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BOARD # 52: Integrating Material Focused on Climate Change into Existing Courses in a Civil Engineering Degree Program

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Integrating Material Focused on Climate Change into Existing Courses in a Civil Engineering Degree Program

Abstract

Meaningfully addressing the climate crisis will require the transformation of civil infrastructure, including the development of utility-scale wind and solar farms to supply clean energy and the redesign of building stock, transportation systems, drinking and wastewater systems, and other infrastructure to reduce energy demand. Civil engineers, as the technical professionals tasked with the design and maintenance of such large-scale infrastructure projects, will be instrumental in the transition. However, the traditional civil engineering education does not include the discussion of how civil engineering expertise might be applied to confront climate change. In addition, traditional engineering education of all disciplines reflects broader societal values that have historically emphasized growth over sustainability and equity. This emphasis on limitless growth is what led to the climate crisis to begin with. Therefore, to prepare engineering students to be a part of the effort to address the climate crisis, civil engineering instructors need to develop curricula that will ensure students acquire the necessary knowledge and skills, as well as an understanding of the far-reaching impacts their work will have.

Many institutions of higher education have begun to prepare undergraduate students to serve as part of this workforce by developing sustainability-focused coursework, concentrations, minors, and in some cases, majors. Such curriculum initiatives, while necessary, take years to develop. Institutions that do not yet offer similar initiatives need strategies to develop them gradually. Engineering instructors can start this development process by designing sustainability-focused teaching material that can be easily integrated into existing courses. One source of guidance for the design of such teaching materials is the Engineering One Planet (EOP) framework, which builds upon ABET Student Learning Outcomes and the United Nations Sustainable Development Goals to provide a list of sustainability-focused learning outcomes for engineering students. The EOP learning outcomes emphasize both skills acquisition and the development of a broader understanding of the context of climate change.

This paper presents newly developed material that can be integrated into existing courses that are part of the civil engineering degree program at an undergraduate-focused engineering school. The material presented draws on the EOP framework and is designed for courses at the first-year, sophomore, and junior level. Student feedback to assess learning outcomes and student interest is presented. In addition, the authors discuss an ongoing effort to coordinate the development of climate change-related curriculum and undergraduate research opportunities across multiple degree programs within the school of engineering at the authors' institution.

1. Background

Meaningfully addressing the climate crisis will require the transformation of civil infrastructure, including the development of utility-scale wind and solar farms to supply clean energy and the redesign of building stock, transportation systems, drinking and wastewater systems, and other infrastructure to reduce energy demand. "Addressing the climate crisis" is inseparable from infrastructure spending. The Organisation for Economic Co-operation and Development (OECD) estimates that USD 6.9 trillion of global annual investment in infrastructure development will be necessary to be consistent with the United Nations Sustainable Development Goals.[1] In the United States, high-profile action on sustainability and climate change has come in the form of major infrastructure spending, through the Infrastructure Investment and Jobs Act of 2021[2] and the Inflation Reduction Act of 2022.[3] Civil engineers, as the technical professionals tasked with the design and maintenance of large-scale infrastructure projects, will be instrumental in the transition.

In addition to the technical expertise civil engineers can bring to bear on infrastructure development, civil engineers have a responsibility to ensure that development is sustainable. The American Society of Civil Engineers "recognizes the leadership role of engineers in sustainable development, and our responsibility to provide effective and innovative solutions in addressing the challenges of sustainability."[4] This professional responsibility starts with the undergraduate curriculum, for engineering students in general and civil engineering students specifically. The American Society of Engineering Education "believes that engineering graduates must be prepared by their education to use sustainable engineering techniques in the practice of their profession and to take leadership roles in facilitating sustainable development in their communities."[5] The Civil Engineering Body of Knowledge states: "Just as sustainability permeates the practice of civil engineering, its associated knowledge, skills, and attitudes must permeate the undergraduate experience."[6]

Of course, civil engineers will not do this work alone. Civil infrastructure projects have always required the collaboration of workers across a variety of technical and non-technical fields. The ability of civil engineers to understand their work in relation to entire systems is therefore essential. As articulated in ASCE Policy Statement 418: "Civil engineers have a leading role in planning, designing, building, and ensuring a sustainable future by providing the bridge between science and society. In this role, engineers must actively promote and participate in multidisciplinary teams with other professionals, such as ecologists, economists, and sociologists, and work with the communities served and affected to effectively address the issues and challenges of sustainable development."[4]

An interdisciplinary approach to civil engineering work will have to include serious consideration of environmental justice and energy equity. Green development is not inherently just, and historical harms can be perpetuated or repeated if the goals of engineering design are not interrogated and recalibrated. As Martin et al note in their call for the transformation of engineering education, "Achieving just and equitable solutions will require engineers to avoid narrowly-defined 'optimal' solutions that can cause disproportionate harm to individual communities."[7] Engineering is more than isolated optimization problems: civil engineers must "do the right projects" and understand that "everything that we do as engineers is in the political arena."[8]

This work presents the authors' first steps to develop new material, for incorporation into existing civil engineering courses, that will impart civil engineering students with skills, knowledge, and ways of thinking that are compatible with this expansive understanding of the importance of sustainability.

2. Existing Resources for Sustainability-focused Engineering Education

There are a variety of resources related to sustainability education for civil engineers. The authors found the following resources particularly instructive in creating the course content described in this paper.

2.1 Existing courses at other universities

To ensure future engineers are equipped to meet the challenges described above, faculty at many universities have begun to develop courses intended to address stated student concerns about climate change.[9] For instance, all undergraduates at Arizona State University[10] and University of California, San Diego[11] are required to take at least one course that is focused on sustainability and climate change. These courses can often be packaged as concentrations or minors: ASU offers a Bachelor of Science in Civil Engineering with a concentration in Sustainable Engineering[12] and UC San Diego offers a minor in Climate Change Studies.[13]

Examples of such courses are plentiful and provide a wealth of material that is helpful for contextualizing sustainability efforts. However, these courses are usually based outside engineering degree programs and satisfy distribution requirements rather than the requirements of the engineering curriculum itself. Coursework that is both focused on sustainability efforts and designed for engineers does exist, but in the authors' experience such coursework seems to be more commonly found at the graduate level. For example, Tufts University offers a master's of science in offshore wind engineering,[14] University of Massachusetts at Lowell offers a master's of science in energy engineering,[15] and Dartmouth offers a master's of engineering in energy engineering.[16]

2.2 Engineering for One Planet

The Engineering for One Planet (EOP) initiative aims to alter the undergraduate engineering curriculum itself. EOP is "an initiative to transform engineering education and equip all future engineers across all disciplines with the fundamental skills and principles of social and environmental sustainability."[17] EOP provides recommendations for educators looking to alter undergraduate engineering education to include sustainability. In particular, EOP provides learning objectives that can be incorporated into existing coursework. Using funding from the EOP Pilot Program, 80 faculty at 5 institutions developed or modified a total of 61 courses, using EOP Learning Outcomes. A total of 50 of these courses were required engineering courses.[18] See

Section 4.3 for further discussion of the learning outcomes and how the authors used them to assess the course content presented in the current work.

2.3 Civil Engineering Body of Knowledge

The Civil Engineering Body of Knowledge is a document, produced by a task committee of ASCE, that "defines the knowledge, skills, and attitudes necessary for entry into the practice of civil engineering at the professional level." In the third edition of the Civil Engineering Body of Knowledge (CEBOK3), sustainability is defined as "a set of economic, environmental and social conditions in which all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely without degrading the quantity, quality, or the availability of economic, environmental and social resources."

In CEBOK3, sustainability is listed as one of 21 learning outcomes considered essential for civil engineers. For these outcomes, CEBOK3 lists an expected level of achievement, abilities that demonstrate a student or engineer has reached that level of achievement, and the typical pathway for achievement, whether it is undergraduate education, postgraduate education, mentored experience, or self-developed. At the highest levels of achievement, civil engineers are expected to be able to "analyze the sustainable performance of complex civil engineering projects from a systems perspective" and to "integrate a commitment to sustainability principles into the practice of civil engineering." See Section 4.3 for further discussion of CEBOK3's guidance on sustainability and how the authors used it to assess the course content presented in the current work.

3. The Wentworth Institute of Technology

3.1 Background

The authors are faculty at the Wentworth Institute of Technology (WIT), which is an undergraduate-focused university with five schools (Sciences and Humanities, Architecture and Design, Computing and Data Sciences, Management, and Engineering) and an undergraduate enrollment of about 4,500 students. WIT offers 22 bachelor's degrees and 11 master's degrees. Faculty are primarily responsible for teaching: a full-time course load is 12 credits per semester for professors and 16 credits for lecturers. WIT is part of the Colleges of the Fenway (COF), which is a collaboration between five colleges in Boston's Fenway neighborhood. Students at the COF institutions have shared access to various amenities, like gyms and dining halls, and can register for classes and join student groups at any of the member institutions.

3.2 The civil engineering degree program at WIT

The civil engineering program at WIT is a four-year ABET-accredited bachelor's degree program. The curriculum is fairly traditional, with students typically completing their fundamental math and science courses, like chemistry, physics, and differential equations, in their first and second years of study. Students begin taking courses specific to the civil engineering program (CIVE), like statics and mechanics of materials and CAD, in their second year. In their third and fourth years, students take courses related to the various sub-disciplines of civil engineering, like structural analysis, environmental engineering, soil mechanics, and highway engineering. In their fourth year, students complete a two-semester capstone project.

WIT's cooperative education program, known as the co-op program, sets it apart from other schools. All students of all majors are required to complete two semester-long co-ops: one during the spring of their third year and one during the fall of their fourth year. The co-ops are full time and paid, and students do not take courses at WIT while they are on co-op. Third- and fourth-year students take full course loads in the summer to replace the semesters they are on co-op, so students graduate after the summer semester of their fourth year. The details of the civil engineering degree program are shown in Appendix B.

3.3 Current sustainability efforts at WIT

Currently, WIT has two main educational initiatives to address climate change: the Colleges of the Fenway (COF) Sustainability Minor and a recently launched bachelor of science degree in Climate Resilience, which is offered through the School of Social Sciences and Humanities.

COF Sustainability Minor—The COF offers a Sustainability Minor to students enrolled at any of the of five member colleges. To complete the minor, students must take a two-semester seminar called the COF Environment Forum and an additional four courses drawn from any two of the following three categories: policy and economics, social equity, or environmental science. The intent of the minor is to encourage students "to explore connections between their specific career-directed studies to issues of the natural world, finite resources, and social justice."[19]

Bachelor of Science in Climate Resilience—The Climate Resilience degree is an interdisciplinary program offered through the School of Social Sciences and Humanities. The degree program combines technical skills, communication, and a focus on the political, economic, and social dimensions of the climate crisis.[20] The coursework for the program is rooted in environmental science, geographic information systems, public policy, and urban studies. The program is intended to prepare students for careers in public administration, environmental science, environmental law, and related fields. The first cohort of students in the Climate Resilience program matriculated in the fall semester of 2024.

At this point, there is no institutional equivalent to the Climate Resilience degree to impart engineering students at WIT with a complementary set of skills and perspectives. Engineering students can enroll in the Sustainability Minor, and advisors frequently recommend that interested students do so, but additional coursework outside the degree program can be burdensome for students. Furthermore, relying on resources outside of a degree program like civil engineering reinforces the notion that explicit discussion of climate change and sustainability are somehow separate from the practice of civil engineering. To only direct students outside of the degree program rather than making an attempt to alter the degree program itself is a shirking of civil engineering responsibility to be a part of the effort to address the climate crisis.

4. Promoting Sustainability in the School of Engineering

4.1 Overview

Since the end of summer 2024, the authors have been trying to coordinate resources related to climate change and sustainability among the various engineering programs at WIT. "Resources" includes lab space, equipment, and teaching and research expertise. The current work was inspired by Voccio and Mansour's work at the 2024 ASEE Annual Conference, in which they presented an assessment of which courses in the mechanical engineering program could be most easily adapted to include more sustainability material.[21] The motivation for this work was to do a similar assessment for the civil engineering program, and to start to actually develop that teaching material.

The current work includes new material in the form of lesson plans that the authors have incorporated or will incorporate into the courses they teach in the civil engineering program. Also included are the syllabi for two new elective courses focused on sustainability and climate change.

4.2 Sustainability topics requiring civil engineering expertise

The authors are currently focused on assessing how the civil engineering curriculum might be altered (or how existing material might be emphasized) to prepare students for work in the following sectors:

- *Renewable Energy Infrastructure*: subtopics include onshore and offshore wind turbine farms, solar farms, hydropower plants, geothermal energy, bioenergy, hydrogen fuel cells, and salt-water electricity generation
- *Decarbonization of Buildings*: subtopics include improved efficiency of building enclosures, increased reuse of materials and design for deconstruction, and use of sustainable materials such as timber
- *Decarbonization of Transportation*: subtopics include the expansion of public transportation and the electrification of rail systems
- *Assessment of Environmental Impacts*: subtopics include air and water quality, ocean acidification, and coastal resilience

In Table 1, we show courses into which we are planning to incorporate sustainability content. All classes shown are required courses for the civil engineering degree program at WIT. An "X" indicates that the traditional content of the course in the column header lends itself most readily to applications related to the subtopic of sustainability in the row header. An "O" indicates that material for that course relevant to that subtopic is included in this syllabus. This chart was inspired by the one presented for mechanical engineering courses by Voccio and Zenouzi.[21]

The authors believe that "systems thinking," or in other words, a more interdisciplinary approach to engineering, can be incorporated into all courses. Therefore, Table 1 indicates courses and subtopics for which specific "sustainability skills" are introduced and taught. If the lesson includes a systems-thinking learning objective, that learning objective will be articulated in the lesson plan itself. (See Appendix A for examples.)

Sustainability Topic	Sustainability Subtopic	First Year		Sophomore		Junior					
		Physics	Chemistry I and II	Geomatics	Mechanics of Materials	Structural Analysis	Environ-mental Engineering	Fluid Mechanics	Soil Mechanics	Highway Engineering	Hydraulic Engineering
Renewable Energy Infrastructure	Wind energy	X				X		X			
	Solar farms		X	X			X				
	Hydropower	X						X			X
	Geothermal								X		
	Bioenergy		X				X				
	Hydrogen fuel cells		X, O				X				
Decarbonization of Buildings	Building enclosures				X						
	Mass timber design				X, O	X, O					
	Design for deconstruction				X	X, O					
	Material life cycle analysis				X		X, O				
Transportation Infrastructure	Railway infrastructure design			X						X	
	Network planning and operations									X	
Environmental Impact	Ocean Acidification		X, O								
	Air Quality						X				
	Water Quality						X				
	Coastal Resilience										X

Table 1. How sustainability topics are related to required courses in the undergraduate civil engineering degree program at WIT

Table 1 represents the authors' first attempt to break the overarching goal of "promoting sustainability in engineering education" into discrete tasks according to relevant topics and courses offered. Ultimately, all courses in a civil engineering program can and should include discussions of sustainability. The courses highlighted in Table 1 were the courses and subtopics that the authors had some familiarity with and could develop course content for quickly. The authors plan to develop a library of the course content produced for this list and to add other courses to this chart, as well as develop similar charts for other engineering degree programs.

4.3 Learning objectives

Both the EOP and the CEBOK3, introduced in Sections 2.2 and 2.3, outline a variety of learning outcomes for civil engineering students. For the EOP, all of the learning outcomes are related to sustainability. Additionally, "Systems Thinking" is central to all EOP learning outcomes: "EOP Framework contributors identified thinking from an environmental and social perspective as the most fundamental concept and approach that students must learn."

For the CEBOK3, sustainability is one of a total of 21 learning outcomes, among others like engineering mechanics and materials science. Sustainability as a learning outcome has both technical components—the development of certain skills, for instance—and an "affective" component. CEBOK3 states that the inclusion of this affective component represents the recognition of "the need for civil engineers to internalize and have a value system that supports practice at the professional level."

Both the EOP and the CEBOK draw on Bloom's taxonomy to define expected levels of achievement. For instance, in the EOP, student proficiency can be described as Low, Medium, or

High. Low proficiency is associated with verbs from the Bloom's Taxonomy such as "remember" and "understand;" Medium is associated with "apply" and "analyze" and High with "evaluate" and "create." CEBOK3 employs a similar framework.

The lesson plans in this work were not initially designed with the EOP and CEBOK3 learning objectives in mind; rather, EOP and CEBOK3 learning objectives and frameworks were used after the fact to assess the lesson plans, provide readers with a standard for comparison, and to develop a plan to develop these lesson plans. At this early stage, the authors think that the specific learning objectives for the lesson plans included in this paper could in general be grouped under the broad, beginner-level affective learning objective of "the ability to identify some concepts and principles of sustainability and acknowledge the importance of sustainability in civil engineering." The authors plan to make use of the EOP and CEBOK3 learning outcomes and proficiency levels as they continue their effort to make sustainability a more integral part of the WIT civil engineering curriculum.

4.4 Examples of Sustainability Course Material and Student Feedback for Spring 2025
Table 2 lists the course material included in Appendix A. In addition to course material for four courses that are required in the civil engineering program, the authors included course material for two experimental elective courses, designed by two of the authors and taught once.

Course Category	**Course Name**	**Year in Degree Program**	**Material Included**
Required Course	General Chemistry I (CHEM 1100)	First Year	2 lab experiments
	Statics and Mechanics of Materials II (CIVE 2500)	Sophomore	1 lab experiment and 1 discussion assignment
	Environmental Engineering (CIVE 3100)	Junior	1 in-class activity and 1 homework assignment
	Structural Analysis (CIVE 3200)	Junior	3 optional discussion assignments
Experimental Course	Introduction to Renewable Energy Technologies (CHEM 3800)	Junior	Course Syllabus
	Engineering the Renewable Energy Economy (CIVE 7800)	Graduate	Course Syllabus

Table 2. Sustainability teaching materials included in Appendix A

Introduction to Renewable Energy Technologies and Engineering the Renewable Energy Economy are courses offered as Chem 3800 and CIVE 7800, respectively. The X800 elective courses at WIT are offered on a one-time basis to allow for experimentation with new courses without having to wait for the full curriculum review process to be completed. If the courses are successful, X800 courses can be included as electives in a degree program. The authors included these elective courses to provide examples of courses that were built around sustainability, in contrast to sustainability material that is incorporated into existing courses with other areas of focus.

4.3 Examples of Sustainability Course Material and Student Feedback for Spring 2025
Below, we present synopses of the sustainability lesson plans introduced in Spring 2025 in two courses: CHEM 1100 (General Chemistry 1) and CIVE 2500 (Statics and Mechanics of Materials II). We also include student feedback for these lessons.

At WIT, the end-of-semester student course evaluations consist primarily of multiple-choice questions that ask students to rate how strongly they agree or disagree with various descriptions of the course. Instructors can also include custom questions of a variety of styles (multiple-choice, open response, etc.). To assess the effectiveness of the sustainability lessons developed for this paper, the instructors included custom questions in the course evaluations.

CHEM1100—CHEM 1100 is a course for first-year students. For Spring 2025, the instructors developed a lab experiment that made use of carbonated beverages to demonstrate the ideal gas law to students. The discussion questions asked students to explain the effect of CO_2 concentration on the pH of water and to reflect on the effect on ocean water of increased atmospheric concentration of CO_2. The learning objectives were for students to: 1) learn to use the ideal gas law to measure the amount of CO_2 dissolved in water, 2) observe how dissolved CO_2 affects the pH of water, and 3) learn to relate their experimental data to broader environmental issues, namely, ocean acidification in this case. See the full lab manual in Appendix A, as well as the lab manual for an additional chemistry lab.

The instructors for CHEM 1100 in the Spring 2025 semester included the following custom multiple-choice course evaluation question: "The gas law lab enhanced my understanding of how chemical processes related to human activity impact the environment and sustainability." The results are shown in Table 3. A total of 43 students were enrolled in three sections of CHEM 2500. A total of 34 students responded to the relevant course evaluation question.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total Responses
9	13	4	3	5	34
26.5%	38.2%	11.8%	8.8%	14.7%	100%

Table 3. Student feedback for Chemistry 1100 sustainability module for Spring 2025

Almost two-thirds (64.7%) of responding students agreed or strongly agreed that the gas law lab enhanced their understanding of how chemical processes related to human activity impact the environment and sustainability.

CIVE 2500—CIVE 2500 is a course for sophomore civil engineering students. For Spring 2025, the instructor developed two activities: a lab experiment and a discussion assignment. For the lab experiment, students had to complete compression testing of samples of steel, aluminum, and timber, calculate various material properties on the basis of their experimental results, and reflect on the differences those material properties might make in engineering design. For the discussion assignment, students were asked to watch a video and read two resources about embodied carbon and mass timber and to answer discussion questions about them, including to consider what it means for a material to be "sustainable." The learning objectives were for students to understand:

1) the relationship between axial and lateral strain for commonly used civil engineering materials, 2) the differences in the behavior of isotropic and orthotropic materials under loading, 3) the differences in the failure modes of isotropic and orthotropic materials, and 4) the idea that the promotion of sustainability can lead to differences in engineering analysis.

The instructor for CIVE 2500 in the Spring 2025 semester included open-response course evaluation questions to assess the effectiveness of the sustainability lesson plans. A total of 24 students were enrolled in two sections of CIVE 2500. A total of 23 students completed the course evaluations, but not all students answered all of the open-response questions pertaining to sustainability. The open-response questions are shown below, along with student responses that were thought to be typical or to provide particular insight. See Appendix C for the complete record of student responses for CIVE 2500, as well as the student responses to similar questions for CIVE 3200: Structural Analysis, taught in Fall 2025 by the instructor that taught CIVE 2500 in Spring 2025.

Q1: Do you think it is important for civil engineering students to learn about climate change, renewable energy, and sustainability? (22 respondents out of 23 survey respondents)

- "I do think it is important for civil engineering students to learn about these topics. It is one thing to understand how to make a structure, but making it last in an environmentally-friendly fashion is just as important. With climate change only taking more of a toll on the Earth, it is important as civil engineering students to prevent further damage from occurring."
- "I think it should be touched on but not focused on."

Q2: Do you have any interest in working in a field specifically related to renewable energy or sustainability after graduation? (20 respondents out of 23 survey respondents)

- "I don't have an interest in working specifically in a renewable energy field, but I would love to use sustainable practices in my line of work."
- "My interests align more with the structural aspects of civil engineering so unless it was integrated into my job then I most likely would not work in sustainability."
- "Not currently but that somewhat due to my lack of knowledge about jobs in that field."

Q3: Is it clear to you how a career as a civil engineer could be related to renewable energy or sustainability? (20 respondents out of 23 survey respondents)

- "Yes, a civil engineer has a significant impact [on] the environment whether or not they are aware of it. It should be an engineer's responsibility to be aware of their impact."
- "Yes and no. I can see how the two may intertwine but [I'm] not sure about specifics."

Q4: During the semester, you tested timber samples and completed a discussion post that asked you to consider the meaning of "sustainability." Do you feel that these assignments improved your understanding of what it means for civil engineers to consider "sustainability"? Why or why not? (17 respondents out of 23 survey respondents)

- "It was cool to become familiarized with materials in the sustainability space but it was only one assignment. I think more assignments would be needed to learn about sustainability. Also just learning about the environmental impact of conventional building methods would be helpful."

- "Yes, I think these assignments helped me understand what sustainability is. It guided me to go look up the definition and changes engineers make to design to improve sustainability and reduce environmental impact."

Q5: What could the WIT civil engineering program do differently to promote greater awareness of the opportunities for civil engineers to be involved in renewable energy and sustainability?
(17 respondents out of 23 survey respondents)

- "Seminars/info sessions could be a good idea. However, I believe the most effective way to get this information to civil students would be to adjust the engineering materials class structure to include more sustainability and information on climate change etc. A lot of the class material lines up with statics in the beginning of the semester. Maybe the time could be optimized to promote awareness." (CIVE 2400—Civil Engineering Materials and CIVE 2500—Statics and Mechanics of Materials II are both offered in the Spring semester and students usually take them at the same time.)
- "I think hands on in class projects on direct impacts of designing/building sustainable energy can be helpful for a lot of students. The projects would have to be engaging to multiple types of students and grab interest in different ways. I also [think] that writing essays on sustainable energy would have a directly negative effect and would make students unengaged and dislike the [concept]."

In response to Q1, almost all responding students said they think it is important for civil engineering students to learn about sustainability. Three said they thought it was important but should not be the focus of civil engineering education; one student said "Not really."

The responses to Q1 and Q2 considered together are interesting. The Q1 responses seem to indicate that there is widespread agreement among students that civil engineers should learn about sustainability, but the Q2 responses indicate that many students view sustainability as something that is separate from, rather than integral to, civil engineering.

The responses to Q5 about changes WIT could make to the curriculum provided a variety of ideas, ranging from new course material and elective courses to dedicated seminars and clubs. Multiple students suggested that sustainability material should be intertwined with existing course material. The authors agree that a variety of means should be employed to integrate sustainability into the civil engineering curriculum.

4.5 Difficulties
In starting this initiative, the authors encountered the typical difficulties related to curriculum development: shortage of time and the constraints represented by existing course catalog learning outcomes. The courses that are already part of the degree program presumably meet institutional requirements both internal (at the department or college level, for instance) and external (from organizations like ABET). Depending on one's lens of analysis, the extra effort to change a course that is already "good enough" is not a valuable use of time, especially when other job requirements and expectations are more pressing.

Furthermore, there is a burden to ensure and sometimes prove that new material is in fact relevant to the course and does not represent a dilution of the required course material. This obstacle is particularly salient when interdisciplinary material is considered. Finding a place for meaningful engagement with concepts like engineering ethics and environmental justice is difficult when courses are already filled with technical content. If there is no dedicated course for such interdisciplinary material, it is easy for it to be pushed to the side.

The authors have not encountered institutional opposition; rather, it is institutional inertia that represents the largest obstacle.

4.6 Future Work
After assessing the student feedback on the sustainability course material taught in Spring 2025, the authors have the following concrete goals:

1. Design more specific criteria to determine whether students are achieving the EOP- and CEBOK3-inspired beginner-level learning outcomes for the course material presented here
2. For each course in the civil engineering program, develop at least one lesson with a beginner-level learning outcome related to sustainability
3. Work on moving beginner-level learning outcomes in the course material presented here to the next highest level of achievement, using EOP and CEBOK3 as guides
4. Coordinate course material across related courses (for instance CIVE 2400—Civil Engineering Materials and CIVE 2500—Statics and Mechanics of Materials II

The authors also have more general goals for this endeavor. As a group, the authors are looking to continue developing a "library" of sustainability course material for the civil engineering degree program. The goal is for all courses to include some discussion of or activity related to sustainability. In addition, we hope that faculty begin to implement similar initiatives for other engineering degree programs at WIT using this strategy as a starting point. Greater faculty involvement across multiple engineering programs will inspire ideas for new course material and interdisciplinary collaboration. We might also consider developing a concentration or a minor, though as noted above, the motivation for this work was ensuring that sustainability became a core part of required courses for engineering degree programs, and a concentration or minor outside of the degree program is not in that same spirit.

We also would like to expand our collaboration beyond the School of Engineering. Faculty in the School of Social Sciences and Humanities who developed the Sustainability Minor and the Climate Resilience bachelor's degree surely have much insight to offer in terms of curriculum development, and their advice will be needed to create teaching materials that can properly contextualize technical engineering coursework.

Lastly, the authors would like to involve undergraduates in this initiative. At present, we see two main avenues for increased undergraduate involvement: undergraduate research projects and collaboration with and support for student groups. WIT offers a variety of opportunities for undergraduates to do research under faculty advisors, and there is at least one undergraduate student group, the WIT Green Team, co-advised by one of the authors, that is focused on campus sustainability efforts. Inviting undergraduate input through research and group project proposals will create more space for learning outside the classroom and take this initiative in new directions.

5. Conclusions

The goal of this work is to share teaching materials, and more broadly to share a strategy for changing a curriculum. There seems to be widespread agreement among engineering professionals and educators that curricula should be "more sustainable," but how exactly an educator or group of educators might actually embark on a path to achieving that is not always clear. The authors developed this strategy by doing it—we make the road by walking—and hope that the descriptions offered here give likeminded engineering educators some ideas for how to start the process of changing traditional programs to include sustainability, environmental justice, and other important but too-long neglected concepts and frameworks.

We also hope that the strategy we have started with is itself sustainable. Too often, new ideas are incorporated into a program only because a particular faculty member, staff member, or student champions them. Once that individual is gone, the material goes with them. By creating a library of materials, one lesson at a time, we can ensure that the inclusion of sustainability is not dependent on one person. Collaboration across different disciplines and schools and with undergraduates will also serve to make the initiative more robust: rather than spearheading a narrowly focused effort, we want to foster the growth of an ecosystem of faculty, staff, and students interested in sustainable engineering and all that it entails.

References

1. OECD. Infrastructure for a climate-resilient future. . 2024. https://doi.org/10.1787/a74a45b0-en.

2. The White House. Fact sheet: The bipartisan infrastructure deal. https://www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal/. Updated 2021.

3. The White House. BY THE NUMBERS: The inflation reduction act. https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/15/by-the-numbers-the-inflation-reduction-act/. Updated 2022.

4. American Society of Civil Engineers. Policy statement 418 - the role of the civil engineer in sustainable development. . 2023. https://www.asce.org/advocacy/policy-statements/ps418---the-role-of-the-civil-engineer-in-sustainable-development.

5. American Society for Engineering Education. ASEE statement on sustainable development education. . 1999. https://www.asee.org/about-us/who-we-are/Our-Vision-Mission-and-Goals/Statements/Sustainable-Development-Education.

6. ASCE: Civil Engineering Body of Knowledge 3 Task Committee. Civil engineering body of knowledge. . 2019. https://ascelibrary.org/doi/epdf/10.1061/9780784415221.

7. Martin MJ, Diem SJ, Karwat DM, et al. The climate is changing. engineering education needs to change as well. *J Eng Educ*. 2022;111(4). https://par.nsf.gov/servlets/purl/10444150.

8. American Society of Civil Engineers. ASCE's roadmap to sustainable development: Four priorities for change. https://www.asce.org/communities/institutes-and-technical-groups/sustainability/sustainability-roadmap.

9. Mowreader A. Tackling climate anxiety with student participation. *Inside Higher Ed*. 2024.

10. Mowreader A. ASU adds sustainability to gen ed curriculum. *Inside Higher Ed*. 2024. https://www.insidehighered.com/news/student-success/academic-life/2024/08/01/sustainability-course-major-requirement-asu.

11. Hook B. UC san diego launches new graduation requirement, bolstering climate change education. *UC San Diego Today*. 2024. https://today.ucsd.edu/story/uc-san-diego-launches-new-graduation-requirement-bolstering-climate-change-education.

12. Arizona State University, Ira A. Fulton Schools of Engineering. Civil engineering (sustainable engineering), BSE. https://degrees.apps.asu.edu/bachelors/major/ASU00/ESCEESUBSE/civil-engineering-sustainable-engineering?init=false&nopassive=true. Accessed Jan 15, 2025.

13. UC San Diego, Scripps Institution of Oceanography. Climate change studies minor. https://scripps.ucsd.edu/undergrad/curriculum/climate-change-studies-minor. Accessed Jan 15, 2025.

14. Tufts University, Department of Civil and Environmental Engineering. MS in offshore wind energy engineering. https://engineering.tufts.edu/cee/current-students/ms-and-fifth-year-masters-degree-program/ms-offshore-wind-energy-engineering. Accessed Dec 23, 2024.

15. UMass Lowell FCoE. Master of science in energy engineering. https://www.uml.edu/engineering/mechanical-industrial/programs-of-study/energy/programs/masters.aspx. Accessed Jan 15, 2025.

16. Dartmouth Engineering. MEng: Energy engineering. https://engineering.dartmouth.edu/graduate/meng/energy. Accessed Jan 15, 2025.

17. Engineering for one planet. https://engineeringforoneplanet.org/. Accessed Dec 24, 2024.

18. Engineering for One Planet. High-level takeaways from the engineering for one planet pilot program. . 2023. https://engineeringforoneplanet.org/wp-content/uploads/2023-EOP-Pilot-Grant-Program-Synopsis.pdf.

19. Wentworth Institute of Technology, School of Sciences and Humanities. COF sustainability minor. https://catalog.wit.edu/sciences-humanities/humanities-social-sciences/sustainability-minor/. Accessed Jan 15, 2025.

20. Wentworth Institute of Technology, School of Sciences and Humanities. Bachelor of science: Climate resilience. https://wit.edu/academics/sciences-humanities/degrees/undergraduate/climate-resilience. Accessed Jan 15, 2025.

21. Zenouzi M, Voccio JP. Board 98: Engineering education curriculum needs for achieving sustainable energy and decarbonize economy. *2024 ASEE Annual Conference & Exposition*. 2024.

Appendix A

First Year General Chemistry I (CHEM 1100) – 2 Lab Experiments

Renewable Energy/Sustainability Lesson Plan Template

1. **Title of Lesson**

   Performing the Water Splitting Reaction with Hydroelectric Power

2. **Target**

   This is intended as part of a laboratory for the General Chemistry II course.

3. **Learning Objectives**

   Students will:

   - Learn electrochemistry through the electrolysis of water.
   - Explore the principles and operation of an emerging sustainable energy technology.
   - Evaluate energy efficiency quantitatively given the experimental inputs and outputs

4. **Description**

   The goal of this lab is to teach students electrochemistry using the water splitting reaction. It directly relates to multiple topics in renewable energy technologies by using hydroelectric power to generate hydrogen gas through electrolysis.

5. **In-class Activity**

   To set up the lab a small hydroelectric generator is required. For example: https://www.amazon.com/Generator-Turbine-Hydroelectric-Portable-Charger/dp/B095P3P42V/ref=asc_df_B095P3P42V?mcid=1c30f403d88f3bc9b2c04fe611fa99f6&tag=hyprod-20&linkCode=df0&hvadid=693458464558&hvpos=&hvnetw=g&hvrand=8358140311345366136&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9001997&hvtargid=pla-1420727640372&psc=1

   - Fill a 600mL beaker with 400mL of 0.25M sodium bicarbonate solution.
   - Insert the wires from the hydroelectric generator into separate 10mL graduated cylinders. Secure the wires with waterproof tape.

- Fill the graduated cylinders with water and place the graduated cylinders into the beaker upside down, so as not to let any water out. The graduated cylinders should have minimal air in them.
- Secure a hose to the hydroelectric generator. Connect the hose to a tank of water. The tank should ideally store at least 2L of water.
- Allow water to flow through the hose and through the hydroelectric generator. This will electrolyze the water, creating hydrogen and oxygen gas bubbles at the wire tips. The gas bubbles will rise to the top of the inverted graduated cylinders.
- Continue the reaction until at least 2mL of hydrogen is produced. This may require the tank of water to be refilled for continued use.
- Students should record the volumes of hydrogen and oxygen produced (note that twice as much hydrogen should be produced), as well as the amount of water that flowed through the generator. The dimensions of the water tank are also needed to determine the amount of potential energy in the water tank. Alternatively, the kinetic energy of the water that flowed through the generator can be obtained by measuring the water's flow rate.

Important note: many hydroelectric generators will produce alternating current. Electrolysis of water requires direct current. If one uses an alternating current generator, this can easily be addressed by connecting the end of one of the generator's wires to a diode, such as an LED light.

6. **Homework Assignment (optional)**

Students are asked the following questions in their post lab assignment:

- The hydroelectric energy generator converted the energy of water into electrical energy. Calculate the energy gravitational potential energy that was in the water initially.
- Hydrogen is a promising form of energy storage, since the reaction of hydrogen and oxygen to form water is highly exothermic. How much energy is stored in the hydrogen you produced in this lab (i.e. how much energy could be released from the reaction of the hydrogen you produced with oxygen)?
- Calculate the energy conversion efficiency: The ratio of energy stored in the produced hydrogen to the initial energy input (from the water).
- What are some ways we might be able to improve the energy conversion efficiency of this lab?

7. **Assessment of Student Interest and Learning Outcomes**

The post-lab assignment will probe student understanding. Anonymous surveys will inquire about student enjoyment.

8. **Additional Resources**

None

Renewable Energy/Sustainability Lesson Plan Template

1. **Title of Lesson**

   Ideal gas law study with carbonated beverages

2. **Target**

   This is intended as part of a laboratory for the General Chemistry I course.

3. **Learning Objectives**

   Students will:

   - Learn to use the ideal gas law to measure the amount of CO_2 dissolved in water.
   - Observe how dissolved CO_2 affects the pH of water.
   - Learn to relate their experimental data to broader environmental issues (ocean acidification). In line with the Engineering for One Planet Framework's learning objective for environmental literacy.

4. **Description**

   The primary purpose of this lab is to teach students the ideal gas law. Students apply the ideal gas law to determine how much carbon dioxide is dissolved in carbonated beverages. Students also observe how dissolved carbon dioxide decreases the pH water. Effects of this are observed in the laboratory and the link to ocean acidification is established in the post-lab assignment.

5. **In-class Activity**

   We first set up a gas collection apparatus:

   - Fill a 1000 mL beaker with water to the 900 mL mark.
   - Fill a 100 mL graduated cylinder with water all the way to the rim. Quickly, invert the 100 mL graduated cylinder into the 1000 mL beaker, so the cylinder is upside-down in the beaker. Some water will be lost from the cylinder during the process. The air bubble trapped in the graduated cylinder should be 20 mL or less. If it is much more than that, try again.
   - Attach a hose to a U-shaped adaptor and place it in the beaker so the adaptor hooks into the inverted mouth of the graduated cylinder.
   - Record the initial volume of air in the graduated cylinder.
   - Connect the other side of the tube to a filter flask.

Running the experiment:

- Obtain about 100mL of seltzer water. Test and record the pH of the seltzer water with a pH meter, and add the seltzer water to the filter flask. Immediately cap the filter flask and start swirling gently to promote bubbling of the seltzer water.
- The bubbles are dissolved CO_2 in the seltzer water. Allow the seltzer water to bubble out CO_2 until it stops. The CO2 released should make its way out through the attached tubing and into the graduated cylinder. Record how much CO_2 was released and measure the final pH of the seltzer water.

6. **Homework Assignment (optional)**

Students are asked the following questions in their post lab assignment:

- How did the pH change as CO_2 was expelled from the seltzer water? Did it become more or less acidic? If I put a piece of metal in seltzer water, would it degrade faster in a closed container or an open container?
- If CO_2 levels in the atmosphere increase, what effect might this have on ocean water?

7. **Assessment of Student Interest and Learning Outcomes**

The post-lab assignment will probe student understanding. Anonymous surveys will inquire about student enjoyment.

8. **Additional Resources**

None

Sophomore Statics and Mechanics of Materials II (CIVE 2500) – 1 Lab Experiment and 1 Discussion Assignment

Title of Lesson: Compression Testing of Civil Engineering Materials

Description (Background)

Compression testing is a fundamental module in any mechanics of materials course. The point of this lab, as part of the civil engineering curriculum, is for students to gain an understanding of the behavior under loading of materials that are used commonly in civil engineering: steel, aluminum, and timber. (Note: the attached lab was altered to test only aluminum to ensure the metal tested would yield and to accommodate time constraints.) All three are used widely in civil engineering, although steel has been the primary material used for large scale structural applications, like commercial structures and high-rise residential structures. In recent years, the use of mass timber for such large-scale structural applications has been touted as a sustainable alternative to steel, the production of which represents a significant contribution to global carbon emissions. By including timber in the “classic” compression testing module, we are 1) introducing students to the current ongoing debate in industry and academia regarding how to define “sustainable” materials and 2) demonstrating to students that, because different materials have different mechanical properties, adoption of “sustainable” materials can lead to changes in engineering analysis.

Target: Sophomore civil engineering students

Placement in Syllabus: Students have already covered stress-strain relationship and Poisson’s ratio

Learning Objectives:

1. Understanding the relationship between axial and lateral strain for commonly used civil engineering materials
2. Understanding the differences in the behavior of isotropic and orthotropic materials under loading
3. Understanding the differences in the failure modes of isotropic and orthotropic materials
4. Understanding that the promotion of sustainability can lead to differences in engineering analysis

Included below are: A) discussion assignment related to the lab content and B) the lab manual itself.

A. Discussion Assignment

Background

Part of being an engineer is recognizing when it is most appropriate to use different engineering materials. Throughout the semester, we have been investigating the behaviors of different materials under different types of loading. We have primarily focused on the mechanical properties of these materials--for instance, calculating the modulus of elasticity using the results of compression tests. There are, of course, other considerations that might affect what materials are the best to use in a particular scenario.

At the start of the semester, we performed compression testing of steel, aluminum, and timber. My motivation for including timber is that timber is often listed as a material that is "sustainable." In this discussion, I want you to consider why some materials are considered sustainable while others are not.

Discussion Questions

Answer the following questions:

- What are common civil engineering materials?
- What might be your reasons for choosing them?
- What benefits might steel have over timber? Timber over steel?
- What does it mean for a material to be "sustainable"?

Reading

Watch the video linked below and read the following two articles. Explain whether they change your answers to the discussion questions.

Belinda Carr. (2023, May 16) Understanding the Basics of Mass Timber Construction. https://www.youtube.com/watch?v=4jtU9Jtc7IQ

Ove Arup and Partners Limited. (2023, June 5). Report on Embodied Carbon: Steel. Buildings and Infrastructure Priority Actions for Sustainability. https://www.istructe.org/IStructE/media/Public/Resources/ARUP-Embodied-carbon-steel_1.pdf

Robbins, J. (2019, April 31). As Mass Timber Takes Off, How Green Is This New Building Material? Yale Environment 360. https://e360.yale.edu/features/as-mass-timber-takes-off-how-green-is-this-new-building-material

B. Lab Manual

Title: Compression Testing of Civil Engineering Materials

Description: In this lab, we will perform compression tests of samples of aluminum and timber.

Learning Objectives:

1. Understanding the relationship between axial and lateral strain for commonly used civil engineering materials
2. Understanding the differences in the behavior of isotropic and orthotropic materials under loading
3. Understanding the differences in the failure modes of isotropic and orthotropic materials
4. Understanding that the promotion of sustainability can lead to differences in engineering analysis

Apparatus:

Instron Universal Material Testing System, and Vernier Software.

Materials

Each group should have the following:

- 1 aluminum sample [6061 aluminum, machined to cylinders 3/8 in. diameter by 1/2 in. length]
- 3 timber samples [pine, cut into 1 in. cubes such that each face is perpendicular to one of the three principal axes of wood with respect to grain direction and growth rings]

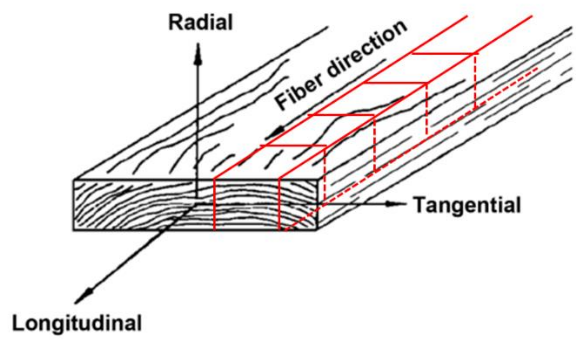

Figure 1. Copied from US Department of Agriculture Wood Handbook (2021), Figure 5-1: Three principal axes of wood with respect to grain direction and growth rings. Red cut lines (not to scale) added by authors of the current work.

Procedure:

1. Measure and record the original dimensions of all specimens. Use the table provided.

2. Put the **aluminum** specimen in the center of the bottom compression disk. Use the Jog Down along with fine adjustments to lower the top compression disk until it almost touches the top of specimen. Use the program “MECH2500-com-2000lb” to run the first test. When it stops, use the Jog Up to raise the top compression disk until you can easily remove the specimen for inspection.

3. Inspect the aluminum specimen and comment on any changes it has undergone.

4. Replace the specimen and repeat step 2 with the program “MECH2500-com-10,000lb.”

5. When the test (“MECH2500-com-10,000lb”) of the aluminum is complete, remove the deformed specimen, measure and record its deformed dimensions, and take a picture of the plot of force-deformation.

6. Put the first **timber** specimen in the center of the bottom compression disk. Orient the timber specimen so that it will be loaded in the longitudinal direction (Figure 1). Use the Jog Down along with fine adjustments to lower the top compression disk until it almost touches the top of specimen. Use the program “MECH2500-com-2000lb.” Start the test and allow it to run until completion. Remove the deformed specimen and measure and record its deformed dimensions. Do NOT close the program.

7. Repeat step 6 for the second timber specimen. Orient the timber specimen so that it will be loaded in the radial direction. Start the test and allow it to run until completion or until the loading no longer increases. Remove the deformed specimen and measure and record its deformed dimensions.

8. Repeat step 6 for the third timber specimen. Orient the timber specimen so that it will be loaded in the tangential direction. Remove the deformed specimen and measure and record its deformed dimensions. Take a picture of the plot of force-deformation, which should include a line for each of the three timber specimens.

Results and Discussion

1. For each of the force-deformation plots you collected, label the following values on the graph:
    a. Proportional limit
    b. Force at yielding
    c. Linear elastic and plastic zones
    d. Maximum force sustained

2. Use the original dimensions of the undeformed specimen to calculate the modulus of elasticity, the yield stress, and the ultimate stress on each specimen. Make a new table to display your results.

3. Use the original dimensions of the undeformed specimens to calculate the axial strain, lateral strain, and Poisson's ratio(s) for each specimen. Make a new table to display your results.

4. Describe the phenomena you observed during the compression tests.

5. You calculated multiple Poisson's ratios for each timber sample. What does this indicate about the behavior of timber under loading? How might this characteristic of timber affect your work as an engineering designer?

6. Aluminum is an isotropic materials. Timber is an orthotropic material. Which of the values you determined from the experimental data (e.g., the modulus of elasticity, the Poisson's ratio, etc.) demonstrate this difference in characteristics? Explain your answer.

Data Sheets

Experimental Data

Material	Measurements	Original Specimen	2000 lb	10000 lb
Aluminum (cylinder)	Diameter			
	Length			
	Length			
Timber Longitudinal (cube)	Length (longitudinal)			
	Width (radial)			
	Width (tangential)			
Timber Radial (cube)	Length (radial)			
	Width (tangential)			
	Width (longitudinal)			
Timber Tangential (cube)	Length (tangential)			
	Width (longitudinal)			
	Width (radial)			

Junior Environmental Engineering (CIVE 3100) – 1 In-class Activity and Homework Assignment

Renewable Energy and Sustainability Lesson Plan

1. **Environmental problems, their causes, and sustainability**

2. **Target**
   Is this lesson intended for sophomore and junior level students in civil engineering. This lesson was presented to two sections with approximately 15-20 students in each section.

3. **Learning Objectives**
   (1) Understand the Principles and Practices of Sustainability: Define sustainability and the scientific principles that support it, including solar energy, biodiversity, population regulation, and nutrient cycling, and explore how individuals and societies can adopt sustainable practices.
   (2) Analyze Environmental Impacts and Solutions: Assess the causes and effects of environmental problems, including pollution, ecological footprints, and resource degradation, while exploring strategies for prevention, mitigation, and sustainable economic development.
   (3) Apply Life Cycle Thinking and Circular Economy Concepts: Use frameworks like Life Cycle Assessment (LCA) to evaluate the environmental impacts of products and understand the transition from linear to circular economic models for sustainable resource management.

4. **Description**
   This lesson explores the relation of environmental challenges, sustainability, and the role of civil engineers in addressing these issues. By introducing the principles of sustainability, such as solar energy utilization, biodiversity conservation, and renewable resources and their efficiency, students gain a foundation in renewable energy and sustainable practices. The lesson emphasizes real-world applications, including Life Cycle Assessment (LCA) and the transition to a circular economy, providing case studies and real-world examples to evaluate and minimize environmental impacts. Aligned with the Wentworth Institute of Technology's Civil Engineering curriculum, this lesson equips students with critical thinking skills and actionable knowledge to design infrastructure and systems that balance societal needs with environmental stewardship, preparing them to practice engineering and applying concepts of sustainable engineering.

5. **In-class Activity**

To help students understand and apply the Life Cycle Assessment (LCA) framework by comparing the environmental impacts of two products, reinforcing concepts of sustainability, ecological footprint, and resource efficiency.

Activity Steps

Step 1: Introduction: A brief overview of LCA and its importance in sustainability and engineering was presented. The goal of the activity to compare the environmental impacts of two common products over their lifecycles was explained.

Step 2: Goal and scope defined: Groups of 2-3 students were created. Each group was asked to define the goal and scope of their LCA. For example, goal: understand the environmental impacts of their assigned product, and scope: focus on manufacturing, use, and end-of-life stages, considering the "use of 1 liter of water over 1 year."

Step 3: Perform an inventory analysis: Students were given data on plastic bottles and stainless-steel bottles:

- manufacturing: energy and materials required per bottle (e.g., oil-based plastic, iron, nickel, etc.),
- usage: one-time use; average of 730 bottles/year for 1 liter/day or daily use over one year
- end-of-Life: assumed recycling rate (e.g., 30% or 70%).

Each group was instructed to estimate the energy consumption, CO_2 emissions, and waste generation for their product.

Step 4: Impact Assessment and Interpretation: Groups summarized the environmental impacts of their product (i.e., which stage had the highest environmental cost (e.g., manufacturing vs. use, what are the long-term impacts of repeated use and recycling). The students were then asked to compare these impacts against potential benefits (e.g., durability of reusable bottles).

Step 5: Class Discussion: Each group presented their findings, and a discussion was facilitated on trade-offs between single-use and reusable products, connecting insights to broader sustainability goals. A follow-up lecture on the discussion included how civil engineers can use tools like LCA to design sustainable systems, aligning this activity with the curriculum's emphasis on practical applications in renewable energy and sustainable design.

6. **Homework Assignment**
   Attached

7. **Assessment of Student Interest and Learning Outcomes**
   To assess whether students achieved the learning objectives, we evaluated their understanding through the small group presentation, where they analyzed the lifecycle impacts of assigned products, and a reflection to reinforce key LCA concepts. Engagement and enjoyment were gauged through a post-activity survey, observing participation during group work and presentations, and collecting informal feedback. This combination of methods ensured both comprehension of sustainability principles and a meaningful, enjoyable learning experience.

Junior Structural Analysis (CIVE 3200) – 3 Optional Discussion Assignments

Note: Due to time constraints, I did not prepare technical content related to sustainability for structural analysis in the fall semester. However, I did design three optional assignments that students could complete for bonus credit. The material for each bonus assignment consisted of a selection of readings. To receive bonus credit, students were asked to complete a short discussion post about the readings. I provided discussion prompts as suggestions, but students were encouraged to write about whatever they felt.

Learning Objectives

My goal in creating these bonus assignments was to encourage students to critically engage with the context in which engineering work is done. The context of engineering work is, of course, frequently the topic of discussion for engineering practitioners, educators, and researchers: what does legislation dictate about engineering design, where will funding for projects come from, and so on. However, students are not often asked directly to provide their input.

The bonus assignments did not necessarily deal directly with sustainability, but since sustainability is an entire framework rather than simply a set of technical skills, I believe that by encouraging students to develop more critical thinking skills about the context of their work, I can promote more sustainable practices among engineers.

Bonus Activity 1

Materials:

1. Seely, Bruce E. "Patterns in the history of engineering education reform: A brief essay." *Educating the engineer of 2020: Adapting engineering education to the new century* (2005): 114-130. [pdf posted to Brightspace]
2. Structural Art - Wikipedia
3. Holgate, Alan. "The Art in Structural Design." Oxford (1986). [Accessed at https://www.ce.jhu.edu/perspectives/handouts_unprotected/holgate1.PDF]
4. Biomimicry in architecture and engineering
5. Biomimicry: Engineering and Technology Inspired by Nature

Assignment Description:

If you complete a short discussion post (5-8 sentences) by Sunday, October 6 at 11:59pm ET, I will give you 1 bonus point on Exam 1.

Read through some of the additional resources I posted in the General Information on Brightspace. Ideas covered were:

- The history of engineering education and how it reflects cultural attitudes and historical events
- Structural art and the boundaries between things we describe as "art" and those we describe as "technology" or "engineering"
- Biomimicry, or how we can design more efficient structures by drawing inspiration from naturally-occurring structures

You can focus on as many or as few of the resources as you would like. What did you think of the ideas presented in the resource(s) you chose? How might you connect those ideas to your work or extracurricular activities as a student and to your (future) work after college?

Bonus Activity 2

Materials:

1. Donna Riley Interview – Public Books
2. Donna Riley Interview—R. S. Koh
3. Massachusetts Organization of State Engineers and Scientists
4. International Federation of Professional and Technical Engineers

Assignment Description:

If you complete a short discussion post (5-8 sentences) by Sunday, November 24 at 11:59pm ET, I will give you 1 bonus point on Exam 3.

Read through some of the additional resources I posted in the General Information on Brightspace. The links included:

- Interviews with Donna Riley, author of the book Engineering and Social Justice
- Engineering unions like the Massachusetts Organization of State Engineers and Scientists and the International Federation of Professional and Technical Engineers

You can focus on as many or as few of the resources as you would like. Questions you might consider in writing your discussion are:

- What do you think the relationship between social justice and engineering should be?
- In one of the interviews, Donna Riley asks "why does the technical have to be in the middle and everything else built around it? Why can't we have community welfare in the middle and the technical built around that?" How would you respond?
- What would it mean for engineers to advocate for community welfare or social justice? How might engineering unions be a way for engineers to advocate for those things?

Bonus Activity 3

Materials:

1. Mass Timber Intro - Video
2. Mass Timber Products - Video
3. Mass Timber - Structure Magazine Article
4. Mass Timber - How Green Is It?
5. Design for Deconstruction - Video
6. Reuse of Structural Steel - Video
7. Design for Deconstruction - Structure Magazine Article

Assignment Description:

If you complete a short discussion post (5-8 sentences) by Sunday, December 8 at 11:59pm ET, I will give you 1 bonus point on the final exam.

Read through some of the additional resources I posted in the General Information on Brightspace. The links included:

- Two videos and two articles about mass timber construction
- Two videos and an article about design for deconstruction

You can focus on as many or as few of the resources as you would like. Questions you might consider in writing your discussion are:

- What sort of cultural shift would be required for widespread embrace of design for deconstruction?
- Mass timber construction is often touted as being an essential part of addressing climate change. Are there groups that disagree with optimistic attitude about mass timber? Why? What do you think?

Introduction to Renewable Energy Technologies (CHEM 3800) – Course Syllabus

Chemistry 3800

Fall 2024

Instructor: Brian Ernst **Office: Ira Allen 308**
Office Hours: M: 1-2PM, W: 3-4PM*
Class Hours: **Class Room:**
WF 1:00PM-2:45PM DOBBS-302
***Also available by appointment. Walk-ins welcome!**

Course Description

This course provides an introduction to renewable energy technologies. It starts with the basics of thermodynamics and heat engines. Covers fossil fuels, solar energy, bioenergy, hydroelectric energy, tidal and wave energy, wind energy, geothermal energy, nuclear fission and fusion, renewable energy integration and future prospects. A big part of this course is following one's particular interests, and assignments will reflect this.

Prerequisites/Corequisites

None

Required Materials

There are no required materials for this course. Much of the content covered will follow *Renewable Energy: Power for a Sustainable Future 4th Edition* by Stephen Peake.

Course Learning Outcomes

- Demonstrate critical thinking skills.
- Demonstrate the scientific method and its applications to inquiry and analysis.
- Demonstrate knowledge of basic facts, principles, and theories of science and their applications in technology.
- Apply analytical tools and skills for evaluating information and solving problems.
- Effectively communicate technical information in written, oral, and/or visual format.

Course Learning Objectives

- Understand what energy is and how it is used by humans
- Understand how renewable and nonrenewable energies differ
- Understand the fundamental principles and inner-workings of various renewable energy technologies, *e.g.* solar, wind, hydroelectric, bioenergy, geothermal energy, and nuclear fusion
- Understand the advantages, disadvantages, and challenges for transition to a renewable energy economy
- Understand the approaches to renewable energy integration and energy storage

Course Structure

<u>Lectures:</u> The course is primarily lectures/discussions. A significant portion of lectures will be devoted to discussions about the topic.

<u>Course Website:</u> We will be using Brightspace to disseminate course materials. All announcements, lecture material, homework assignments, supplements, and study tools will be located on this site. It is the student's responsibility to visit the site regularly to ensure that they are aware of the most current postings. You are also advised to regularly check your e-mail for announcements.

Course Policies

Attendance Policy

10% of the course grade is "participation" which refers to attending class and engaging in discussion. It is **not** necessary to attend all lectures to achieve a perfect participation grade. There will be activities throughout the semester in the class where attendance is mandatory (*e.g. final presentations*).

Grading Policy

- Written Exams (2 total): **<u>30%</u>**
- Assignments/Homework: **<u>30%</u>**
- Final Presentations: **<u>30%</u>**
- Participation: **<u>10%</u>**

In lieu of a final exam, this course will have final presentations, where students will present information about a company that is utilizing renewable energy technologies. Homework assignments will include short readings and "back of the envelope" calculations. Since a major goal of this course is for students to pursue their own interests, extra credit opportunities will be available throughout the semester. Students can also propose extra credit work.

Exams

There will be two written exams. See the Course Calendar for specific dates. Phones cannot be used during exams.

Wentworth Grading System

Grade	Weight	Numerical Definition	Definition
A	4.0	93-100	Student learning and accomplishment far exceeds published objectives for the course/test/assignment and student work is distinguished consistently by its high level of competency and/or innovation.
A-	3.67	90-92	
B+	3.33	87-89	Student learning and accomplishment goes beyond what is expected in the published objectives for the course/test/assignment and student work is frequently characterized by its special depth of understanding, development, and/or innovative experimentation.
B	3.0	83-86	
B-	2.67	80-82	
C+	2.33	77-79	Student learning and accomplishment meets all published objectives for the course/test/assignment and student work demonstrates the expected level of understanding and application of concepts introduced.
C	2.0	73-76	
C-	1.67	70-72	
D+	1.33	67-69	Student learning and accomplishment based on the published objectives for the course/test/assignment were met with minimum passing achievement.
D	1.0	60-66	
F	0.0	0-59	Student learning and accomplishment based on the published objectives for the course/test/assignment were not sufficiently addressed or met.

Add/Drop:

Students should check the academic calendar to confirm the add/drop deadline. Dropping and/or adding courses is done online. Courses dropped in this period are removed from the student's record. Non-attendance does not constitute dropping a course. If a student has registered for a course and subsequently withdraws or receives a failing grade in its prerequisite, **then the student must drop that course.** In some cases, the student will be dropped from that course by the Registrar. However, it is the student's responsibility to make sure that he or she meets the course prerequisites and to drop a course if the student has not successfully completed the prerequisite. The student must see his or her academic advisor or academic department chair for schedule revision and to discuss the impact of the failed or withdrawn course on the student's degree status.

Make-Up Work:

Make-up work is solely at the discretion of the instructor and must be agreed upon in advance, when applicable.

Academic Honesty Statement:

Students at Wentworth are expected to be honest and forthright in their academic endeavors. Academic dishonesty includes but is not limited to cheating, prohibited collaboration, coercion, inventing false information or citations, plagiarism, tampering with computers, destroying other people's coursework or lab or studio property, theft of course materials, posting coursework/course materials to websites, or other academic misconduct. If you have any questions, contact your professor prior to submitting an assignment for evaluation. See your academic catalogue for a full list of definitions and the WIT Academic Honesty website for the procedures: wit.edu/academic-honesty.

Student Accountability Statement:

All assignments submitted shall be considered graded work and shall be completed on an individual basis unless otherwise stated. While discussing assignments and getting help outside of class is both authorized and encouraged, copying solutions from any source (examples: classmates, internet, textbook) is considered a violation, as is sharing or re-use of computer files. Cheating on an exam includes, but is not limited to, using a cell phone (all cellphones must be put away during exams), talking to other students, referring to notes, etc.

Any suspected violations will be promptly addressed and may warrant a 0% on the exam or assignment and possible further action. If you ever have a question on how the Academic Honesty and Conduct Policy is applicable to a piece of work, feel free to contact the instructor for clarification.

Use of Artificial Intelligence (AI) Tools

The use of AI tools (such as ChatGPT) in this course may be considered plagiarism in certain contexts. **Wentworth Institute of Technology does not have a school-wide policy on the use of AI tools.** The policy in this course is as follows: when an AI tool is used to perform a task that would be considered plagiarism if another person performed that task for the student, this constitutes plagiarism. For example, having another person or an AI tool write a lab report for you in its entirety, even if you make changes to it afterwards, is not allowed. Asking another person/AI tool for complete answers to homework problems without attempting them yourself is not allowed. Asking another person/an AI tool for additional practice problems, or for hints on homework problems you have put considerable effort into already, is allowed (and even encouraged).

Support

Academic Support:

The Success Studio (Beatty Hall, 3rd floor) offers many resources and supports to facilitate your success including:

- Academic Advising – Student Success Advisors
- Academic Support Services – tutoring, study groups
- Student Accessibility Services – for students with documented disabilities
- Resources and workshops on academic success skills

In addition to meeting with your Student Success Advisor when you have questions or concerns, you can participate in appointment based individual tutoring, drop-in group tutoring, and workshops. Most individual appointments can be scheduled to take place remotely or in-person.

70% of Wentworth students participate in tutoring. Our data shows that attending three or more tutoring sessions is proven to significantly increase your grade!

To make an advising or tutoring appointment, please login to Navigate (https://wit.campus.eab.com/) using your Wentworth email credentials. If you do not see a tutor for your class, please contact academicsupport@wit.edu. For up-to-date information on workshops, programs, and drop-in study groups, please visit the Success Studio on wit.edu.

Student Support Specialists/Dean of Students Office:
Rubenstein Hall 003
Drop in Hours M-F 11AM-12PM and 3PM-4PM

Student Accessibility Services:

Wentworth Institute of Technology requires that students with disabilities are provided reasonable accommodations to ensure their equal access to course content. If you have a documented disability and require accommodations, please contact me privately to make arrangements for necessary classroom adjustments. Please note, you must first verify your eligibility for these through Student Accessibility Services (contact 617–989–4545 or visit Success Studio on wit.edu. for more information on registration procedures).

The Center for Wellness:

College can be challenging and it is common to feel overwhelmed or stressed at times. If these feelings are related to course work or academic performance, please talk to me. For more significant mental health concerns, The Center for Wellness (Williston Hall, 2nd Floor, 617-989-4390) provides free and confidential mental health counseling.

If you or someone you know needs support around thoughts of suicide, the following resources are available:

- The Center for Wellness, 617-989-4390, 24/7

- CARE Referal: Concerned about a friend? wit.edu/CARE
- BeWell@WIT 24/7 telephonic emotional support, 617-989-4390 and pressing number 2
- Public Safety, First level of 610 Huntington Avenue, 617-989-4444, 24/7
- Samaritans, call or text 1-877-870-4673
- Crisis Text Line, text “start” to 741-741
- National Suicide Prevention Lifeline, call 1-800-273-8255
- GLBT Youth Hotline, call 1-866-488-7386
- Beth Israel Deaconess Emergency Room, 190 Pilgrim Rd Boston, MA

College of Fenway Students

If you are enrolled in this course through COF Cross Registration, notify your course instructor. Please provide them with your email address to be sure that you receive course information in a timely way. You should also discuss how to access online applications that might be used in the course.

Diversity and Inclusion Statement

We are committed to building a learning community where diverse perspectives are welcome, respected, and regarded as valuable resources for enriching and strengthening our capacity for empathy, reflection, and critical thinking. While the course materials and experiential activities presented in the course are intended to be inclusive of historically underrepresented voices, overt and covert biases of privileged views may still be dominant. We encourage you to offer any suggestions to enhance a more inclusive, comprehensive learning environment especially for those whose voices have been marginalized.

Attributed to Dr. Tomoyo Kawano, Assistant Professor in Applied Psychology, Antioch University.

Tentative Course Schedule

	Topic	Important Dates
Week 1 (Sept 2)	Course Introduction/Overview	Classes Begin Tuesday, September 3
Week 2 (Sept 9)	Thermodynamics and Heat Engines	Last Day of Drop/Add September 10
Week 3 (Sept 16)	Solar Thermal Energy	
Week 4 (Sept 23)	Solar Photovoltaics	
Week 5 (Sept 30)	Bioenergy	Exam 1 Oct 2
Week 6 (Oct 7)	Hydroelectric & Tidal Power	
Week 7 (Oct 14)	Wind Energy	Indigenous People's Day No Class - Oct 14
Week 8 (Oct 21)	Wave Energy & Geothermal Energy	Midterm Grades Due Oct 16
Week 9 (Oct 28)	Nuclear Fission and Fusion	Exam 2 Nov 1
Week 10 (Nov 4)	Integrating Renewable Energy	
Week 11 (Nov 11)	Presentation Discussion	Veteran's Day No Class - Nov 11
Week 12 (Nov 18)	Future Prospects	
Week 13 (Nov 25)	No Classes	Thanksgiving - No class Nov 27 - Nov 30
Week 14 (Dec 2)	No Classes	

Engineering the Renewable Energy Economy (CIVE 7800) – Course Syllabus

Wentworth
INSTITUTE OF TECHNOLOGY

CIVE-7800 Engineering the Renewable Energy Economy

Course Information

Course Name and Number: ***CIVE-7800 Engineering the Renewable Energy Economy***

Classroom: Beatty Hall 401

Class Schedule: 5:00pm – 6:20pm TR

Lecture/Lab/Total Credits: 3/0/3

Meet Your Instructor

Instructor Name and Pronouns: Dr. Andrew Summerfield (he/him/his)

Office Location: CEIS 405

Student Hours: By appointment

Telephone Number: NA

Email Address: summerfielda@wit.edu

Course Description

The goal of this class is to prepare engineering students to participate in the transition to a renewable energy-driven economy by imparting them with both technical skills and an understanding of the social, political, and economic context in which their work will take place. The class will consist of a series of projects focused on different topics relevant to the transition to renewable energy, such as energy resource maps, electricity generation and grid integration, and the reliability of renewable energy infrastructure. Students will develop coding, data analysis and visualization, and technical communication skills through the use of MATLAB and open-source simulation software and through the preparation of technical reports. They will develop their understanding of the broader context of the transition through assigned readings, classroom discussion, and written reflections. No prior coding or MATLAB experience is required.

Course Prerequisites/Corequisites

Graduate Student Standing or Dean's Approval

Course Learning Outcomes

By the end of this course, students will be able to:

1. define and critique energy systems through the lens of sociotechnical systems
2. identify obstacles to the transition to a renewable energy economy
3. apply technical skills, like modeling, coding, data analysis, and data visualization
4. prepare technical reports

Required Textbooks

Purchase the following required textbooks at the Wentworth Bookstore located at 103 Ward Street:

- NA

Recommended Learning Materials

To be added to Brightspace as semester progresses

Instructional Methodologies

The course is split into five modules: an introductory module and four modules that address different components of energy systems. Each module will consist of weekly readings and discussion posts. The readings will be a jumping off point for discussion of energy systems and the role that civil engineers play in shaping them. We will discuss both the energy systems of the world we have and those of the world we need—the former refers to our current fossil fuel-based economy, and the latter refers to a transition away from fossil fuels to an economy rooted in more sustainable practices, like reduced consumption and reliance on renewable sources of energy. In addition to the weekly discussion posts, there will be three projects. Each project will involve the use of technical skills like coding, modeling, and data analysis in a civil engineering application relevant to the current module. The project deliverables are technical reports following a typical format, including project background, methodology, results, discussion, and conclusion. The intent of each project is for the student to perform a technical study that attempts to answer a question raised by our discussion of the guiding questions.

Grading Criteria

Final Grades will be computed as follows:

- Participation and attendance 20%
- Discussion Moderation 5%
- Project 1 20%
- Project 2 20%
- Project 3 (Final Project) 20%

- Visual Essay 10%
- Visual Essay Presentation 5%

Detailed grading criteria specific to each graded assessment will be provided when assigned.

Attendance Policy

I expect students to attend all classes in-person or, if approved, remotely and synchronously. Attendance is graded. Students are responsible for letting me know **prior to class** if they are unable to attend.

Late Work Policy

Whether an absence is excused or unexcused, missed work must still be made up. It is the responsibility of the student, not the faculty member, to ensure that this happens. Late assignments will be accepted but penalized. More points are deducted as the time after the assignment due date increases.

Successful Students

To be successful in this course:

- Check the course announcements regularly
- Attend the required class meetings
- Arrive on time
- Participate in in-class activities
- Read and respond to email messages as needed
- Complete assignments by the due dates specified
- Communicate regularly with your instructor and peers
- Create a study schedule to stay on track
- Ask for help early
- Use student support resources such as the Success Studio, Center for Wellness, and Schumann Library
- Balance mental, physical, and social health to support academic success

Instructor Promise/Shared Expectations

I hope our time together in class is fun and prompts you to think about your role as an engineer in a different way. Firstly, I will try to foster classroom discussions that are lively and thought-provoking. My expectation is that you contribute by 1) preparing to participate in classroom discussions by doing the readings and writing your discussion post ahead of time and 2) actually participating. There are very low stakes to participating! There are no right or wrong answers—I want to hear your thoughts!

Secondly, I hope to help you develop technical communication skills by guiding you through the process of producing technical reports. My expectation is that you complete the deliverables on schedule so that your classmates and I can give you feedback on your progress. The intent is not so much that you generate thesis-caliber work, but rather that you understand how to structure the process of producing a technical report.

My hope is that our open-ended discussions will expose you to a broad range of new ideas, and that our progress through technical reports will help you understand how to focus on one specific technical idea for analysis.

Because this a graduate elective, we are not bound by specific learning objectives like we would be in a class like statics. My goal is to give you tools to hone your ability to understand, analyze, and communicate ideas that **you** choose.

Lastly, because this a graduate elective, my expectation is that you will be able to complete assignments with less guidance than I would provide to undergraduates. The opportunity I describe above—that **you** get to choose specific ideas to explore through your discussion posts and technical reports—will also be the biggest challenge of this course. But I am confident you all can do it! I'm excited to see what you come up with!

Wentworth Grading System

Numerical Definitions

Grade	Weight	Numerical Definition
A	4.00	93-100
A-	3.67	90-92
B+	3.33	87-89
B	3.00	83-86
B-	2.67	80-82
C+	2.33	77-79
C	2.00	73-76
C-	1.67	70-72
D+	1.33	67-69
D	1	60-66
F	0.00	0-59

Letter Definitions

- **A:** Student learning and accomplishment far exceeds published objectives for the course/test/assignment and student work is distinguished consistently by its high level of competency and/or innovation.

- **B:** Student learning and accomplishment goes beyond what is expected in the published objectives for the course/test/assignment and student work is frequently characterized by its special depth of understanding, development, and/or innovative experimentation.
- **C:** Student learning and accomplishment meets all published objectives for the course/test/assignment and student work demonstrates the expected level of understanding and application of concepts introduced.
- **D:** Student learning and accomplishment based on the published objectives for the course/test/assignment were met with minimum passing achievement.
- **F:** Student learning and accomplishment based on the published objectives for the course/test/assignment were not sufficiently addressed or met.

Add/Drop

Please check the academic calendar to confirm the add/drop deadline. Add/drop is done online. Courses dropped in this period are removed from your record.

Non-attendance does not constitute dropping a course. If you registered for a course and subsequently withdrew or received a failing grade in its prerequisite, then you must drop that course. In some cases, you will be dropped from that course by the Registrar. However, it is your responsibility to make sure you meet the course prerequisites and to drop a course if you have not successfully completed the prerequisites. Please meet with your student success advisor or major advisor for schedule revision and to discuss the impact of the failed or withdrawn course on your degree status.

Colleges of the Fenway Students

If you are enrolled in this course through COF Cross Registration, please let me know and provide me with your email address so I can be sure that you receive course information in a timely way. Let's also discuss how to access online applications that might be used in the course.

Non-Discrimination Statement

Per Wentworth's Office of Institutional Equity: "Wentworth Institute of Technology values diversity, equity, and inclusion. The University is committed to providing a safe and respectful educational experience and work environment free from discrimination and harassment on the basis of an individual's race, color, religion, gender, age, marital status, national origin, ancestry, alienage, physical or mental disability, sexual orientation, gender identity or expression, genetic information or any other characteristic protected by law."

For more information on reporting, refer to the Office of Institutional Equity section below.

Accessibility Statement

Students with physical, medical, psychiatric, and learning disabilities are eligible to utilize Student Accessibility Services (a branch of the Success Studio) to arrange for reasonable accommodations and seek ongoing support at any point in their Wentworth career. Please contact AccessibilityServices@wit.edu to begin the accommodation request process.

For more information on accessibility, refer to the Success Studio section below.

Academic Integrity

Members of our community are expected to be honest and forthright in all their academic endeavors. Not only does this add value and credibility to a Wentworth degree, but it also establishes trust and respect as we share knowledge within and beyond our community.

Academic integrity includes:

- Acknowledging the work of others with citations and attributions
- Submitting work that authentically reflects your own knowledge, skills, and abilities – not someone else's
- Collaborating with others on work only when collaborating is an intended part of the activity
- Respecting each other's work, property, and possessions

Learn more about academic integrity by contacting SuccessStudio@wit.edu. View our Academic Honesty Policy Procedures to learn how Wentworth investigates potential academic integrity violations.

Intellectual Property

Any intellectual property developed by you as part of your work for this course is yours. You own it! View Wentworth's Intellectual Property policy for details.

Student Support Resources

Wentworth is proud to offer a variety of support resources to enable students to succeed academically, professionally, and personally. Due to the variety of resources available, start at WhoCanHelp to determine what your needs are and what offices and organizations are best suited to help you. Here is a sample of the student support resources listed on WhoCanHelp:

Success Studio

At Wentworth, we are wholeheartedly committed to student success. In support of this mission, the Success Studio acts as the central hub dedicated to helping our students thrive through the provision of Advising, Student Accessibility Services, and Tutoring. Questions? Email SuccessStudio@wit.edu.

Center for Wellness

At Wentworth, we value physical, mental, social, and spiritual wellbeing as much as academic success. The Center for Wellness is comprised of Counseling Services, Health Promotion and Education, as well as Fitness and Wellness Programs. Each provides specific services to our students while working together holistically to improve students' experiences. Need urgent support? View all crisis hotlines and resources.

Douglas D. Schumann Library & Learning Commons

The Schumann Library provides numerous on-campus and virtual services to the Wentworth community, including an extensive library catalog, research support, study spaces, copyright guides, and more.

Center for Diversity and Global Engagement

The Center for Diversity and Global Engagement (CDGE) programs at Wentworth promote cross-cultural perspectives, inclusivity, leadership development and personal growth among the Wentworth community, and fosters a welcoming, brave and safe environment for all students with a specific focus on underserved populations and their allies.

Office of Institutional Equity

The Office of Institutional Equity supports the university in cultivating and maintaining a campus environment that is equitable, inclusive, and accessible. Students, faculty, staff, and guests have a right to be free from discrimination and harassment, including harassment and sexual misconduct. You can report discrimination, harassment, and sexual misconduct to the University by using the Reporting Bias and Discrimination Form or the Sexual Misconduct and Sex-Based Discrimination Reporting Form.

Course Schedule

Outline

Module 1: Introduction

- Guiding Questions:
    - What are energy systems and what does it mean to describe them as sociotechnical systems?
    - What is the role of the civil engineer in transforming our energy system?
- Keywords: sociotechnical systems, energy transition

Module 2: Energy Supply

- Guiding Questions:
    - Where does our energy come from?
    - How do we know how much we have?
- Keywords: recoverable resources, resource potential versus technical potential

Module 3: Energy Demand

- Guiding Questions:
    - What drives our demand for energy?
    - How does demand vary over time and from one country to another?
    - How can we reduce demand?
- Keywords: sustainability, adaptive reuse, energy codes

Module 4: Energy Generation

- Guiding Questions:
    - What technologies do we use to generate energy?
    - What are the true costs of each energy-generating technology?
    - What is technological optimism and how does it affect our ability to confront the climate crisis?
- Keywords: levelized cost of energy, carbon capture and storage, technological optimism

Module 5: Energy Distribution

- Guiding Questions:
    - What infrastructure exists to connect supply to demand?
    - How will the landscape need to change to connect new supplies to existing demand?
    - Is a society powered by renewable energy necessarily a more equitable society?
- Keywords: reliability, risk, environmental justice

Week	Topics	Graded Activities
1	Module 1: Introduction	
2	Module 1: Introduction	
3	Module 2: Energy Supply	Project 1: Deliverable 1
4	Module 2: Energy Supply	Project 1: Deliverable 2
5	Module 3: Energy Demand	Project 1: Deliverable 3
6	Module 3: Energy Demand	Project 1: Deliverable 4 (Final)
7	Module 3: Energy Demand	Project 2: Deliverable 1
8	Module 4: Energy Generation	Project 2: Deliverable 2
9	**SPRING BREAK**	
10	Module 4: Energy Generation	Project 2: Deliverable 3
11	Module 4: Energy Generation	Project 2: Deliverable 4 (Final)
12	Module 5: Energy Distribution	Project 3: Deliverable 1
13	Module 5: Energy Distribution	Project 3: Deliverable 2
14	Module 5: Energy Distribution	Project 3: Deliverable 3
15	**FINALS**	Project 3: Deliverable 4

This schedule is subject to adjustment by the instructor as needed throughout the semester. Updated versions will be discussed in class or sent by email.

Appendix B

Wentworth Institute of Technology Civil Engineering Bachelor of Science Degree Program

Year	**Fall Semester**	**Spring Semester**	**Summer Semester**
First	CHEM 1100: General Chemistry 1	ENGR 1300: First-Year Engineering Design	
	ENGR 1100: Introduction to Engineering Experience	ENGR 1403: Applied Engineering Analysis	
	ENGR 1203: Engineering Laboratory	PHYS 1250: Engineering Physics I	
	MATH 1776: Calculus 1A	MATH 1876: Calculus 2A	
	MATH 1777: Calculus 1B	MATH 1877: Calculus 2B	
	English Sequence 1	English Sequence 2	
Second	CIVE 2000: Statics & Mechanics of Materials I	CIVE 2300: CAD in Civil Engineering	
	CIVE 2205: Introduction to Geomatics	CIVE 2400: Civil Engineering Materials	
	CHEM 1600 or PHYS 1750: Gen Chem II or Eng. Phys. II	CIVE 2500: Statics and Mechanics of Materials II	
	MATH 2025: Multivariable Calculus	MATH 2500: Differential Equations	
		MGMT 3200: Engineering Economy	
		COOP 2500: Introduction to Cooperative Education	COOP 3000: Optional Coop Education
Third	CIVE 3000: Fluid Mechanics	COOP 3500: Coop Education 1	CIVE 3700: Highway Engineering
	CIVE 3100: Environmental Engineering		CIVE 3900: Hydraulic Engineering
	CIVE 3200: Structural Engineering		Civil Engineering Elective
	CIVE 3300: Soil Mechanics		Humanities/Social Science Elective
	Civil Engineering Elective		
Fourth	COOP 4500: Cood Education 2	CIVE 4000: Civil Engineering Design Projects	CIVE 5500: Civil Engineering Capstone Design
		Science Elective	MATH 2100: Probability and Statistics for Engineers
		Civil Engineering Elective	Civil Engineering Elective
		Humanities/Social Science Elective	Humanities/Social Science Elective

Appendix C

CIVE 2500: Statics and Mechanics of Materials II

Spring 2025 Course Evaluations

Do you think it is important for civil engineering students to learn about climate change, renewable energy, and sustainability?

[*The responses to this question will be used as part of a research paper to be published and presented at the 2025 American Society for Engineering Education Annual Conference. Your responses, to this question and all other questions, will remain anonymous, but if you do not want your response to be included in the paper (or if you are under 18), please leave this question blank.*]

- I think that it is important but not really fully necessary
- Yes because it at least introduces it towards the civil engineering students things to think about when it comes to building/bridge projects.
- I think it should be touched on but not focused on
- Yes one major aspect of their job is determining the environmental impact a project will have
- Yes, i do because while it is something that we may not have to worry about right now or when we have our first job out of college, it will be important down the road and an understanding of that beforehand would help.
- Absolutely
- Yes, because when you eventually become an engineer things like renewable energy and use of sustainable materials does come into play. So, it is possible that engineers who are uneducated in climate change and the importance of using sustainable materials do not implement the "safest" option for our climate/ecosystem.
- Yes, these topics will inevitably become more important and are already important for professionals, so studying them now will be valuable preparation. Also, the construction industry is one of the largest consumers of resources globally, so it's highly relevant regardless of social or government attention.

- Yes, it's very important for civil engineering students to learn about sustainability because we use materials that come directly from the Earth everyday in civil engineering structures. Everybody knows that although we can reforest, and recycle things, the Earth doesn't have infinite resources for us. Along with not having endless resources, a lot of processes in civil engineering cause countless tons of carbon emissions into the atmosphere, slowly chipping away at the ozone layer. If we continue to mass produce these materials that require lots of energy and emissions, our world will continue to deteriorate.
- We live in a built environment and are constantly innovating and developing new techniques to construct structures. These factors have impacts on the surrounding environment, and I believe it is important for students to understand the environmental impacts construction can have. Finding new ways to limit damaging aspects of construction will only be beneficial as the world continues to grow and develop.
- I believe that it is important for civil engineering students to learn about these topics because it is essential that future engineers have background on these topics in order to find ways to create more sustainable solutions for projects.
- I do think it is important for civil engineering students to learn about these topics. It is one thing to understand how to make a structure, but making it last in an environmentally-friendly fashion is just as important. With climate change only taking more of a toll on the Earth, it is important as civil engineering students to prevent further damage from occurring.
- Yes because these are all impactful on the world as a whole. However, I feel that there are other jobs and sectors that have more impacts if they became sustainable compared to civil engineering.
- Yes, I believe it is important that civil engineers learn about sustainability. We should always understand the impact of structures and civil engineering projects on the environment and how we can better prevent carbon emissions and reduce environmental impact.
- Yes, since climate change is an existential threat to human society, and the downplaying of it by the current administration in tandem with an over arching corporate environment, reaffirms the need to tackle it
- I think it is important to learn the effects on the climate that different materials that are used in civil engineering have.
- Yes
- I think it is important for civil engineering students to learn about how engineering effects the topics of climate change, renewable energy and sustainability. While studying the applications of different materials and how they're used to construct things, it's also important to understand how the materials are made, and how these processes effect our environment since not all project are necessarily environmentally friendly in the construction and everyday use.
- I think it is very important for civil engineering students to learn about climate change and renewable energy, and sustainability. I remember having a conversation with professor summerfield about how civil engineering is more political than it is perceived because this field deals with many laws and regulations. So, yes, i think it is extremely important and it is our duty to be educated about this.
- I do believe it is important for civil engineering students to learn about climate change, renewable energy, and sustainability because it is a large issue that needs to be lowered soon and emphasized before it is too late. Civil engineering deals with many materials that have an impact on the environment in a negative way, whether that is by source or production.
- Not really.
- I think that it's important to bring up climate change however it shouldn't be the main topic of every class

Do you have any interest in working in a field specifically related to renewable energy or sustainability after graduation?

[*The responses to this question will be used as part of a research paper to be published and presented at the 2025 American Society for Engineering Education Annual Conference. Your responses, to this question and all other questions, will remain anonymous, but if you do not want your response to be included in the paper (or if you are under 18), please leave this question blank.*]

- Yes, I'm interested in sustainable building practices.
- Not particularly but if the opportunity was presented I wouldn't be opposed.
- I dont particularly have an interest in those but i wouldn't rule them out.
- Not currently but that somewhat due to my lack of knowledge about jobs in that field
- no
- No
- No I do not

- I personally do not have interest into working in a field directly related to renewable energy as it is not directly related to the career path I would like to go into.
- not really
- I have an interest in working on projects with sustainability in mind.
- Yes I do! I think this is the path the world is going and it is more important than ever to do be educated in this. Especially if I want to be successful in this field I think it is important.
- Somewhat, I want to work in transportation, and seeing more sustainability in the ways people get around would be nice
- no
- Transit, main goal is to expand the infrastructure for it to begin with, and then possibly shift focus onto green energy use
- I wouldn't mind learning about sustainability or taking a course in it, but it is not something that I would pursue as a career.
- If work was there and the money was right then yes.
- I would say probably not. While it is an interesting topic, I don't thing I would enjoy having it as my "specialty."
- I don't have an interest in working specifically in a renewable energy field, but I would love to use sustainable practices in my line of work.
- My interests align more with the structural aspects of civil engineering so unless it was integrated into my job then I most likely would not work in sustainability.
- I would definitely have an interest in working in a field that has to do with renewable energy and sustainability.

Is it clear to you how a career as a civil engineer could be related to renewable energy or sustainability?

[*The responses to this question will be used as part of a research paper to be published and presented at the 2025 American Society for Engineering Education Annual Conference. Your responses, to this question and all other questions, will remain anonymous, but if you do not want your response to be included in the paper (or if you are under 18), please leave this question blank.*] -

- Yes
- Yes, when it comes to the material, it's necessary to know how it'll react at certain temperatures or climates.
- yes
- yes
- Yes and no. I can see how the two may intertwine but im not sure about specifics.
- Yes, civil engineers are directly involved in the construction of structures. Part of the job is selecting optimal materials and/or sources of energy.
- Yes, a civil engineer has a significant impact of the environment whether or not they are aware of it. It should be an engineer's responsibility to be aware of their impact.

- Yes, because as much as we want to, the structures we build will not last forever, so we need a way to recycle or decompose the materials our structures are made of.
- Yes, it is very clear how renewable energy or sustainability is related to civil engineering.
- Yes
- Yes, it is very clear. Civil engineers work with materials to create structures that need to last a long time, while maintaining an eco-friendly balance.
- To sustainability yes, Moreso then renewable energy. But for everything in general I feel as a civil engineer you are playing with the cards delt to you and the sustainability topic would be more impactful in other fields.
- Yes, it is clear to me that when we construct structures we are affecting our environment.
- Yes, since every man-made structure has an environmental ramification
- It is clear how a career as a civil engineering can be related to renewable energy or sustainability.
- yes
- It is clear. I feel as though Wentworth could expand on this a little more though. But yes, it is clear.
- Yes.
- yes
- I see how civil engineers are needed for renewable energy and through design and installation of physical structures.

During the semester, you tested timber samples and completed a discussion post that asked you to consider the meaning of "sustainability." Do you feel that these assignments improved your understanding of what it means for civil engineers to consider "sustainability"? Why or why not?

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- It was cool to become familiarized with materials in the sustainability space but it was only one assignment. I think more assignments would be needed to learn about sustainability. Also just learning about the environmental impact of conventional building methods would be helpful.
- Yes, because not only are you considering or choosing the strongest and most efficient material, but you also have to consider cost effectiveness and how much of the material you need and how it relates to how sustainable it is as well.
- Yes, i feel as though it helped. They showed us that sustainable materials like wood are useful in civil engineering.
- yes because it made me do some research into what sustainability actually means
- Yes because I grew to learn the calculations of internals physics within structures with supplied loads.

- I feel that it was informative however it only focused on one the idea of "sustainability" and left out other key factors that are not as sustainable or safe.
- yes!
- I do feel that the assignments helped me understand what it means for civil engineers to consider sustainability. The articles included in the discussion post clearly detailed material impacts on carbon emissions, and I feel like I learned a lot. It was interesting to learn about timber's material properties under loads too.
- I wasn't here for that class. But I feel open discussions like that are useful and helpful.
- Yes. Considering the environmental impact of the materials we build with and their sustainability was not something we covered in really any capacity in other courses so far, so reading the articles and watching the videos needed for this discussion helped improve my understanding of that a little more.
- It does help me understand. That is because I used more sustainable materials for test and see the results that those materials have. This allowed me to see how sometimes you have to make sacrifices in for say stress to make a building more sustainable.
- Yes, I think these assignments helped me understand what sustainability is. It guided me to go look up the definition and changes engineers make to design to improve sustainability and reduce environmental impact.
- These assignments I don't feel that these assignments improved my understanding of what it means for civil engineers to consider sustainability.
- Yes, I would say so. It was very beneficial to identify the tradeoffs between steel and timber and the various pro's and con's that go along with it.
- Yes because timber can be a sustainable building material that can have strong structural properties when used properly.
- It helped me understand how versatile some materials are when it comes to recycling material.
- Yes, they did improve my understanding to some extent. It improved my understanding because it allowed me to explore the effects that mass timber has on the environment as an alternative to construction materials.

What could the WIT civil engineering program do differently to promote greater awareness of the opportunities for civil engineers to be involved in renewable energy and sustainability?

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- Add more discussions about sustainability into the curriculum
- They could intertwine it into more classes and discussions. They could also have a sustainability day maybe where they have presentation, and students can choose to attend the presentation or go to class.
- Seminars/info sessions could be a good idea. However, I believe the most effective way to get this information to civil students would be to adjust the engineering materials class structure to include more sustainability and information on climate change etc. A lot of the class material lines up with statics in the beginning of the semester. Maybe the time could be optimized to promote awareness.
- More lecture time on the environmental impact of building materials and practices. Also more discussion of the societal impact of the work. For example the social impact of building highways and roads in a certain manner that produces car dependent societies, and what that means for people's quality of life.

- Create more/diverse courses that introduce us to the world of sustainability and allow us to build a solid foundation on how to build/design in the future while keeping our materials sustainable.
- If they had a course that specifically went over aspects of renewable energy and sustainability, then I think it would promote greater awareness to this sector of civil.
- Relate more content to it in all classes.
- I think a realistic thing that the WIT civil engineering program could do to promote greater awareness of renewable energy and sustainability amongst civil engineers is offer several elective based classes on these topics. I would try to specifically make them involve civil engineering, instead of a more generalized sustainability class that doesn't necessarily pertain to civil engineers.
- I honestly don't really no I'm not up to date enough and/or have enough knowledge to speak on this.
- I think WIT could create a class that discusses the topic, or even a short online program to help promote awareness. Although, I do think most civil engineers understand the impact we have on the environment. It is fairly obvious that whenever we do something that it will affect the environment in a negative way, the course should then be about how we reduce our impact.
- Keep bringing up the dire consequences of man-made climate disasters
- Maybe have an elective class about sustainable materials
- Maybe introduce the topic in one of the freshman courses that goes over the broad topics of civil engineering, just to give freshman food for thought and have them consider sustainability going forward.
- More involved clubs, attending conferences with the civil engineering class, classes specific to this type of education.
- I feel like the WIT civil engineering program could run more courses focusing on sustainability aspects as electives and also hold events or include projects on sustainability and renewable energy related to our course material.
- maybe spend more labs looking at real situations
- I think hands on in class projects on direct impacts of designing/building sustainable energy can be helpful for a lot of students. The projects would have to be engaging to multiple types of students and grab interest in different ways. I also thing that writing essays on sustainable energy would have a directly negative effect and would make students unengaged and dislike the cooncept.

CIVE 3200: Structural Analysis

Fall 2024 Course Evaluations

Do you think it is important for civil engineering students to learn about climate change, renewable energy, and sustainability?

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- While it is important to consider renewable energy and sustainability in engineering, I do not think it is important to dedicate any more time of the civil engineering course towards this. Engineers are problems solvers, and there is always multiple ways to solve these problems. While some aspects of renewable energy and sustainability can be implemented to solve these problems easily, most of these "green" practices and devices are not sufficient, not actually "green", and often times drive up prices for the consumer. I think that renewable energy and sustainability practices are something that students should learn in the field, so they understand what practices work and don't work, not something that should be indoctrinate in the classroom.
- yes it is because we get more information
- Yes it is important especially for civil engineers since we work directly with the environment. The purpose of a civil engineer is to improve public well-being whether being in a structural, environmental, transportation, or any other engineering concentration, and taking the time to learn about new ways to preserve the planet is always a plus.
- I think it is important to learn about these topics. As structural engineers we have the ability to pick materials and members that may negatively effect society.
- YES 100%. We are creatures of adaptability and so our infrastructure should be too. We owe it to future generations.
- I think it is very important for civil engineering students to learn about climate change and the like. The projects civil engineers take on have such an impact on the climate and sustainability and starting to teach that responsibility as soon as possible is best.
- Yes, it is extremely important as the world moves toward renewable energy. Understanding the ever changing environment will successfully prepare future engineers to enter the conversation better. It is important for this material to be up to date and bias free. It should acknowledge the strengths and weaknesses of certain materials and processes.

- Yes! As a civil engineering student who is also getting an environmental engineering minor, I think it is very important. I think it should be discussed in all majors since it impacts everyone. However, civil engineering especially as we are creating the next generation of buildings and infrastructure, we have the ability to truly make some change in this aspect.
- Yes
- Yes, because it is going to be a big pillar in our future careers especially the way the earth is going (slowly killing our planet) we are going to need to be able to house more people while also focusing on how big of an impact itr will be to our planet.
- Yes!
- Yes I do, especially if someone were to go into environmental or geotechnical engineering it would be very good if we understood, even a vague understanding of it.
- Yes, save the planet!
- Yes
- Yes
- I think it is important for students to think about all the repercussions of their actions and how to do due diligence and research, But climate change is only one issue on that list and I don't tend to like how it is taught about in non environmental classes.
- I believe that students should learn about it, because that is our future. We will change to renewable energy more in more until it finally takes over fossils fuels.
- Yes one hundred percent, I feel as though as future engineers we need to understand how to sustain the environment that we are living in and we need to come up with ways to reduce the affects of climate change.

Do you have any interest in working in a field specifically related to renewable energy or sustainability after graduation?

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- I have thought about working in the field but changed direction with a loss of interest in the prerequisites.
- I am not interested in focusing on sustainability or renewable energy, but I am interested in integrating the ideals into the discipline I choose to specialize in.
- Yes
- Yes. I'm not sure which path but I am interested in a sustainability field.
- no
- No.

- I am interested in working in a field related to sustainability , I believe I can apply my knowledge to make some sort of a difference.
- If it pays well.
- Yes.
- Possibly.
- definitely
- No
- No
- Yes
- Im unsure at this time. However, I am interested in these topics and would definitely be interested in possibly doing a career.
- Possible
- Yes!
- no

Is it clear to you how a career as a civil engineer could be related to renewable energy or sustainability?

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- Yes, there are certainly ways where renewable energy and sustainability tie into civil engineering.
- For me, yes.
- Yes. The projects we work on are meant to stand for a long time, and they need to be able to interact with the world in the future.
- I think sustainability is deeply embedded in civil engineering and more so now than ever before. Renewable energy is not just a civil engineering project, much needs to be done in the manufacturing side. Current commercial and residential options are not very efficient while lab results are much better. Bringing the lab results to the field may allow for exponential growth.

- Yes!
- Yes
- Yes, because our population is only going up and we are overwhelming our planet. We are going to need more housing but also be aware of what pressure we are putting on our planet.
- Yes
- Yes.
- Yes
- Yes
- I understand the general idea that civil engineering is related to these topics although I don't have a deep knowledge of their relationship.
- yes.
- Yes
- Yes I do because we can make changes to help the planet.

What could the WIT civil engineering program do differently to promote greater awareness of the opportunities for civil engineers to be involved in renewable energy and sustainability?

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- Incorporate it into the already existing environmental engineering program. That seems to be the most obvious place for this to exist. There are many over lapping topics between environmental and fluids and soils. These overlaps make sense but seem redundant especially when variables and wording changes which ultimately make the topics more confusing. Leave soil contamination to soil mechanics where it truly belongs. Allow the environmental class to discuss environmental topics.
- Integrate it into the classes we take. Especially into the design classes where they could easily integrate it into projects and assignments.
- More related classes.
- Provide an elective that introduces different types of renewable energies or a sustainability class.
- The WIT civil engineering program should do nothing more than they are doing right now to promote renewable energy and sustainability. Like I said before, these are topics that should be learned in the field, not indoctrinated in the classroom. Not specifically the Wentworth Civil Department, but I believe Wentworth as a whole is far too political to give a fair analysis and teach a fair course in renewable engineering and sustainability. These practices often aren't as "green" as they seem, put America last while using cheap foreign labor, and drive up costs for the customer. If Wentworth continued with this, it would ultimately hurt their future civil engineers who need to enter the American work force.

- We could have more workshops to spread awareness or even creating an elective course designated towards it or even would have more projects which incorporate sustainability in a way.
- Teach more about it
- have in depth classes dedicated to it.
- Make an elective that dives deeper into renewable energy and sustainability.
- Talk at asce
- I think there could be more classes on these types of classes and maybe the professors could hold a get together for civil engineering students in the CEIS lobby to explain what types of classes could go with these topics.
- Work with organizations that are made to promote green / climate / environmental opportunities for students and recent grads. (College to Climate is a good one) :^)
- I believe wentworth does a good job of this. We have several clubs focused in this. As well as a whole class on environmental engineering that shows the impacts things have on our environment. My only thing would possibly be to have it introduced earlier to students. I only really understood the impact this year as a junior.