



High-Level Takeaways from the  
**Engineering for One Planet  
Pilot Grant Program**

*How Five Colleges Are Changing the Course  
of Engineering in Higher Education*

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# Introduction

Launched in 2020, the **Engineering for One Planet** (EOP) initiative is a coalition of organizations and individuals seeking to transform engineering education to prepare all future engineers with the sustainability and related professional skills and knowledge increasingly required in engineering professions. Catalyzed by The Lemelson Foundation and VentureWell, the initiative aims to engage higher education faculty, leaders, and institutions and other stakeholders – such as industry, government, funders, and engineering accreditation bodies – to create systems change to support curricular transformation.

The EOP Framework is a cornerstone of the EOP initiative, the first of its kind to guide coursework, teaching tools, and student experiences that define what it means to be an engineer who is equipped to protect and improve our planet and our lives. It provides faculty with a vetted menu of competencies that every graduating engineer, regardless of subdiscipline, needs to acquire to design, code, build, and implement solutions that are socially and environmentally sustainable. The EOP Framework is mapped to ABET's engineering accreditation requirements, which include sustainability competencies, and to the United Nations' Sustainable Development Goals.

One key and early use case of the EOP Framework is The Lemelson Foundation-funded EOP Pilot Grant Program. The program included five pilot grantees – **Arizona State University (ASU)**, **Villanova University**, **Oregon State University (OSU)**, **The University of Maryland (UMD)**, and **University of Central Florida (UCF)** – who were initially funded up to \$30,000 to test the integration of the EOP learning outcomes in their curricular offerings over the course of two years, from June 2020 to June 2022. Teams were also provided up to \$10,000 in supplemental funds to address challenges and opportunities that emerged after the first year, which was marked by the COVID-19 pandemic. The project was guided by an evaluation plan co-created with VentureWell and The Lemelson Foundation and through a Community of Practice led by VentureWell.

# What were the goals?

Grantees submitted proposals to address the following goals, with the understanding that their approaches were likely to change given the pioneering work they were undertaking.

## Enabling conditions

Identify and begin to develop the enabling conditions on campus to foster changes to engineering education aligned with EOP Framework learning outcomes

## Course modification and testing of the EOP Framework

Experiment with modifying one or more courses or programs to include EOP Framework learning outcomes; leverage experiences to suggest potential changes and refinements to the EOP Framework

## Curricular plan

Develop a credible plan for curricular changes designed to reach most or all engineering students at their institution; teams were encouraged to use the plan to inform and fundraise for future expansion

## Dissemination

Capture and publicly disseminate learnings and tools used in planning and implementing curricular changes

## Assessment

Design and implement measurement and evaluation approach

*“Through collaboration and action,” says Lemelson Foundation Senior Program Officer Cindy Cooper, “we can collectively go beyond changing engineering courses to change the course of engineering.”*

This program synopsis shares some of the diverse approaches that grantees took to implement sustainability, and illuminates the success of each, as well as key findings. It is a deliberately concise distillation, showcasing approaches that led to positive outcomes, to provide clear and applicable takeaways for other faculty, administrative leaders, institutions, and stakeholders.



# How did they do it?

Participants used a variety of approaches designed for their situations. The following exemplary approaches are illustrative of ideas that could be broadly adoptable by other faculty and schools.

## **Exemplary Approach # 1: Train the Trainers**

### ***Create a faculty training workshop and support implementation.***

Leveraging the school's commitment to sustainability and support from its highest levels of leadership, Villanova focused on a bottom-up approach through faculty capacity-building on how to integrate EOP learning outcomes in diverse courses, bolstered by a Community of Practice (CoP) to foster regular peer interaction and learning. Villanova also provided incentives through stipends.

### ***Develop an EOP CoP with participation requirements.***

All of the pilot grantees also participated in a CoP supported by VentureWell, which helped them not only learn from each other but also support each other through challenges and roadblocks.

## **Exemplary Approach # 2: Core Course Integration**

### ***Incorporate the EOP Framework into a core course required for all engineering disciplines.***

ASU incorporated the EOP Framework into its EGR 201, a course all engineering majors are required to take as part of the "project-based spine," a series of eight courses taken over a student's four-year education. This ensured that all of their engineering students would receive early exposure to sustainability concepts and tools, thus instilling a sustainability-focused mindset at the outset of their engineering education. It also enabled them to quickly reach a large population of students by replicating changes across several sections of the same course. After this initial success, ASU is now shifting its approach to incorporate sustainability into multiple courses.



## ***Integrate Environmentally and Socially Responsible Engineering (ESRE) content into multiple required courses.***

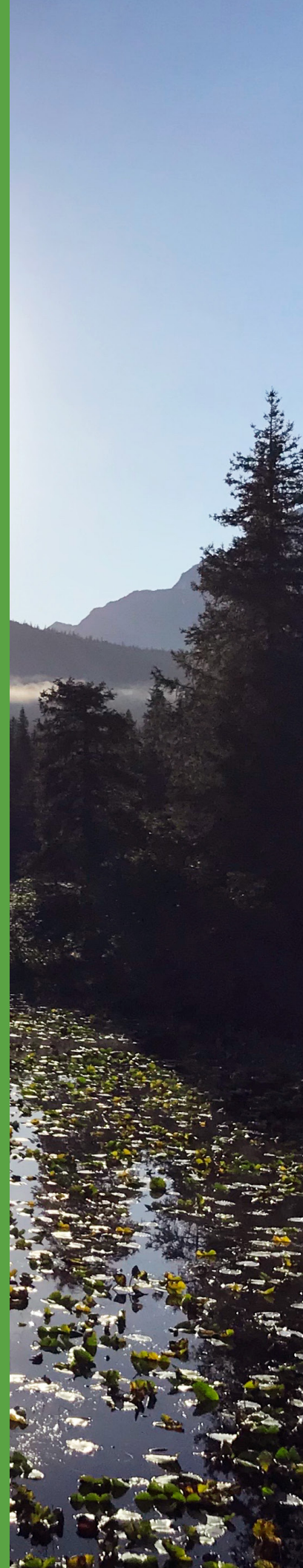
The team at UMD focused on integrating ESRE content into required courses for all engineering freshmen and sophomores, weaving a coherent message throughout the curriculum. It also created a central **website** to feature its ESRE initiatives, and is pursuing the idea of a potential EOP minor to create a connection across the school's various sustainability programs that are currently not connected.

From UMD's pilot grant project proposal:

*“Bridging the disconnects between engineering and policy and including a wide range of expertise in conversations, from public health to business and journalism, is needed to achieve effective change. Therefore, our long-term plan will involve engaging across campus and the region...Our changes place greater emphasis on the “why” of engineering and on a larger frame of reference for systems thinking, creating a changed student body.”*

## ***Create models for other faculty.***

To serve as models for other faculty looking to change curricula, UCF modified six courses and developed two new courses in a range of engineering sub-disciplines. Of these eight courses, seven were required.





From UCF's pilot grant project proposal:

*“The focus for student outcomes is to create a student population well versed in the science and culture of sustainability. We hope this will give students a competitive advantage in the marketplace and a clear understanding of the importance of this topic in everyday life at home and in business.”*

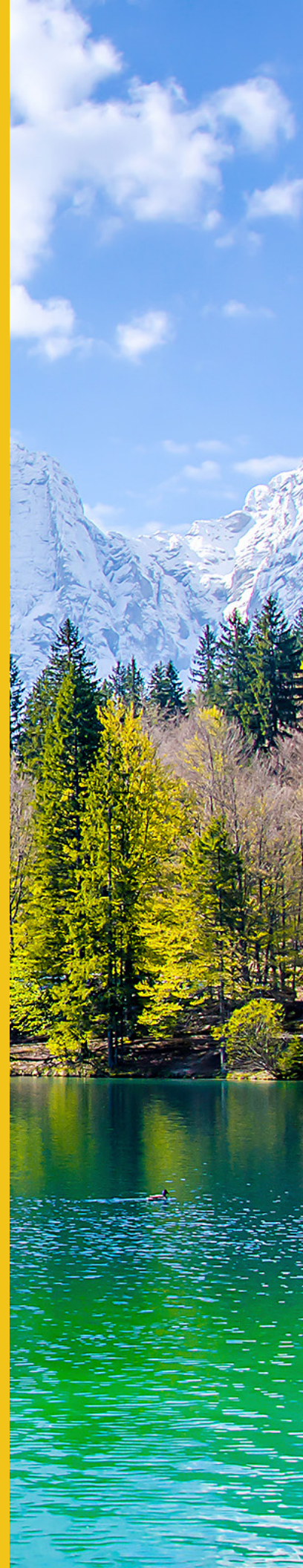
### **Exemplary Approach # 3: Integrate with and Leverage Complementary Initiatives**

#### ***Integrate the EOP Framework into other transformative initiatives and efforts.***

OSU tied the EOP Framework directly to the new ENGR+ course rollout in its College of Engineering. Leveraging the existing change effort allowed OSU to begin from the ground floor, integrating EOP learning outcomes into the work that ENGR+ instructors were already doing as they created new courses.

From OSU's pilot grant project proposal:

*“We believe that engineering...can benefit from and broaden participation by connecting computation, innovation, and [EOP] learning outcomes to relevant, global engineering topics early in undergraduate education and providing students with degree options in environmentally responsible computational engineering.”*



### ***Leverage existing university sustainability commitments, expertise, and other resources.***

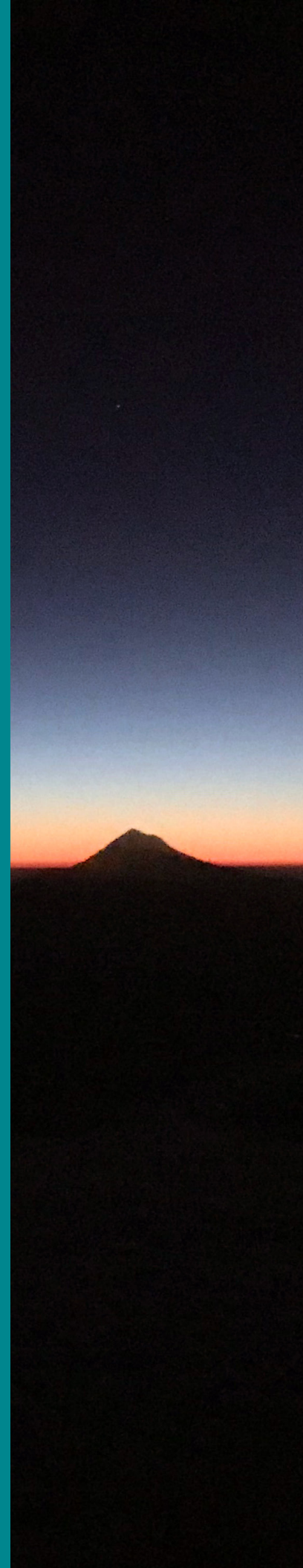
Villanova's success was facilitated by its university-wide commitment to sustainability, demonstrated by the work of its Sustainability Leadership Council – supported at the highest levels by the school's President and Provost – and the fact that it had already identified the incorporation of sustainability into courses as a strategic university initiative.

Villanova also tapped the expertise of a project team member who brought sustainability-focused tools that had been developed as part of a former consulting practice.

OSU also did a landscape analysis that helped them identify resources and collaborators within and beyond the engineering college.

The team at UMD leveraged other academic resources within the school, including its Women in Engineering program (WIE), Center for Environmental Science, and College Park Scholars Science, Technology, and Society (STS) living-learning program.

***“In all of our efforts, success has come from the ad hoc relationships and connections we have built with other departments and centers on campus that helped us,” says Vince Nguyen, a Mechanical Engineering Senior Lecturer at UMD.***





# What were the results and what have we learned?

Overall, the EOP Pilot Grantee program demonstrated a significant value and several key findings that can serve as a model for other higher education institutions.

**In total, grantees developed 21 courses that integrated EOP learning outcomes and modified 40 courses. Of the 61 total courses modified or developed, 50 were required engineering courses, far exceeding the minimum goal of one course per institution.**

“In two years,” says Cooper, “these trailblazing faculty and schools impacted nearly 6,000 students and are paving the way for embedding sustainability across engineering courses on their campuses.”

## Student Reach

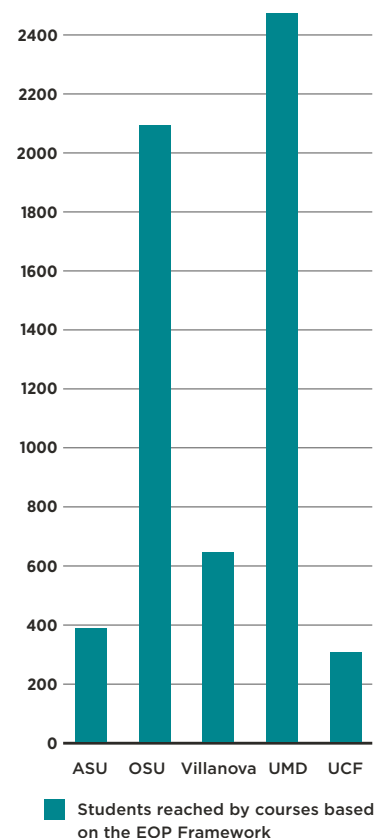
**ASU:** The single course reached 398 undergraduate students since the start of the grant period. Assessment revealed that the project-based learning course had a moderate to large impact on student competencies that comprise the EOP framework.

**OSU:** The 23 courses reached 2,090 undergraduate engineering students over the course of the project term.

**Villanova:** In total, over the course of the project term, the 19 courses reached 620 engineering students (505 engineering undergraduate students).

**UMD:** In total, the 10 courses reached 2,485 undergraduate engineering students over the course of the project term.

**UCF:** In total, the eight courses reached a total of 315 engineering students (110 undergraduate, 205 graduate students) over the course of the project term.



## Faculty Reach

In total, 80 faculty used the EOP Framework for the design or modification of a course.

## Enabling Conditions

Following were identified as key factors that facilitated curricular change efforts. Conversely, when these conditions were weaker or absent, higher barriers were encountered.

1. *Leadership support and institutional prioritization of sustainability:* A “green light” from leadership can support the momentum needed to pursue EOP curricular change efforts. When sustainability was already an institutional priority, a supportive culture and existing teaching resources were readily available to aid faculty in their change efforts.
2. *Faculty motivation, knowledge, and skills:* While faculty may be interested in embedding sustainability into their engineering courses, they often lack time and capacity to explore how to go about doing it. Providing faculty with the resources they need may reduce these barriers. Faculty champions can also support the EOP initiative within and outside of their departments. Having a robust change team including at least two faculty champions and individuals responsible for project management, measurement and evaluation, and documentation also aided progress and the ability to weather challenges.
3. *Seed grants:* The seed funds provided by the program were modest but helped teams offset costs including faculty time, stipends for participation in training workshops, and student workers. External funding provided credibility to the efforts.
4. *Building relationships and aligning with campus resources/efforts:* While a challenge during COVID, grantees explored how to leverage existing campus resources, initiatives, and efforts – including connecting with sustainability offices, teaching hubs/communities of practice, and other centers/departments fostering innovation and entrepreneurship – to identify resources and capacity to support their initiative, and to find ways to align efforts, rather than create competing efforts.
5. *Student engagement:* Student interest and support is critical to institutionalizing the importance of sustainability on campus. Student champions can serve as advisors, researchers, and advocates for curricular change.



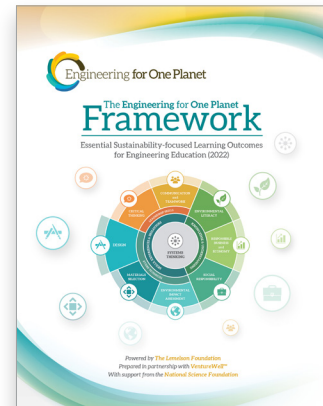
Grantees also suggested that modification of promotion and tenure (P&T) systems could help enable similar curricular change efforts. Particularly at research universities, where publications and grant funding are highly recognized and rewarded, efforts to improve and enhance pedagogy are often less emphasized and rewarded. Integrating the teaching of sustainability as a priority in P&T is likely to incentivize more faculty.

## EOP Framework

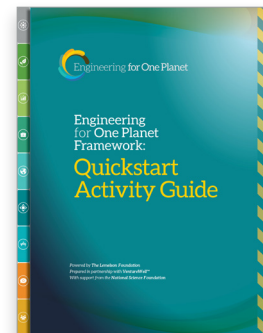
The EOP Framework proved to be a valuable tool to inform curricular change efforts. As Villanova stakeholders wrote in their project grant proposal, “The College believes that the [EOP] Framework provides fundamental learning outcomes that every graduating engineer should acquire.”

Pilot grantee feedback led to key modifications to the EOP Framework, including:

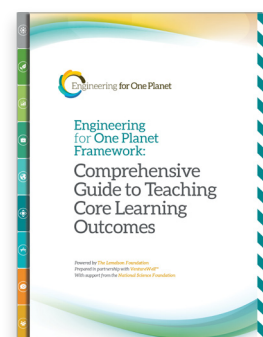
- Defining and emphasizing sustainability as both social and environmental
- Clarifying EOP Framework audience
- Revising outcomes to be measurable and tracked to Bloom’s Taxonomy
- More clear and specific alignment between EOP Framework learning outcomes and ABET student outcomes outlined in Criterion 3
- Making a stronger connection to Diversity, Equity, Inclusion, and Justice
- Development of companion teaching guides



**The Engineering for One Planet Framework**



**EOP Framework: Quickstart Activity Guide**



**EOP Framework: Comprehensive Guide to Teaching Core Learning Outcomes**

## Going Forward

As the climate crisis and other sustainability concerns escalate, a shift in college engineering courses is critical to ensuring a future in which solutions are designed not only to solve problems and improve lives in equitable and inclusive ways, but also to safeguard the environment **upon which all life depends.**

From ASU's pilot grant project proposal:

*“Infusing future engineers with ideals of social justice, with practical tools to understand engineering’s impact on the world, and the ability to work intimately with those who have different kinds of knowledge, is to change the world. This is because any and all invention that comes from the ethos of a new responsibility towards the environment will be different, in function and in essence. We believe this project will help improve all lives—human and non-human—through [EOP]-focused inventions.”*

The results of the EOP Pilot Grant Program have helped inform the Engineering for One Planet initiative, provided feedback to revise the EOP Framework, and generated new insights on successful curricular change and teaching and assessment tools that will enable more institutions to accelerate their efforts to infuse sustainability across engineering education.

*“It’s the best organization and visionary program around,” says University of Central Florida professor Thomas O’Neal.*

The EOP initiative continues to expand and reach more faculty, students, and institutions, providing curricular change tools, funding, and supporting collaborative projects among stakeholders.

To learn more about EOP, visit us at [engineeringforoneplanet.org](https://engineeringforoneplanet.org) and join our rapidly growing movement by **becoming a signatory.**



## Core Team Members and Project Responsibilities\*

**ASU's Core Team**

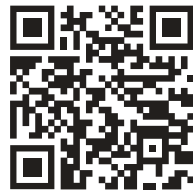
					
Dr. Darshan Karwat Principal Investigator (PI)	Dr. Ira Bennett Co-PI	Dr. Adam Carberry Co-PI	Prof. Philip White Co-PI	Dr. Wendy Barnard Evaluator	Dr. James Larson Consultant

<b>OSU's Core Team</b>				<b>UCF's Core Team</b>	
					
Dr. Jennifer Parham-Mocello - PI	Dr. Meagan Wengrove Co-PI	Dr. Tom Weller Co-PI /administrative lead	Dr. Rachael Cate Evaluator	Dr. Tom O'Neal PI	Dr. Woo Hyoung Lee Co-PI

<b>UMD's Core Team</b>				<b>Villanova's Core Team</b>	
					
Dr. Natasha Andrade Co-PI	Dr. David Bigio Co-PI	Dr. Vince Nguyen Co-PI	Dr. Elisabeth Smela Co-PI	Dr. Andrea Welker PI	Dr. William Lorenz Co-PI

\*Some team members have since changed roles and institutions





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