng – Energy Systems Engr.	
112. Villanova					MS – Sustainable Engineering	
X. Boston U					MS – Energy & Environment	

Curriculum Decisions

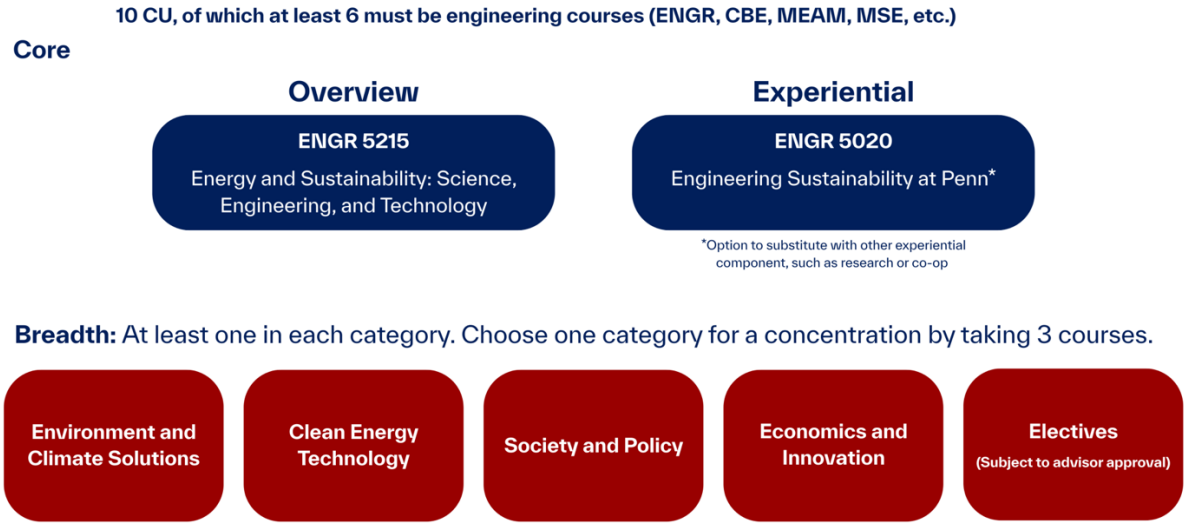
Based on the initial research presented above, school leadership determined that creating a new professional master's program in energy and sustainability would align with the best interests of the school. In particular, one motivating factor was the relatively small number of technical, engineering-focused engineering master's programs offered at peer institutions (dark green in Table 1). While there were even fewer such PhD programs, the school's analysis of tuition and budget models indicated that a master's program would be more impactful. Thus, in fall 2024, I began the process of designing the curriculum, drawing on the strengths of existing programs, including by speaking with the leaders of several such programs. Those conversations did not include informed consent for use in a study and thus are not described here.

Master of Science in Engineering degrees at the University of Pennsylvania have a standard requirement of 10 course units (CUs), where a typical one-semester course is credited as one CU. Courses credited at 0.5 CUs are offered, but are relatively rare; the vast majority of courses taken by engineering students are one-semester courses credited as one CU. The specifics of those courses, such as how many are specified and how many are electives, vary between programs. One challenge for the Energy and Sustainability Engineering program was that I was the sole faculty hire for its creation, which limited the curricular design possibilities compared to other institutions, such as Stanford University, which houses a School of Sustainability and therefore many faculty who can be deployed to teach program-specific courses. By necessity, our curriculum, depicted graphically in Figure 2a, was designed around existing courses, with new courses designed and introduced strategically.

I began teaching an introductory overview course in Energy and Sustainability (ENGR 5215), covering theoretical fundamentals and overviews of key technologies, such as the operating principles of power plants, solar panels, fuel cells, and so forth. This course was initially offered as an elective, with the intention that it would become the core introductory course for the new program. I also launched a project-based course (ENGR 5020), which would eventually become the capstone course for the program. The remainder of the curriculum was assembled from existing courses which were used to create four breadth categories: Environment and Climate Solutions, Clean Energy Technology, Society and Policy, and Economics and Innovation. Students must

select one breadth category as their concentration, taking three CUs in that category, and must take one CU in each of the other categories, for six total breadth CUs. Each breadth category contains at least 10 offerings; sample courses in each category are given in Figure 2b, and full lists can be found on the program's website: https://energy-sustainability.seas.upenn.edu/academics/course-lists/. The remaining two CUs are electives, which may be chosen from an extensive pre-approved list. Students may petition to add additional approved electives.

a.



b.

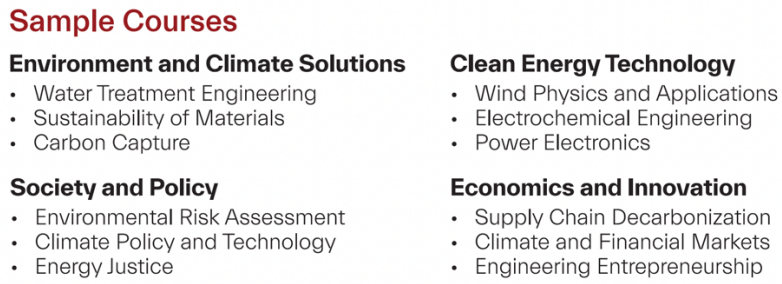


Figure 2. Graphic depicting the curriculum of the program (a) and sample courses in each breadth category (b).

During the time period during which the curriculum development took place, political shifts in the United States resulted in uncertainty among many leaders about the financial wisdom of emphasizing sustainability. A feasibility assessment by an external firm – required by the program approval process – described an "unfavorable landscape for program launch." One leader suggested removing the word "sustainability" from the program name, focusing on energy resources more broadly. In this case, I allowed my *Object* of advancing renewable energy education to supersede acquiescence to possible job security concerns and insisted on maintaining a focus on sustainability. This decision was reinforced through discussions with students, whom I perceived to be "galvanized by" and "indignant about" political headwinds facing sustainability education, according to my notes.

In spring 2025, the curriculum was reviewed and modified through focus groups with existing Penn students, staff, and faculty members, along with informal interviews with industry leaders.

In total, I consulted with 219 people: 71 Penn faculty, 40 Penn staff and administrators, 60 Penn undergraduate students, 24 Penn master's students in other programs, 11 faculty at other institutions, and 13 industry leaders. 105 meetings were 1-on-1, while the rest were in small groups; the distribution of consulted stakeholders and meeting types is depicted in Figure 3.

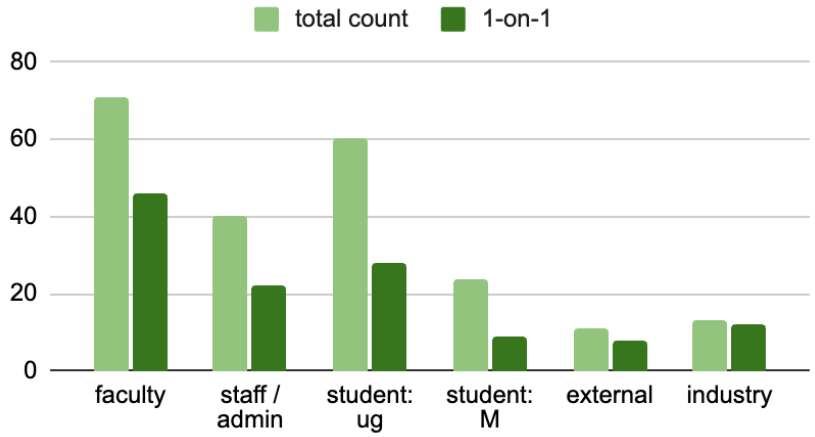


Figure 3. Total count of individuals consulted about the formation of the Energy and Sustainability Engineering master's program who were Penn faculty, Penn staff and administrators, Penn undergraduate students, Penn master's students in other programs, faculty at other institutions, and industry leaders, and count of those meetings that were 1-on-1.

Notably, most of this work was conducted in spring 2025, which was my second semester at the University of Pennsylvania, and my first teaching at my full contracted load. My notes from before, during, and after each of these meetings reflect a certain fear about my own lack of understanding of the *Rules* and *Division of Labor* within my system. In multiple cases, a faculty member suggested that I talk to another faculty member, the next line in my notes is a to-do list item to meet with that person, and I scheduled that meeting within the week. I did not yet have the institutional knowledge to understand which meetings were essential and so met with everyone who responded to my emails. This created a predictable draw on my time – multiple weeks in April and May of 2025 have 30 different meetings and events recorded in field notes – impeding my ability to pursue other aspects of my professional *Object*.

However, my notes also reflect strong *Community* among the faculty with whom I met. There are several other environment-related offerings at the University of Pennsylvania, including a Master of Environmental Studies program in the School of Arts and Sciences, which is less technical and designed for individuals with a wider variety of backgrounds and levels of experience, and a Master of Environmental Building Design in the Architecture program of the School of Design. My notes prior to such meetings reflect anxiety about being seen as encroaching on the academic "territory" of such programs, but this was seldom the case. Instead, faculty colleagues from across the university were enthusiastic about working together to enhance interdisciplinary opportunities for students in all programs, and I left those meetings with long lists of potential collaboration opportunities. In fact, as of spring 2026, a dual degree offering with the Environmental Building Design program is under development as a direct result of my initial conversations with program leadership.

Program Launch

As of June 2025, the new program had been approved by the School of Engineering and had advanced to university provost-level consideration. During these approval processes, I continued to meet with faculty stakeholders, and each step proceeded smoothly through school-level approval.

At that time, our intended timeline was to finalize approvals by the end of 2025, work on advertising and recruitment during the first half of 2026, and open for admissions in fall 2026, so that new students would begin in fall 2027. However, funding cuts to higher education in general, and especially to areas concerning sustainability, created a changing financial environment [12]. In June 2025, the program launch timeline was accelerated, with a goal of opening admissions in early fall 2025, so that new students could begin in fall 2026. While I had concerns about the feasibility of this timeline (my memos contain many exclamation points), I did not have the institutional power, given the *Rules* of my system, to change it.

Over the summer of 2025, my work split among two tracks. First, I met with staff who managed admissions, marketing, and recruitment to write the content for and build the program website, record promotional videos, and prepare admissions processes so that they could be launched quickly upon receipt of final university-level approvals. While those staff were excellent, this area was extremely time consuming for me. As the expert in the program, curriculum, and subject matter, it was necessary for me to lead the development of recruitment and promotional material, which made an effective *Division of Labor* challenging. Developing promotional materials, aside from traditional academic grants, is not a skill commonly developed in engineering faculty. In one example, I was asked to write a script for a one-minute video announcing the program launch. I suspect that for a marketing professional, such a task would be trivial, but my notes indicate that it took me several hours, and my memo at the end of that work session stated simply, “I have no idea what I’m doing.”

Second, I met with university-level administrators regarding receiving final approvals. They expressed that their primary concern was ensuring that different schools within the university were not in competition for students. Given my extensive and well-documented meetings with faculty across the university, I was surprised by this concern; administrators expressed that faculty input did not preclude a conflict, and that school deans needed to be consulted, since the concern had to do with tuition flows between schools (a *Rule*), which faculty leaders may not have considered. I thus reached out to the deans of relevant schools, who in turn consulted with the very faculty with whom I had already met, and proceeded to approve the program. Because of the busy schedules of those leaders, this process delayed the program’s approval by several months. Given the tight timeline, my notes from those meetings reflect frustration with what I perceived as delays caused by unnecessary administrative hurdles. In hindsight, I understand why the input of school leaders, not just program faculty leaders, was important, and the delay could have been prevented if I had known earlier in the process that I should consult them.

Final approval was received in mid-November of 2025, and the pre-prepared website, announcement video, and admissions site were launched. The school’s typical application deadline is February 1, but due to the delayed launch, an extended deadline of March 1 was approved.

Admitted students must accept their offers of admission by June 1. As of this writing, the first admissions cycle has not yet concluded, and future work will report on lessons learned from the admission, recruitment, orientation, and early experiences of the first cohort, which will begin in the fall semester of 2026.

Discussion and Conclusions

The professional master's program in Energy and Sustainability Engineering at the University of Pennsylvania was designed through extensive background research into existing programs and consultation with student, staff, and faculty stakeholders. We hope that others seeking to establish programs in this space may find this to be a useful resource in their work. In particular, based on the experience of creating this program, we suggest the following steps to others:

1. Faculty leaders should search for similar programs at peer institutions and analyze the strengths of their curricula along with the ways that they might not be compatible with your institution's unique context. Where possible, they should meet with leaders of those programs to learn from their experiences.
2. Faculty leaders should consult with faculty at their own institution to seek input on the program and document those meetings systematically. This documentation helped us to demonstrate cross-campus support when it came to university-level approval.
3. Faculty leaders should consult with students at their own institution, who can provide insight on student interest and curricular preferences.
4. Faculty and administrative leaders should learn about all steps of the approval process as early as possible. We experienced several delays that could have been prevented if we had known that later stages in the process would require consultation with specific leaders.
5. Administrators should not underestimate the faculty time required for developing promotional materials; even with excellent marketing teams, extensive faculty input is required. Where possible, course release or summer funding should be offered to faculty leaders tasked with that work.

Additionally, the process of perturbing the University of Pennsylvania activity system through the introduction of a new program provided insights into the *Rules*, *Tools, Community, Objects,* and *Division of Labor* within the system. My personal *Objects* often came into tension with those of school and university leaders, who, given the *Rules* governing the system, controlled the outcome of important processes, including program approval and my own employment. While faculty prioritized collaboration and interdisciplinarity, administrators expressed concerns about tuition flows, especially given conditions of financial exigency, which resulted in tensions between educational and economic *Objects*. Future work will further explore these contradictions, in particular through analysis of interviews with students, faculty, and administrators conducted throughout the development, approval, and launch process.

Acknowledgements
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References

[1] Y. Engeström, *Learning by expanding: An activity-theoretical approach to developmental research*. Helsinki: Orienta-Konsultit, 1987.

[2] A. N. Leontiev, *Problems of Psychic Development*. Moscow: Moscow St. Un. Publ., 1981.

[3] L. S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press, 1978.

[4] L. S. Grundy and M. Koretsky, "Contradicting Objects: An Activity Systems Perspective Towards Transformative Learning," in *2024 ASEE Annual Conference Proceedings*, Portland, Oregon: ASEE Conferences, 2024, p. 47075. doi: 10.18260/1-2--47075.

[5] M. Burawoy, "The Extended Case Method," *Sociological Theory*, vol. 16, no. 1, pp. 4–33, Mar. 1998, doi: 10.1111/0735-2751.00040.

[6] W. Lorenz, R. Lee, K. Schmidt, and P. Singh, "A Unique Sustainable Engineering Master's Program," in *2015 Spring ASEE Middle Atlantic Section Conference Proceedings*, Villanova University, Villanova, Pennsylvania: ASEE Conferences, Apr. 2015, p. 49835. doi: 10.18260/1-2-1153-49835.

[7] A. Lueking, D. Ross, and W. Weber, "Environmental Sustainability Education At The University Of Michigan: Collaboration With Industry To Provide Experiential Learning Opportunities," in *2003 Annual Conference Proceedings*, Nashville, Tennessee: ASEE Conferences, Jun. 2003, p. 8.528.1-8.528.5. doi: 10.18260/1-2--12090.

[8] S. Ghoshal, J. Nicell, and Y. Zhao, "Developing an interdisciplinary Master's program in sustainability in engineering and design," in *2025 ASEE Annual Conference & Exposition Proceedings*, Montreal, Quebec, Canada: ASEE Conferences, Jun. 2025, p. 56254. doi: 10.18260/1-2--56254.

[9] R. Gharabagi, H. Mallikarjuna, and D. Webb, "An Interdisciplinary Master's of Sustainability Program," in *2012 ASEE Annual Conference & Exposition Proceedings*, San Antonio, Texas: ASEE Conferences, Jun. 2012, p. 25.172.1-25.172.9. doi: 10.18260/1-2--20932.

[10] A. Elsawy, F. Vondra, and A. Kamal, "Development of Professional Science Master's Degree Program in Manufacturing Sustainability," in *2016 ASEE Annual Conference & Exposition Proceedings*, New Orleans, Louisiana: ASEE Conferences, Jun. 2016, p. 26826. doi: 10.18260/p.26826.

[11] D. Riley, "Rigor/Us: Building Boundaries and Disciplining Diversity with Standards of Merit," *Engineering Studies*, vol. 9, no. 3, pp. 249–265, Sep. 2017, doi: 10.1080/19378629.2017.1408631.

[12] Executive Office of the President, Office of Management and Budget, "Fiscal Year 2026 Discretionary Budget Request." The White House, Washington, D.C., USA, May 02, 2025. [Online]. Available: https://www.whitehouse.gov/wp-content/uploads/2025/05/Fiscal-Year-2026-Discretionary-Budget-Request.pdf

Appendix 1. Information on Existing Programs

This appendix contains details on the programs compiled in Table 1. As described in the description of Table 1, this information is presented as it was compiled in 2024, and therefore there are several programs missing from the list: Duke University and Brown University have both relatively recently launched programs in this field. The program at Brown had not yet been announced as of summer 2024, and the one at Duke was just beginning. We apologize for any errors or omissions.

1. MIT

Undergraduate Education

Concentration within ChemE
Course 10 does not have a concentration. Course 10-ENG is "flexible and incorporates many of the core components of the traditional chemical engineering program while providing concentrations in specific relevant areas in the field" – two of these concentrations are Energy and Environment and Sustainability. Both involve choosing four courses from a list of about 25.

Minor
Minor in Energy Studies
Four core classes:

- one of two options in Science Foundations, "Physics of Energy" or "Earth Science, Energy, and the Environment"
- one of two options in Economics Foundations, "Principles of Microeconomics" or "Economic Analysis for Business Decisions"
- one of five options in Social Science Foundations, e.g. "Energy Economics and Policy" or "Global Energy: Politics, Markets, and Policy"
- one of five options in Energy Technology/Engineering in Context, e.g. "Applications of Energy in Global Development"

24 units (typically two classes) of electives from a list of ~40 choices. Some are energy specific (e.g. "Fusion Energy") and some are not (e.g. "Transport Processes," the core required chemical engineering transport course).

Minor in Environment and Sustainability
Three core classes:

- "People and the Planet: Environmental Governance and Science"
- One of six options in "Context and Perspective" (e.g. "Environment and History", "Planetary Change and Human Health")
- One of five options in "Sustainable Solutions" (e.g. "Tools for Sustainable Design")

24 units (typically two classes) of electives from a list of ~80 options, most of which are non-technical.

Major
Bachelor of Science in Climate System Science and Engineering

Interdisciplinary between the Department of Civil and Environmental Engineering and the Department of Earth, Atmospheric and Planetary Sciences. Curriculum is not immediately available online.

Graduate Education

No formal Programs found, but the MIT Energy Initiative takes master's students as research assistants.

2-tie. Caltech

Undergraduate Education

Concentration within ChemE
Students are *required* to choose a "track" in Chemical Engineering. One option is the Sustainability Track, which requires:

- Two of ChE 111 (Sustainable Engineering), ESE 101 (Earth's Atmosphere), ESE 102 (Earth's Oceans), ESE 103 (Earth's Biogeochemical Cycles)
- One of ChE 128 (Chemical Engineering Design Lab), ChE 90 c (Undergraduate Thesis), Ge 114a (Mineralogy)
- Additional units of 100-level ESE / EST electives (unclear how many units)

Minor
Minor in Environmental Science and Engineering

- 27 units (3 courses) of ESE 1, ESE 101 (Earth's Atmosphere), ESE 102 (Earth's Oceans), ESE 103 (Earth's Biogeochemical Cycles)
- 27 additional units (3 courses) of ESE courses, including up to 18 units (2 courses) of research.

Major
Major in Environmental Science and Engineering is the closest.

Graduate Education

None found other than Ph.D. in Environmental Science and Engineering.

2-tie. Stanford

Undergraduate Education

Concentration within ChemE
None found.

Minor
Energy Science and Engineering Minor – program plan
Three required courses:

- Energy 101: Energy and the Environment
- Energy 120: Mass and Energy Transport in Porous Media
- Energy 160: Uncertainty Quantification in Data-Centric Simulations

Three electives from a list of eleven.

Major

Energy Science and Engineering – program plan

Core program requirements:

- Energy 101: Energy and the Environment
- Energy 104: Sustainable Energy for 9 Billion
- Energy 110: Engineering Economics
- Energy 120: Mass and Energy Transport in Porous Media
- Energy 160: Uncertainty Quantification in Data-Centric Simulations
- Energy 199: Senior Project and Seminar in Energy Science and Engineering

Other requirements: 3 calculus classes, 3 physics classes (Mechanics, Electricity and Magnetism, Light and Heat + lab), 4 "Cognate Engineering" classes (Solid Mechanics, Engineering Thermodynamics, Programming Methodology, Programming Abstractions)
"Energy and Earth Depth" classes, which are presumably electives, but it's unclear how many are required or what the choices are.

Energy Resources Engineering – I believe this is out of date, because links direct to information on the Energy Science and Engineering programs.

Atmosphere / Energy – requirements unclear. Program sheet here is very sparse, seemingly very flexible, but does require math and science (e.g. calculus, ODEs, physics, chemistry) two "engineering fundamentals" courses, CEE 63 "Weather and Storms", CEE 107 "Understanding Energy" and four courses from an "Atmosphere" group (options unclear) and four courses from an "Energy" group (options unclear).

Graduate Education

Engineering Master's

MS in Energy Science and Engineering

Housed in Doerr School of Sustainability, Energy Science and Engineering Department
Two options: 45-unit coursework degree, or research degree with 39 units of coursework, 6 units of research. Both require 3 units of Energy 351 seminar, which do not count towards the 45/39 unit minimums. Most courses seem to be 3 units, so a 45-unit coursework degree would be 15 courses (on quarters, so can be done in 1 year)

Requirements:

- ENERGY201A - Energy Systems Fundamentals
- ENERGY201B - Fundamentals of Energy Processes
- ENERGY201C - Energy storage and conversion systems: Solar Cells, Fuel Cells, Batteries
- ENERGY297 - Fluid Mechanics and Heat Transfer
- CME200 - Linear Algebra with Application to Engineering Computations

- ENERGY281 - Applied Mathematics in Sustainability
- ENERGY223 - Subsurface Flow Simulation
- Three courses from one of the theme options: Geothermal (4 choices), Low Carbon Energy (3 choices), Modeling Natural Resources (3 choices), Oil and Gas (7 choices), plus two more electives for 15 units total. Note that not all of these are very specific – for example, ME131 "Heat Transfer" is an option under geothermal, and ENERGY 251 "Thermodynamics of Equilibria" is an option under both low carbon energy and oil and gas.

Other Master's
MS in Atmosphere/Energy, housed in Civil & Environmental Engineering. Requirements are here. There are no required courses, but there is a minimum of 30 units, including 4 energy-core courses (of about 20 options) and 4 atmosphere-core courses (of about 20 options), plus 15 additional units to satisfy a 45 unit minimum.

MS in Environmental Engineering – requirements here.

Doctoral
Energy Science and Engineering PhD
Four courses of seminar, and 18 units (6 courses) from a list of about 25 courses. There are no courses specifically required, but "Students with an MS degree or other specialized training from outside ESE are generally expected to include":
- Energy 201A – Energy Systems Fundamentals
- Energy 201B – Fundamentals of Energy Processes
- Energy 201C – Energy Storage and Conversion Systems: Solar Cells, Fuel Cells, Batteries
- Energy 297 – Fluid Mechanics and Heat Transfer

And the candidacy exam covers material from the above four and also:
- CME 200 – Linear Algebra with Application to Engineering Computations
- Energy 281 – Applied Mathematics in Sustainability
- Energy 223 – Subsurface Flow Simulation

Energy Science and Engineering PhD Minor
20 units of graduate coursework in the department, including
- Energy 201A – Energy Systems Fundamentals
- Energy 201B – Fundamentals of Energy Processes
- Energy 201C – Energy Storage and Conversion Systems: Solar Cells, Fuel Cells, Batteries
- Energy 297 – Fluid Mechanics and Heat Transfer

With remaining courses chosen from a list of ten.

2-tie. UC Berkeley

Undergraduate Education

Concentration within ChemE
None found.

Minor
Energy Engineering
Housed within Engineering Science Program.
Requirements:

- MEC ENG 40: Thermodynamics
- EL ENG 137A: Introduction to Electric Power Systems
- One of ENE,RES C100 Energy and Society, CIV ENG 111 Environmental Engineering, CIV ENG C106 Air Pollution
- Two from a list of about 25

Energy and Resources
Housed within Energy and Resources Group
Requirements: "Energy and Society", "Quantitative Aspects of Global Environmental Problems", and three electives (five courses total).

Sustainability
Summer minor or certificate housed within Energy and Resources Group
Requirements: one core course (among four "Energy and Society" options or "Climate Change Economics") and four of seven electives.

Environmental Engineering
Housed within Civil and Environmental Engineering
Fluid Mechanics, Environmental Engineering, and three electives from about 10 choices.

Climate Science
Housed within Department of Earth and Planetary Science.
Requirements: one of EPS7 "Introduction to Climate Change", or EPS81 "Extreme Weather and Climate" and five upper division courses from a list of about 15.

Sustainable Design
Jointly offered by the Department of Architecture and the Department of Landscape Architecture and Environmental Planning.
Requirements: Introduction to Environmental Design, Drawing a Green Future, and Environmental Science for Sustainable Development, plus five courses from a list of about 100.

Conservation and Resource Studies
Within Department of Environmental Science, Policy, and Management

Environmental Economics and Policy

Housed within Department of Agricultural and Resource Economics.
Three economics courses, one quantitative methods, one natural resource analysis and policy.

Major
Energy Engineering
Housed within Engineering Science Program.
Requirements:

- Calculus, Chemistry, Thermodynamics
- Fluid Mechanics
- Design of Internet-of-Things
- Fundamentals of Photovoltaic Devices
- Energy and Society
- Undergraduate Research
- Heat Transfer
- Two of four courses in "Electric Power"
- One of five courses in "Sustainability"
- One of nine courses in "Economics"
- One of seven courses in "Math/Statistics/Analysis"
- Four engineering electives

Conservation and Resource Studies
Within Department of Environmental Science, Policy, and Management

Sustainable Environmental Design
In the College of Environmental Design
Requirements: six lower division courses (calculus, statistics, physics, economics, environmental science), nine upper division courses (planning for sustainability, urban design)

Society and Environment
Within Department of Environmental Science, Policy, and Management

Environmental Economics and Policy
Housed within Department of Agricultural and Resource Economics.
Three economics courses, one quantitative methods, five upper division electives.

Graduate Education

Engineering Master's
None found.

Other Master's
Energy and Resources MS / MA – curriculum here
40 units, including at least 18 in energy and resources. The masters degree series is:

- ENERES 201 – Interdisciplinary Analysis in Energy and Resources (3 units)
- ENERES 292B – Master's Research Skills and Project Development (2 units)
- ENERES 292C – Masters Project Development (2 units)

- ENERES 292D – Masters Project Presentation (2 units)
- ENERES 295 – ERG Colloquium (2 units) Two semesters are required to ensure exposure to a broad array of topics and approaches.

One course in interdisciplinary analysis (two options), plus four in other areas (environmental science, resource and environmental economics, social science approaches, engineering approaches, and humanities)

Public Policy & Energy and Resources MPP/MS

Doctoral
Energy and Resources PhD
Coursework portion overlaps with MS program described above.

5. Georgia Tech

Undergraduate Education

Concentration within ChemE
None found.

Minor
Energy Systems
15 total credit hours, not including prerequisites, which is typically 5 courses.
Requirements

- One economics prerequisite, in addition to standard physics and calculus
- Two courses (among 5) in energy systems – includes bioprocess engineering, biocatalysis, electrochemical engineering
- Two breadth courses (among 3) – Economics of International Energy Markets, Energy Policy, and the Science of Alternative Energy
- Project in Energy Systems

Sustainable Cities
Within College of Design

Sustainable Development and Construction

Major
None found.

Graduate Education

Engineering Master's
None found.

Other Master's
None found, other than MS in Environmental Engineering.

Doctoral
None found, other than PhD in Environmental Engineering.

6. University of Minnesota

Undergraduate Education

Concentration within ChemE
None found.

Minor
Sustainability Studies
Requirements:

- SUST 3003 – Sustainable People, Sustainable Planet
- SUST 4004 – Sustainable Communities
- Three electives, not more than one from each of four categories (Economics and Policy, Social Science and Humanities, Biophysical Sciences, Design and Technology)

Major
None, other than Environmental Sciences degrees.

Graduate Education

Engineering Master's
None found.

Other Master's
Science, Technology, and Environmental Policy MS
Within the School of Public Affairs – non-technical.

Doctoral
None found.

7-tie. Princeton

Undergraduate Education

Concentration within ChemE
Requirement to choose one of six area of concentration, including "Energy & Environmental Technology" – three electives come from this area, and two from other areas. The energy area has about 30 courses to choose from.

Minor
Certificate in Sustainable Energy
Note: this is being phased out, to be replaced by the below.

Requirements:

- One of three in “Introduction to Energy Technology”
- One of seven from “Introduction to Climate Change and Geo-environmental Science”
- Four electives, with at least one from a different subject area. Subject areas are “Energy Science and Technology” and “Environmental Science and Geoscience”

Minor Program in Sustainable Energy, Andlinger Center
Replacing the above certificate program beginning in 2026.
Requirements:

- MAE 228 – Energy Technologies in the 21st Century
- ENE 202 – Designing Sustainable Systems
- Any four of 100+ electives, no more than two of which can be double counted with requirements of the major or other certificates.
- Attendance at a total of four of the Andlinger Center’s monthly seminars, with a half-page reflection on each
- Independent research – either a separate research project or a substantial part of the (required for all students) senior thesis project.

Certificate in Environmental Studies

Major
None found.

Graduate Education

Science, Technology, and Environmental Policy (STEP) Certificate is available for graduate students in any program.

Engineering Master’s
None.

Other Master’s
None.

Doctoral
None.

7-tie. Delaware

Undergraduate Education

Concentration within ChemE
None found.

Minor
Sustainable Energy Technology

Five total courses, three from a list of about 25 technical courses, one of four policy courses, one of about 15 economics courses.

Environmental Sustainability
Requirements:

- CIEG 445 – Industrial Ecology
- CIEG 465 – Global Sustainable Engineering
- One of three courses in Pollution Control Technology
- Two of about 15 courses in Sustainability

Sustainable Infrastructure
Two core courses in sustainability, three electives.

Energy and Environmental Policy
All policy courses (non-technical).

Major
Energy and Environmental Policy
Some science requirements, but mostly non-technical.

Graduate Education
Certificate in Renewable Energy Engineering and Policy

Engineering Master's
None found.

Other Master's
Energy and Environmental Policy 4+1

Doctoral
None found.

7-tie. Michigan

Undergraduate Education

Concentration within ChemE
Energy Systems Engineering Concentration – 12 credits (4 courses)
Three technical electives from 10 choices, one policy/law course from 8 choices.

Sustainability "mini-minor" – 9 credits
One core course, one elective in engineering, one elective outside of engineering

Minor
Minor in the Environment, Sustainability, Energy, Food, or Water

18 credits, specifics depend on which area is chosen. Typically one introductory course, one practical / field experience course, one capstone course / design experience, and three distribution requirements.

Energy and Science Policy
15 credits – one introductory course from three options, four electives – areas are Energy Economics & Policy and Energy Production, Extraction, & Technology

Minor in Environmental Engineering

Major
Environmental Engineering

Graduate Education

Engineering Master's
Energy Systems Engineering MEng – curriculum
30 total credit hours (10 courses). Requirements:

- MECHENG 433: Advanced Energy Solutions
- CHE 696: Energy Generation and Storage Using Modern Materials
- ESENG 501: Seminars on Energy Systems, Technology, and Policy
- Two of five in "Program Core"
- One or two in "Immersive Practice"
- Three in "Career Pathways", including battery science and engineering, transportation power, etc

Other Master's
Environment and Sustainability MS
Several tracks, the most technical of which seems to be Sustainable Systems. It requires 42 credits, in several themes, including Mobility/Transportation Systems, Energy Systems, etc.

Doctoral
Environment and Sustainability PhD

7-tie. Texas – Austin

Undergraduate Education

Concentration within ChemE
Requirement of 12 semester hours (three courses) in each of two areas. Areas include Environmental Engineering (12 choices) and Energy Technologies (12 choices). Courses listed here.

Minor
Sustainable Energy Minor
Requirements:

- ES 369N: Sustainability Issues in Energy
- ME 363M: Energy Technology and Policy
- GEO 302C: Climate: Past, Present, and Future
- Three additional electives from a list of about 20.

Major
BA in Sustainability Studies
Largely non-technical

BS in Environmental Engineering

Graduate Education

Engineering Master's
Environmental and Water Resources Engineering, Sustainable Systems
Both within Civil, Architectural, and Environmental Engineering Department

Other Master's
Energy and Earth Resources
In Geosciences

Sustainable Design
In Architecture

Doctoral
None found.

11. Wisconsin – Madison

Undergraduate Education

Concentration within ChemE
None found.

Minor
Engineering for Energy Sustainability Certificate
Requirements:
- 6 credits in Liberal Studies and Science (e.g. Climate Change Economics and Policy, or Energy Economics)
- 6 credits in Engineering (e.g. Power Plant Technology)
- 3 additional credits, either a course or capstone
- 1-credit seminar

Sustainability
Requirements:
- 15 total credits

- At least two credits each in Environmental Dimension, Social Dimension, Economic Dimension, Systems Dimension
- Independent study or seminar

Engineering Thermal Energy Systems

Major
Environmental Engineering

Graduate Education
Sustainability certificate available for any graduate student
Energy Analysis and Policy certificate available for any graduate student
Energy Analysis and Policy doctoral minor

Engineering Master's
Sustainable Systems Engineering – online
- 9 credits in Science and Sustainability Courses
- 9 credits in Engineering and Design Courses
- 9 credits in elective courses
- Capstone

Other Master's
None found.

Doctoral
None found.

12. Illinois Urbana-Champaign

Undergraduate Education

Concentration within ChemE
None found.

Minor
Sustainability, Energy, and Environment Fellows Program Minor
Requirements:
- ENVS 301: Tools for Sustainability
- ENVS 492: Sustainability, Energy and Environment Capstone
- One of five courses in "Introduction to Sustainability"
- One of ~25 in "Economic/Policy/Social Dimensions"
- One of ~25 in "Environmental/Natural Systems"

Earth, Society, & Environment Minor
Requirements:
- ESE 200: Earth Systems

- Introductory course from the Earth's Physical Systems, Resources, and Hazards Area
- Introductory course from Environment and Human Response or Sustainability, Policy, and Global Change Area
- Three advanced courses

Major
Engineering Technology & Management for Agricultural Systems: Energy & the Environment
Agriculture-focused.

Sustainability in Food & Environmental Systems

Sustainable Design

Earth, Society, & Environmental Sustainability

Urban Studies & Planning: Sustainability

Graduate Education
Graduate Certificate in Energy & Sustainability Engineering available to all graduate students

Engineering Master's
Engineering: Energy Systems, MEng
Note: MEng "differs from the Master of Science degree in that it is a terminal degree and not a pathway to a doctoral program."
Total of 32 credit hours, where a given class is typically 3-4
Requirements:
- ENG 471: Seminar Energy & Sustain Engrg
- ENG 571: Theory Energy & Sustain Engrg
- ABE 436: Renewable Energy Systems
- NPRE 480: Energy and Security or NPRE 481: Writing on Technol & Security
- 16 units of electives
- Professional Practicum or Capstone Project (each is 4 units)

Other Master's
Sustainable Urban Design, Management

Doctoral
None found.

13-tie. Carnegie-Mellon

Undergraduate Education
Concentration within ChemE
None.

Minor

Minor in Environmental & Sustainability Studies
Housed in College of Engineering
Requirements:

- 66-69 total units (5-6 courses)
- Environmental Systems on a Changing Planet
- Introduction to Environmental Ideas
- Statistics and Data Science
- "Global Course"
- 36 units of electives

Major
Additional Major in Environmental & Sustainability Studies
Seemingly only available as a second major. Similar requirements to the minor with the addition of a Senior Capstone, more electives, a course in Earth and Environmental Science, and a course in Political Economy.

Graduate Education

Engineering Master's
Energy Science, Technology, and Policy MS
Options:

- EST&P (base) – 2 semesters
- EST&P Advanced Study – 3 semesters
- EST&P Applied Study – 2 semesters with a summer internship
- EST&P Applied Advanced Study – 3 semesters with a summer internship

Requirements:

- Energy Core: 6 units each (a full-semester course is typically 12) in Energy Conversion and Supply; Energy Transport and Storage; Energy Demand and Utilization; Energy Policy and Economics
- 36 units (3 courses) in an Engineering Concentration, e.g. Chemical Engineering; these courses are core graduate courses, e.g. Advanced Fluid Dynamics
- Breadth Electives, "most engineering graduate courses are acceptable" (36 units for base)
- Advanced Study program has three specialization choices:
    - Energy Projects concentration
    - Data Science concentration
    - Second Engineering concentration

Other Master's
MS in Sustainable Design

Doctoral
None found.

13-tie. Cornell

Undergraduate Education
Concentration within ChemE
Optional specializations, including Energy, Environmental Quality. Within Energy, one option is Energy Systems Modules, which are mini-courses.

Minor
Sustainable Energy Systems
Requirements:

- Six courses / minimum 18 credits, with at least 3 credits from each category. Categories:
    - Energy Systems Analysis
    - Energy Sources and Technologies for a Transition to Sustainability (two courses required)
    - Natural Systems Impacted by Energy Production and Use
    - Social Impact

Major
Environment & Sustainability
Collaboration between the College of Agriculture & Life Sciences and the College of Arts and Sciences

Graduate Education
Graduate Minor in Sustainable Energy Systems
Requirements:

- One foundational course in Sustainable Energy Systems
- Three credits (typically one course, or three mini-courses / modules) in Energy Sources and Technologies for a Transition to Sustainability
- Three credits related to environmental, policy, economic, and business consequences

Engineering Master's
Civil and Environmental Engineering MS with a Concentration in Environmental Engineering offers a Specialization in Sustainable Energy Systems (8 course choices)

Other Master's

Doctoral
None found.

13-tie. UC Santa Barbara

Undergraduate Education
Concentration within ChemE
None found.

Minor

Earth Science

Major
Environmental Studies BS

Earth Science - Climate and Environment Emphasis

Graduate Education

Engineering Master's
None found.

Other Master's
Environmental Science and Management - MES

Doctoral
Environmental Science and Management - PhD

16-tie. Northwestern

Undergraduate Education
Concentration within ChemE
Six areas of specialization available (optional), including "environmental engineering and sustainability" – requires 4 (of 5) electives be in the area. For environmental engineering and sustainability:

- CHEM ENG 365 Sustainability, Technology, and Society
- CHEM ENG 367 (Quantitative Methods in Life Cycle Analysis) OR CHEM ENG 345 (Process Optimization for Energy and Sustainability)
- CIV ENG 367 (Chemical Processes in Aquatic Systems) OR MAT SCI 381 (Energy Materials)
- CHEM ENG 361 (Introduction to Polymers) OR CHEM 393 (Green Chemistry)

Minor
Note: both "certificates" and "minors" are available. I'm not sure what the difference is.

Sustainability and Energy Certificate
In Institute for Sustainability and Energy
Requirements:

- Introduction to Sustainability
- Introduction to Energy Systems for the 21st Century
- Climate Change and Sustainability: Ethical Dimensions
- Four electives from an approved list (~50 options)

Environmental Engineering

Major

Environmental Engineering BS

Environmental Sciences

Graduate Education

Engineering Master's
None found.

Other Master's
Energy and Sustainability MS - curriculum
In Institute for Sustainability and Energy
10 months (3 quarters); curriculum is very constrained, mostly required courses
Fall Quarter:

- Fundamentals of Natural Resources Distribution
- Corporate Sustainability and Value Creation
- Energy and Sustainability Economics
- Finance Fundamentals for Energy and Sustainability OR Energy and Sustainability Market Foundations

Winter Quarter:

- History and Politics of Resource Innovation
- Resource Markets Design, Regulation, and Reform
- ESG, Reporting and Tools for Energy & Sustainability
- Strategy & Project Management Fundamentals (prep for Practicum)

Spring Quarter:

- Understanding Global Energy and Sustainability Markets
- Energy and Sustainability Project Practicum

Three specializations are available, each requiring 4 credits of electives. Options are Energy Technology, Sustainability, and Energy and Sustainable Finance.

Doctoral
None found.

16-tie. Purdue

Undergraduate Education
Concentration within ChemE
Optional 9 credit (3 classes) concentrations, one is in Energy and Environment

Minor
Sustainable Engineering
18 Credits (6 classes). Requirements:

- Engineering Environmental Sustainability
- Industrial Ecology and Life Cycle Analysis
- Natural Resource and Environmental Economics

- Global Green Politics
- One Public Policy elective (4 choices)
- One Technical elective (~20 choices, divided into categories: Sustainable Energy, Sustainable Design and Construction, Energy Utilization and Equipment, Agricultural/Environmental Sustainability, Energy Conversion and Storage)

Environmental and Ecological Engineering

Sustainable Environments
(College of Agriculture)

Major
Energy Engineering Technology, BS
Within Electrical Engineering Technology Program; very focused on power electronics, etc

Graduate Education

Engineering Master's
MS in Environmental and Ecological Engineering

Other Master's
None found.

Doctoral
PhD in Environmental and Ecological Engineering

18. Colorado – Boulder

Undergraduate Education
Concentration within ChemE
None found.

Minor
Energy Engineering
18 credit hours, including
- One fundamentals (e.g. Material and Energy Balances)
- One "energy policy / environment-based course" (options: Energy Policy and Society; Energy and the Environment; Sustainable Energy)
- Four elective courses from a list of 30+

Major
Environmental Design, Environmental Studies, Environmental Engineering

Graduate Education
Engineering Master's
MS in Environmental Engineering

Other Master's
MS in Environmental Studies

Doctoral
PhD in Environmental Studies

PhD in Environmental Engineering

19-tie. Johns Hopkins

Undergraduate Education
Concentration within ChemE
Specializations exist, but only in "Interfaces and Nanotechnology" and "Molecular and Cellular Biology"

Minor
Energy - requirements
Within Ralph O'Connor Sustainable Energy Institute
Requirements:

- Required course: Introduction to Renewable Energy Engineering
- One fundamental science / engineering class, either physics or thermodynamics
- Two classes from approved Science & Policy Context list (30+)
- Two classes from approved Technical Energy Electives list (30+)

Engineering for Sustainable Development
I could not find the exact curriculum, other than "We begin with a one-semester core course that surveys the various issues involved, followed by an individually-designed but coherent program organized around a particular theme, disciplinary approach or region of the world. We conclude with a one-semester seminar in which students come together and share their experiences and insights from their various program trajectories."

Major
Environmental Engineering

Graduate Education

Engineering Master's
Climate, Energy, and Environmental Sustainability, MS
Part time, online – ten courses that must be completed within five years.
Requirements:

- Principles of Environmental Engineering
- Four courses from a list of 15 in "Climate, Energy, and Environmental Sustainability" – technical but zoomed out, e.g. "Climate Change and Global Environmental Sustainability"
- Five electives

Environmental Engineering and Science, MS

Other Master's
Energy Policy and Climate, MS
Five core courses:

- Principles and Applications of Energy Technology
- Science of Climate Change and its Impact
- Research Design for Capstone Projects in Energy and Environmental Sciences
- Two of:
    - Climate Change Policy Analysis
    - Energy & Climate Finance
    - Introduction to Energy Law & Policy

Five electives

Sustainable Energy, MA (online)

Doctoral
None found.

19-tie. Penn

Undergraduate Education
Concentration within ChemE
Optional concentration in Energy and the Environment – choose 4 courses from 23 options.

Minor
Energy and Sustainability
Requirements:

- 1-2 courses in Fundamental Engineering (e.g. Thermodynamics)
- 1 course (1 option) in Energy and Sustainability Systems and Technologies
- 1 course (5 options) in Energy and Sustainability Policy, Regulation, and Societal Impact
- 2-3 Energy and Sustainability Electives

Sustainability and Environmental Management

Environmental Science

Environmental Studies

Major
Science, Technology and Society: Energy and Environment, BA
Housed in History and Sociology of Science

Business, Energy, Environment, and Sustainability, BS – Wharton

Environmental, Social, and Governance Factors for Business: Business, Energy, Environment and Sustainability, BS – Wharton

Earth and Environmental Science / Environmental Studies

Graduate Education
Energy Management & Policy, Certificate available for all graduate students through the Kleinman Center for Energy Policy at The Weitzman School of Design.

Engineering Master's
None.

Other Master's
Business, Energy, Environment and Sustainability, MBA

Doctoral
None.

21-tie. NC State

Undergraduate Education
Concentration within ChemE
Optional Concentration in Sustainable Engineering, Energy, and the Environment, seemingly requires "Principles of Green Chemistry" and two concentration electives from a list of 10.

Minor
Sustainable Materials and Technology
Requirements:

- Sustainable Materials for Green Housing
- Intro. To Industrial Ecology
- Environmental Life Cycle Analysis
- 2-3 electives from a list of 7

Renewable Energy Assessment
Five core courses, four of which are online.
There is a similar "certificate" which is identical except only 4 of the 5 courses are required.

Environmental Sciences

Environmental Technology and Management

Major
Sustainable Materials and Technology - requirements
In College of Natural Resources. Seems similar to environmental science but with a sustainability focus; very flexible curriculum.

Environmental Engineering

Environmental Technology and Management

Graduate Education
Certificate in Renewable Electric Energy Systems

Engineering Master's
MS Environmental Engineering

Other Master's
None found.

Doctoral
None found.

21-tie. Texas A&M

Undergraduate Education
Concentration within ChemE
The requirements mention "specialty options" but provide no more public information other than "see a chemical engineering advisor"

Minor
Analysis, Design and Management of Energy Conversion Systems
In Mechanical Engineering
Requirements:

- Fluid Mechanics
- Thermal-Fluids Analysis and
- Heat Transfer
- Two of: Internal Combustion Engines; Principles of Heating, Ventilating and Air Conditioning; Principles of Building Energy Analysis; Gas Dynamics

Climate Change - reqs
In Arts and Sciences
Requirements:

- ATMO 210 – Climate Change
- ATMO 444 – Science and Politics of Global Climate Change
- Three electives from a list of 8

Major
Environmental Engineering

Graduate Education

Engineering Master's

Energy, MS
Face-to-face or online, 10 months, with thesis and non-thesis options
Required "modules", each of which is 1.5 weeks long:

- Environmental Issues of Energy Systems
- Energy Systems Engineering I
- Energy Policy
- The Global Energy Future
- Economics of Energy
- Natural and Shale Gas Monetization
- Management of Energy Projects

Plus elective modules, the number of which depends on if the student is doing thesis or not (9 if yes, 16 if no)

Other Master's
None found.

Doctoral
None found.

21-tie. UCLA

Undergraduate Education
Concentration within ChemE
There are "options" – Biomolecular, Biomedical, Environmental, and Semiconductor Manufacturing. Seemingly they require two electives.

Minor
Environmental Engineering

Environmental Systems and Society

Major
Environmental Science BS

Graduate Education

Engineering Master's
None found.

Other Master's
None found.

Doctoral
Environment and Sustainability

Environmental Science and Engineering

24. Rice

Undergraduate Education
Concentration within ChemE
Optional Specializations, one option is "Energy/Sustainability". One core requirement (separations – which is not required in the core but is required for every specialization) and three electives chosen from a list of 20.

Minor
Energy and Water Sustainability - requirements
Within Civil and Environmental Engineering
Requirements:

- Engineering Economics and Project Management OR Environmental Economics
- Sustainable Design OR Intro to Environmental Law
- Energy and the Environment
- "Special Problems" Design Practicum (at least 1 credit – a typical class is 3)
- Three electives, with at most two from any category of Energy (4 choices), Water (4 choices), or Sustainability (11 choices)

Major
Environmental Science

Environmental Studies

Graduate Education

Engineering Master's
Environmental Engineering MS

Other Master's
Energy Geoscience

Environmental Analysis

Energy Economics

Doctoral
Environmental Engineering PhD

25-tie. Columbia

Undergraduate Education
Concentration within ChemE
Seemingly optional concentrations in four topics, including Climate, Environment, and Energy Solutions. Requires four courses from a list of 14.

Minor
Sustainable Engineering
Requires a total of six courses:

- Four from a list of ~15 that seem technical (e.g. hydrosystems engineering)
- One from a list that seems focused on economics / planning
- One from a list that seems focused on policy

Earth and Environmental Engineering

Major
Earth and Environmental Engineering

Climate System Science

Graduate Education
Engineering Master's
MS in Chemical Engineering offers concentrations:
Climate Solutions – four courses out of a list of 11
Electrochemical Energy – four courses out of a list of 10

MS in Earth and Environmental Engineering
Requirements difficult to locate.

Other Master's
MS in Sustainability Science
Requires a STEM undergraduate degree

- Integrative Courses in Sustainability: 3 courses
- Methods of Earth Observation and Measurement: 3 courses
- Analysis and Modeling Environmental Conditions and Impacts: 3 courses
- Scientific Tools for Responding to Sustainability Challenges: 2 courses
- Sustainability Policy and Management: 1 course

Doctoral
Ph.D. in Sustainable Development

25-tie. Ohio State

Undergraduate Education
Concentration within ChemE
The requirements mention an "environmental focus" but I can't find mention of this elsewhere as a concentration or something that would appear on a CV.

Minor
Environment, Economy, Development, and Sustainability
In School of Environment and Natural Resources

Environmental Engineering

Environmental Science

Major
Environment, Economy, Development and Sustainability
In School of Environment and Natural Resources

Graduate Education
Graduate Interdisciplinary Specialization (GIS) in Data-driven Sustainable Energy Systems available to any graduate student; seems like what others might call a certificate.
Requirements:

- Foundations of Data-Driven Sustainable Energy Systems
- Innovating for Sustainable Energy Systems
- Four electives "from five thematic areas related to sustainable energy systems: energy system modeling; information systems; energy policy, regulation, and economics; energy-business modeling; and energy technologies, components, and subsystems"

Engineering Master's
None found.

Other Master's
Environmental Science, MS

Environment and Natural Resources

Doctoral
Environmental Science

25-tie. Penn State

Undergraduate Education
Concentration within ChemE
None found.

Minor
Energy Engineering
In the College of Earth and Mineral Science.
Requirements

- Three courses of six options that seem fundamental (e.g. Principles of Energy Engineering; Heat and Mass Transfer)
- Three courses of eight options that seem like electives (e.g. Design of Solar Energy Conversion Systems)

Earth and Sustainability
In the College of Earth and Mineral Science.

Electrochemical Engineering
In the College of Earth and Mineral Science.

Environmental Engineering

Major
Energy Engineering BS
In the College of Earth and Mineral Science.
Requirements:

- Core in math, chemistry, programming, etc
- Engineering fundamentals – Heat and mass Transfer, Thermodynamics, Fluid Mechanics
- Electrical Circuits and Power Distribution
- Principles of Energy Engineering
- Energy Science and Engineering Lab
- Intro to Combustion
- Design of Solar Energy Conversion Systems
- Electrochemical Engineering Fundamentals
- Energy Conversion Processes
- Energy Design Processes
- Geo-resource Evaluation and Investment Analysis / Engineering Economy

Energy and Sustainability Policy BS

Earth Sciences BS

Earth Science and Policy BS

Graduate Education
Minor available in Energy and Mineral Engineering

Engineering Master's
Renewable Energy and Sustainability Systems MPS
Master of Professional Studies – 33 credits (11 courses)
Requirements:

- Core:
    - Ethical Dimensions of Renewable Energy and Sustainability Systems
    - Foundations in Sustainability Systems
    - Energy Markets, Policy, and Regulation
    - Renewable and Sustainable Energy Systems
- Electives (18 credits)
- "Culminating Experience" (3 credits) – either capstone course or scholarly paper

Energy and Mineral Engineering MS
Thesis-based option requires 30 credits + thesis, non thesis-based option requires 36 credits, including either non-thesis research or a capstone research course.

Requirements:

- Two of the following:
  - Design Under Uncertainty in Energy and Mineral Systems
  - Interfacial Physical-Chemical Systems
  - Mathematical Modeling of Energy and Mineral Systems
  - Thermodynamics of Energy and Mineral Systems
  - Safety, Health, and Environmental Risks in Energy and Mineral Production
- Optional disciplinary options, including energy systems engineering

Other Master's

Doctoral
Energy and Mineral Engineering PhD
Similar to the MS, except three of the five courses are required, plus dissertation research.

Climate Science PhD

25-tie. University of Washington

Undergraduate Education
Concentration within ChemE
Optional "focus areas" include "Energy Conversion" and "Environmental & Bioresource Engineering". Require one exploratory course (for Energy Conversion, it's "Energy & Environment") and 6 credits (2 classes) of electives; for Energy Conversion there are 7 options.

Minor
Sustainability
UW-Tacoma only
Requires 32-35 credits (one class typically seems to be 5).
Requirements:

- The Science of Environmental Sustainability
- Valuing Ecosystems Services and Natural Capital
- Introduction to Sustainability
- 15 more classes selected from "Policy, Society, and Economics", "Science, Environmental Issues, and Environmental Thought", and "Social Justice and Global Perspectives in Sustainability"
- Capstone project

Environmental Studies

Major
Environmental Engineering

Environmental Studies

Environmental Science and Terrestrial Resource Management

Graduate Education
Graduate Certificate in Clean Energy Science, Engineering, & Society available to all graduate students.
Requirements:

- 1-credit CEI Interdisciplinary Seminar Series for three quarters
- Advanced Topics in Clean Energy Science & Engineering (6 credits) – seemingly technical electives, and a 1 quarter class seems to be typically 3 credits.
- Broader Impacts Coursework (2 to 4 credits)
- Broader Impacts of Clean Energy Research Capstone (2 to 4 credits) – seems to be under development ("The course will be first offered in Winter or Spring 2024.")

Engineering Master's
MS in Civil Engineering (Energy Infrastructure)
2-3 years, part time, 100% online.
42 credits; 12 core (3 credits each), 6 focus-topic courses (1 credit each) (18 options)
Core:

- Geomatics in Energy Infrastructure
- Energy Infrastructure & the Environment
- Construction Procurement Systems
- Design & Construction Law
- Air Pollution & Occupational Safety & Health
- Accounting & Finance for Construction
- Project Field Assembly
- Operation of a Power Plant
- Statistical Fundamentals for Construction and Materials Application
- Building Energy and Resiliency
- Utility System Construction

MS in Civil Engineering (Sustainable Transportation)
3 years, part time, online
Requirements here.

Other Master's
None found.

Doctoral
None found.

35. Yale

Note: Yale's chemical engineering department is Chemical and Environmental Engineering, offering grad and undergrad degrees in Chemical Engineering and Environmental Engineering (separately).

Undergraduate Education

Concentration within ChemE
None found.

Minor
(Like Princeton, Yale has "certificates" instead of "minors")
Energy Studies
Listed under "Interdisciplinary and Specialized Programs", housed in the Department of Earth and Planetary Sciences
Requirements:
Two courses in each of three tracks:

- Energy Science & Technology
- Energy & Environment
- Energy & Society ("ENRG 300, Multidisciplinary Topics in World Energy" required)

Capstone seminar optional.

Major
Environmental Studies

Graduate Education

Engineering Master's
Joint Master's Degree Program
2.5 year program leads to the simultaneous award of two graduate professional degrees: either the Master of Environmental Management (M.E.M.) or the Master of Environmental Science (M.E.Sc.) from YSE, and a Master of Science (M.S.) from SEAS.
Requirements:

- 60 credits / 20 courses
- Internship / capstone over one summer
- ENAS 641 – Biological Processes in Environmental Engineering
- ENAS 642 – Environmental Physicochemical Processes
- ENAS 660 – Green Engineering and Sustainability
- ENV 773 – Air Pollution Control
- ENV 838 – Life-Cycle Assessment
- ENV 712 – Water Management or ENV 724 – Watershed Cycles and Processes (no longer offered, it seems)
- Additional Electives

Other Master's
Several within the School of the Environment (none energy)

Doctoral
None found.

42. Wash U. – St. Louis

Note: department is "Energy, Environmental & Chemical Engineering" with BS degrees offered in Chemical Engineering, Environmental Engineering, and Applied Science (Chemical Engineering).

Undergraduate Education

Concentration within ChemE

None found.

Minor

Energy Engineering

Requirements:

- Two fundamental courses, chosen from Thermodynamics; Fluid Mechanics; Heat Transfer; and Power, Energy, and Polyphase Circuits
- One "Social Science/Policy/Economics Elective" (six choices)
- Three electives (12 choices)

Major

BS in Environmental Engineering, BA in Environmental Analysis, BA in Earth, Environmental, and Planetary Sciences: Environmental Science

Graduate Education

Engineering Master's

MS in Energy, Environmental & Chemical Engineering

(MEng also available)

Coursework only, Research Project, and Thesis options.

Coursework only requirements (30 units = 10 classes):

- Transport Phenomena
- Mathematical Methods
- Three out of: Advanced Thermodynamics, Aerosol Science and Technology, Aquatic Chemistry, Kinetics, Bioprocess Engineering
- Electives with approval of advisor
- Seminar

Other Master's

None found.

Doctoral

PhD in Energy, Environmental & Chemical Engineering

53. Lehigh

Undergraduate Education

Concentration within ChemE

Optional to choose three courses for a concentration (which also satisfy elective requirements).

One option is Energy and Environment, which has eight course options

Minor
Energy Engineering
Info is here, scroll to bottom; housed in Mechanical Engineering.
Requirements:

- Thermodynamics
- Three of: Nuclear Reactor Engineering; Nuclear Fusion and Radiation Protection; Renewable Energy; Power Generation Technologies
- One elective out of 6 choices, with option to substitute other courses with approval.

Sustainable Development

Earth and Environmental Sciences

Environmental Studies

Major
Environmental Engineering, Earth and Environmental Sciences, Environmental Studies

Graduate Education
Engineering Master's
MEng in Chemical Energy Engineering - curriculum
31 credits
Requirements:

- 16 credit core:
    - Energy: Issues and Technology (3 credits)
    - Thermodynamics (3), Reaction Engineering (3), Transport Processes (4), Mathematics Methods in Chemical Engineering (3)
- Group A "electives" choose 2 from 2 options (Heterogeneous Catalysis and Surface Characterization; Electrochemical Engineering)
- Remainder from either ChemE (e.g. Separation Processes, Process Control) or Non-Departmental Elective Energy Courses (e.g. Nuclear Reactor Engineering)

MEng in Energy Systems Engineering - curriculum
30 credits (10 classes), over 10 months
Requirements:

- 18 credit core (note: the below do not add up to 18):
    - Energy Generation (3 credits)
    - Transmission and Distribution / Smart Grid (3)
    - Energy and the Environment (3)
    - Energy Systems Project Management (3)
    - ESE Seminars and Field Trips (6 credits)
- 6 credits: Energy Systems Engineering Project
- Electives. Curriculum says 6 credits but list says 4-5 classes, which seems incompatible.

Other Master's

Environmental Engineering - curriculum

Earth and Environmental Sciences

Doctoral
Environmental Engineering - handbook

Earth and Environmental Sciences

112. Villanova

Undergraduate Education
Concentration within ChemE
None found.

Minor
Sustainable Engineering
Open to engineering students only.
Requirements:

- SUSE 2110: Sus Eng: Risk & Opportunities
- SUSE 2111: Sus Eng: LCA & Circular Econ
- One Humanities elective (13 choices)
- One Policy elective (~20 choices)
- Two technology electives (40+ choices)

Sustainability Studies

Major
Environmental Science

Graduate Education
Engineering Master's
Sustainable Engineering MS - curriculum
Courses Only, Capstone, and Thesis Options
Requirements:

- Core:
    - SUSE 7110: Fundamentals – Sustainable Engr
    - SUSE 7111: Life Cycle/Impact Assessment
    - SUSE 7112: Econ/Social Equity Integrators
- 2+ electives (9 options)
- Three courses in a concentration:
    - Alternative and Renewable Energy
    - Sustainable Infrastructure and Built Environment
    - Sustainable Materials
    - Sustainable Systems
    - Water Resources Sustainability

Other Master's
Environmental Science

Doctoral
PhD in Sustainable Engineering

For those in other programs, a concentration in Sustainable Engineering (5 courses) is available.

X. Boston University

Note: no chemical engineering program.

Undergraduate Education

Concentration within ChemE
N/A

Minor
Sustainable Energy
Requirements:

- Core:
  - CAS EE 150 Sustainable Energy: Technology, Resources, Society, and Environment
  - ENG EK 225 Introduction to Energy Conversion and Environmental Engineering
  - QST SM 131 Business, Society, and Ethics
  - QST SM 132 Measuring Financial Value
- Practicum: Cleantech Venture Consulting Program
- One course in quantitative environmental modeling (5 choices)
- One elective (~20 choices)

Earth & Environmental Sciences

Environmental Analysis & Policy

Major
Earth & Environmental Sciences BA

Environmental Analysis & Policy BA

Graduate Education

Engineering Master's
None found.

Other Master's

Energy & Environment MS
Core:
CAS EE 516 Multivariate Analysis for Geographers* or CAS MA 614 Statistical Methods
CAS EE 519 Energy, Society, and the Environment
CAS EE 545 Methods of Environmental Policy Analysis
CAS EE 555 World Oil Markets
CAS EE 660 Food, Energy, and Water Policy or CAS EE 528 US Environmental Policy
CAS EE 712 Regional Energy Modeling
Two electives

Earth & Environment MA

Doctoral
Earth & Environment PhD