

Pathways to Green Economy Occupations in Engineering and Construction

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For this project, led by Melanie Villatoro under the ASEE Engineering for One Planet (EOP) Mini Grant, Dr. Azarderakhsh contributed to the integration of sustainability concepts into the Fluid Mechanics course, including revised lectures and laboratory activities connecting fluid dynamics to environmental applications.

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Abstract

The Department of Construction Management and Civil Engineering technology (CMCE) at New York City College of Technology is incorporating curricular modifications to prepare our students to enter “focus occupations,” identified by New York City as critical to the sustainable growth of the Green economy. We offer three degrees in construction management, civil engineering technology and construction engineering technology. The Department was recently selected as part of the 2025 ASEE Engineering for One Planet (EOP) mini grant cohort. The EOP grant provided support for curriculum development to incorporate sustainability focused learning outcomes. The project team used the EOP framework to modify five existing courses targeting core learning outcomes. The topic areas included environmental literacy, social responsibility, environmental impact assessment, materials selection, and design. These changes will be gradually implemented in the curriculum and become a permanent part of the program. The EOP framework will be integrated in our ABET self-study and continuous improvement to stay current with ASEE updates. The proposed project will impact all the students in our program; it will expose them to the significance of sustainability with respect to the engineering discipline and practice. Our graduates will be better prepared for industry demands and more importantly prepared to make decisions in their professional practice that impact society’s future. The poster will highlight the outcomes of the mini grant and discuss the plans for implementation of EOP in core engineering classes.

Keywords

Sustainability, curriculum development

Introduction

New York City has one of the most vibrant ecosystems and fast-growing environment for creating jobs. Hands-on laboratory equipment plays a critical role in engineering education by bridging theoretical knowledge with real-world application. In 2025, CMCE was awarded grant funding to procure laboratory equipment to better prepare students for “focus occupations” in the Green Economy, critical to economic growth in NYC (1). These occupations include civil, electrical, and mechanical engineers which are all projected to experience increased demand over the next decade, with employment growth ranging from approximately 5% to 9% (2). Preparation of our students to enter the workforce with exposure to sustainability both in theory and in practice is integral to their success. In summer of 2025, CMCE was awarded the ASEE Mini grant for curriculum development. These grants supplement each other and allow CMCE to incorporate new laboratory exercises in the curriculum. The procurement of laboratory equipment would be completed in phases therefore the project will begin with the modification of five courses, described in this paper. Once the new equipment is setup, the department will continue to incorporate the EOP framework across the curriculum. In the context of this project, laboratory experiences are essential for reinforcing sustainability-focused concepts introduced through the EOP framework, particularly in areas such as environmental impact, materials selection, and

system design. Given New York City’s rapidly evolving and sustainability-driven workforce, it is essential that students—across diverse backgrounds—are provided with both the technical competencies and applied learning experiences necessary to succeed. Integrating laboratory-based learning with sustainability-focused curriculum enhancements ensures that graduates are better prepared to enter the workforce and contribute to environmentally responsible engineering and construction practices.

Background

Our student population reflects several dimensions of New York City’s diversity, including ethnicity, socioeconomic background, age, and enrollment status. While the program remains predominantly male (over 80%), racial and ethnic diversity within the student body is significant, and groups historically underrepresented in engineering—such as Black and Hispanic students—are meaningfully represented. This highlights both the program’s role in broadening participation in engineering and the continued need to improve gender balance. Figures 1 through 3 provide a snapshot of these demographics.

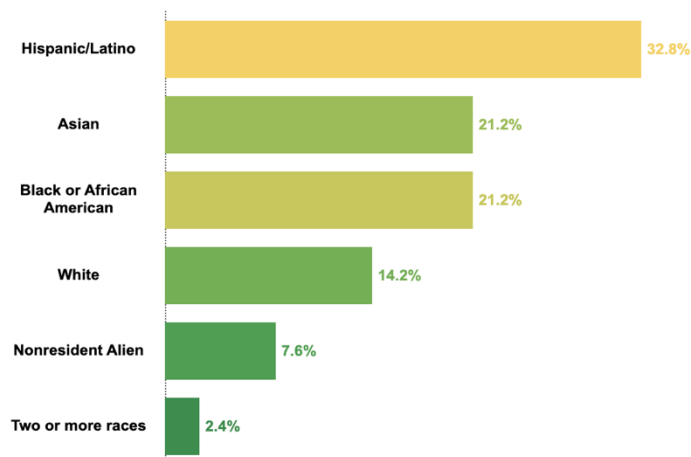


Figure 1: Enrollment by Ethnicity

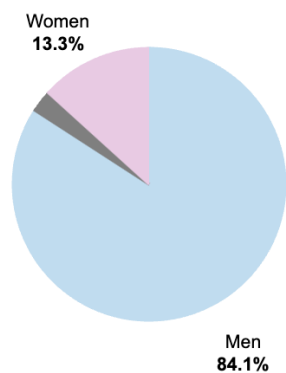


Figure 2: Enrollment by Gender

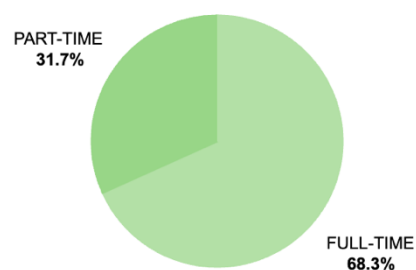


Figure 3: Enrollment Status

EOP Learning Outcomes

The EOP framework was developed as a practical implementation tool to help educators embed sustainability into engineering education. The framework aligns with accreditation standards for engineering programs as well as the United Nations Sustainable Development Goals (3). The framework is structured around student learning outcomes divided into knowledge and understanding and Skills, Experiences and Behaviors. The framework lists “what” graduating engineers should know and be able to do. This framework is shown in Figure 4.

Knowledge and Understanding - Sustainability-focused theories and concepts that are critically important to cultivate competencies related to environmental and/or social sustainability in engineers are divided into topic areas of environmental literacy, social responsibility, and responsible business and economy.

Skills, Experiences and Behaviors – A series of interdependent and interconnected skills, experiences, and behaviors are divided into technical skills, including environmental impact assessment, materials selection, and design; and, leadership skills, including critical thinking, and communication and teamwork.



Figure 4: EOP Framework

Course Modifications and Implementation

A total of five existing courses have been selected for implementation of the EOP framework. This will be achieved either by adding new learning activities and modules (CMCE 1115, CMCE 1224, and CMCE 2457) or by substantially modifying course content and incorporating new laboratory experiences (CMCE 2351 and CMCE 4461). By leveraging existing courses rather than creating new ones, the proposal significantly reduces the scope of curricular changes required for formal approval and inclusion in the college catalog. To determine the most appropriate

modifications, the team referenced the 13 Step-by-Step Ideas for Integrating Sustainability into Core Engineering Courses (4). Table 1 below summarizes the planned modifications to the selected courses.

Implementation of the course modifications are planned for fall 2026; however, modifications for CMCE 2351 were piloted in spring 2026, under the instruction of one of the project leads. The project lead attended the Engineering for One Planet (EOP) Faculty Development Workshop hosted by Villanova University's Sustainable Engineering Team in January 2026. Participation in this workshop positioned the project lead to effectively integrate sustainability principles into engineering courses and equipped them with curated resources, practical tools and proven strategies.

Table 1: Course modifications

First Year Courses	
CMCE 1115	Statics (Planned Implementation Fall 2026)
EOP Learning Outcome: Social Responsibility New Activity: Bridge Design considering ethical consideration for communities/societies, and environmental justice.	
CMCE 1224	Materials and Methods of Construction II (Planned Implementation Fall 2026)
EOP Learning Outcome: Environmental Impact Assessment New Activity: Analyzing the Environmental Impact of a product and life cycle assessment.	
Second Year Course	
CMCE 2457	Construction Techniques in Civil Engineering (Planned Implementation Fall 2026)
EOP Learning Outcome: Environmental Impact Statement New Activity: Analyzing the Environmental Impact of a product and life cycle assessment.	
Third Year Course	
CMCE 2351	Fluid Mechanics (Pilot Implementation Spring 2026)
EOP Learning Outcome: Environmental Literacy, Materials selection, Design, Communication & Teamwork Revised lectures and laboratory activities—focused on fluid forces, jet impacts, and hydropower.	
Fourth Year Course	
CMCE 4461	Instrumentation and Condition Assessments (Planned Implementation Fall 2026)
EOP Learning Outcomes: Environmental Literacy, Material Selection, and Design Course Title Change: Instrumentation and Green Roof Systems for Resilient Infrastructure New Course Content: Environmental literacy is reinforced through the addition of topics related to the history and benefits of green roofs. Material selection is strengthened through the study of green roof components and vegetation. Design is reinforced through topics related to green roof design and construction. New Laboratories: The course will also include new laboratory activities that support these learning outcomes, including green roof installation, green roof instrumentation, and system monitoring.	

Impact

The proposed project will impact all the students in our program by providing an understanding of the significance of sustainability in engineering and construction practices. The modified courses include freshman through senior level courses assuring students will have a comprehensive and sustained exposure to EOP learning outcomes. These modifications equip students with practical

sustainability knowledge across all levels, preparing them as future engineers aware of environmental impact. Approximately 400 students per year will benefit from this integration.

Evaluation

Implementation will take place in fall 2026 and evaluated at that time. As a first step, an anonymous end-of-lab student feedback form will be administered to gather student perceptions of sustainability integration, relevance to green economy applications, and clarity of connections between core engineering concepts and real-world practice. Course artifacts, such as revised laboratory reports and design assignments, will be reviewed to inform instructional refinement. Results from this initial evaluation will guide future development of assessment tools and expanded evaluation efforts as the EOP framework is implemented across additional courses.

Future Work

The integration of the EOP framework is a long-term project for the department. The modifications described in this paper will occur in fall 2026 and upon evaluation become a permanent part of the program. As we perform future cycles of continuous assessment for ABET, we will incorporate the EOP framework and stay current with industry standards. The project team plans to pursue additional funding for a comprehensive curriculum review for integration across majority of courses.

Acknowledgements

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References

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4. Engineering for One Planet Framework: 13 Step-by-Step Ideas for Integrating Sustainability into Core Engineering Courses (2023).