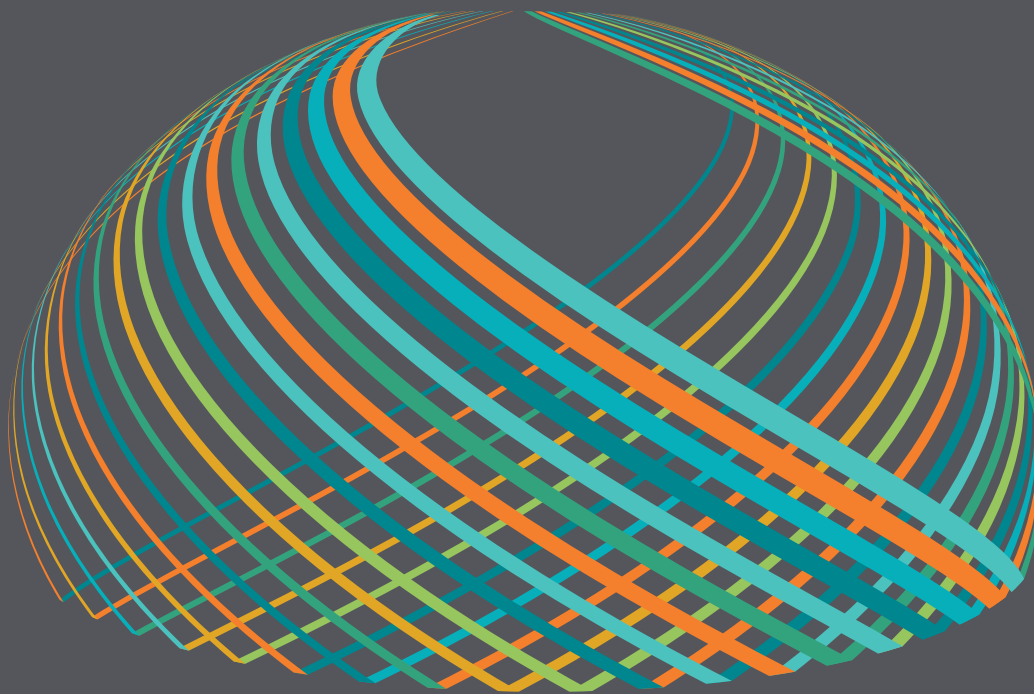


ENGINEERING FOR ONE PLANET:

A Strategic Roadmap



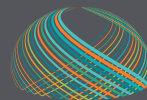
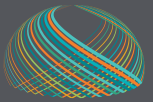


Table of Contents

INTRODUCTION	4
BACKGROUND	5
The Engineering for One Planet Initiative	5
Developing the Strategic Roadmap	7
Twelve Recommended Approaches for Scaling the EOP Initiative	8
 THE STRATEGIC ROADMAP	
Five-Year Strategic Vision	9
Strategies for Advancing the Initiative Nationally	10
Key Levers of Change Within Higher Education Institutions	12
Implementation Considerations	13
TAKING ACTION	15

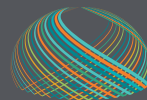


The Engineering for One Planet Framework is a tool for organizing and modifying curricula and experiences to incorporate essential sustainability-related competencies into engineering education.



The Engineering for One Planet initiative aims to transform engineering education to reflect the critical importance of sustainability in all engineering functions. It has already developed and piloted a curricular framework that has demonstrated relevance to hundreds of stakeholders. In the next five years, it can scale significantly by mobilizing national organizations, institutional leadership, educators, students, and industry—building their capacity to equip students with the skills, knowledge, mindsets, and understanding to protect and improve our planet and our lives.





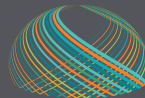
INTRODUCTION

Converging crises—including climate change, loss of biodiversity, pollution, and accumulating waste—are leading stakeholders across sectors to demand solutions to protect and regenerate the environment, ensure environmental justice, and advance human health, welfare, and prosperity. Engineers can be powerful agents of change because they directly and indirectly influence the creation of everything, from consumer goods to hardware and software products, as well as buildings and modes of transportation. But for engineers to help mitigate these crises, they must be literate in the tools, concepts, and principles of sustainability, and trained to integrate sustainability into their practice.

The **Engineering for One Planet** initiative is premised on the belief that building this critical training into engineering education—making it a fundamental part of undergraduate and graduate engineering programs—is the most effective way to ensure that the future engineering workforce is equipped to solve the great challenges of our time. Right now, only a fraction of engineering students receive this training as part of their education. The Engineering for One Planet initiative aims to change that, with the ambitious goal of transforming engineering education such that *all* future engineers, across *all* disciplines and lived experiences, learn the fundamentals of social and environmental sustainability as well as the leadership skills needed to be effective advocates for sustainability throughout their careers. With 560 U.S. institutions currently accredited for engineering programs, reaching this goal will require broad engagement and robust national leadership to coordinate efforts and accelerate an educational movement.



The scaling strategy outlined in this strategic roadmap is based on the input of more than 100 stakeholders across the U.S. who gathered in 2022 to identify ways of scaling the Engineering for One Planet initiative. The Scaling for Impact workshop was supported by the National Science Foundation and co-hosted by VentureWell and The Lemelson Foundation. This strategic roadmap has also been informed by the lessons learned and results achieved from the initiative to date (see Background for more information), and key considerations drawn from a Collective Impact approach that centers equity. This strategic roadmap calls for stakeholders—including academia, industry, accrediting and professional organizations, community organizations, nonprofits, funders, and those communities most affected by the negative impacts of environmental and social sustainability challenges—to move beyond singular programmatic interventions, and instead work to collaboratively understand and construct coordinated solutions to integrating sustainability into engineering education.



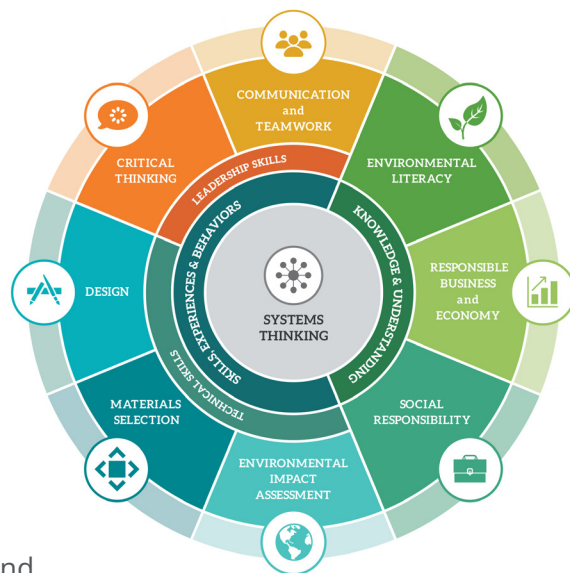
BACKGROUND

The Engineering for One Planet (EOP) Initiative

Vision: Sustainability is a core tenet of the engineering profession.

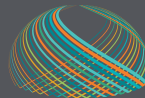
Goal: Transform engineering education to ensure all engineers are equipped with the skills, knowledge, mindsets, and understanding to protect and improve our planet and our lives.

Catalyzed by The Lemelson Foundation and VentureWell, Engineering for One Planet is an initiative to transform engineering education to reflect the growing importance of sustainability in all engineering functions. The initiative has been developed and is evolving through collaboration among hundreds of sustainability advocates across sectors, geographies, and lived experiences. It utilizes three interrelated strategies to achieve its vision to transform engineering education so all engineers are equipped to design, build, and create in environmentally and socially sustainable ways:



1. **Teaching Resources:** a common framework and related teaching and assessment tools to facilitate curricular change and peer learning
2. **Catalytic Grants:** support for curricular change through funding and mentorship, and
3. **Collaborative Community:** stakeholders across sectors collaborate and take actions that accelerate change.

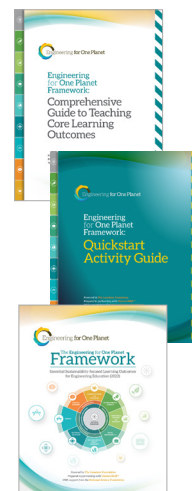
The Engineering for One Planet Framework, first launched in 2020 and revised in 2022, provides faculty with a vetted menu of competencies—presented as a total of 93 advanced and core student learning outcomes across nine topic areas—that every graduating engineer, regardless of subdiscipline, needs to acquire to design, code, build, and implement solutions that are socially and environmentally sustainable. Framework outcomes are mapped to the seven student outcomes published by the engineering education accreditation body, ABET, as well the United Nations Sustainable Development Goals.



To better support faculty efforts to integrate the Framework and sustainability-focused content into engineering courses and programs, three companion teaching guides were collaboratively developed and launched in 2023: the *Quickstart Activity Guide*, the *Comprehensive Guide to Teaching Core Learning Outcomes*, and *13 Step-by-Step Ideas for Integrating Sustainability into Core Engineering Courses*. New resources will continue to be developed.

Collaborators

- Experts from across sectors, disciplines, and lived experiences collectively developed and refined the Framework.
- The 72-member Engineering for One Planet Network is a volunteer action network launched in 2021 to support collaborative stakeholder efforts.
- Five universities (the Pilot Schools) received grant funding from The Lemelson Foundation in 2020-2022 to pilot the use of the Framework in driving curricular change: Arizona State University, Oregon State University, University of Maryland, University of Central Florida, and Villanova University.
- A total of 27 institutions received grants in 2022 and 2023 through the American Society of Engineering Education (ASEE) Engineering for One Planet Mini Grant Program, including 11 Minority Serving Organizations. This funding supports teams of educators pursuing new approaches to integrating sustainability into curricula.



Reach To Date

Today, 33 higher education institutions have received funding to use EOP's resources to support curricular changes by more than 100 faculty members, having an impact on 10,000 students and nearly 200 courses. EOP's open source resources are also being used by faculty and institutions without direct grant funding.

EOP initiative and EOP Framework design

Background research, interviews, roundtables, briefs, and EOP Framework open commenting period (200 plus stakeholders engaged)

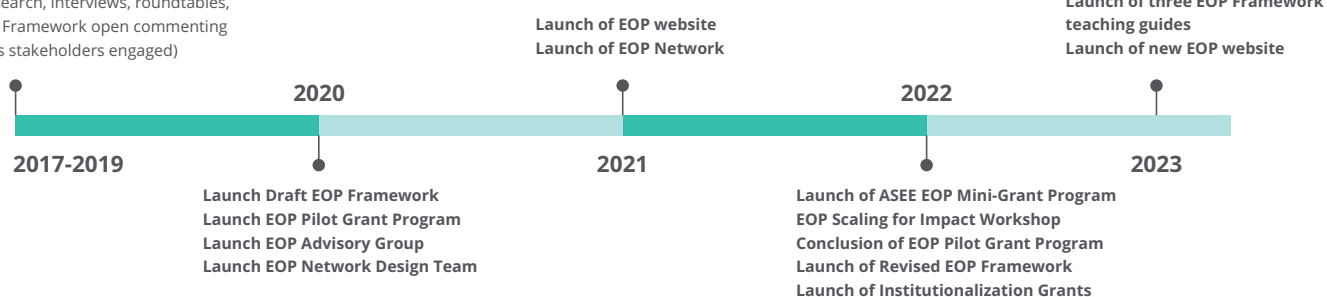
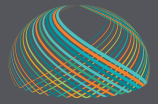


Figure 1: Early development of the Engineering for One Planet initiative



Developing the Strategic Roadmap

The Engineering for One Planet initiative is ambitious, aiming to augment the education that all engineering students receive, and it is driven by the urgency of the environmental and social crises that inspired it.

In June 2022, with the support of the National Science Foundation (NSF) and the collaboration of The Lemelson Foundation, VentureWell hosted the **Engineering for One Planet Scaling for Impact Workshop** to engage a broader group of stakeholders in order to increase awareness of the initiative, attract new supporters and champions, and inform a scaling strategy. Participants recognized that a scaling strategy must foster both propagation (defined as the action of widely spreading and promoting related ideas or tools to foster systems change), and institutionalization (defined as the action of establishing related ideas or tools across and within an organization or institution).

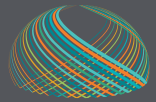
This two-day workshop brought together 101 participants from multiple sectors including academia, industry, government, and nonprofit organizations to achieve the following goals:

- **Share lessons learned from the extant literature** regarding how to embed sustainability into the curriculum, and lessons from the pilot grantees regarding how to integrate the Engineering for One Planet Framework into curricula and programs.
- **Surface approaches and recommendations to inform the design of a roadmap** to achieve the initiative's vision at scale, that considers and incorporates:
 - Recommendations for refining and scaling the EOP Framework, including measuring the integration of the Framework across engineering programs nationally.
 - Diversity, equity, inclusion, and justice (DEIJ).
 - Approaches that foster both propagation and institutionalization.

Of the 101 workshop participants, 29 were involved in the planning and execution of the workshop. The remaining 72 participants were recruited in a way that sought demographic diversity and representation from each sector.

Recruited attendees identified as follows:

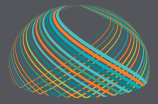
- 39% women
- 50% non-white
- 69% were from academia
- 19% of academics were from minority-serving institutions
- 15% were from industry



Twelve Recommended Approaches for Scaling the EOP Initiative Generated at the EOP Scaling for Impact Workshop:

The workshop yielded 12 synthesized approaches to increasing sustainability in engineering training and practice, which are listed below in the order of frequency that they were proposed by participants, working in groups.

1. EOP community works with ASEE to create a sustainability division with a web hub/platform to share resources, host training and professional development opportunities, and foster and support communities of practice or a fellows program to move the EOP initiative forward.
2. EOP leads public campaigns around sustainability and EOP initiative to foster cultural change.
3. Industry (and/or community organizations) and higher education institutions collaborate to change their culture/ environment around sustainability.
4. Targeted funding to support sustainability-related projects, programs, courses, research, and/or assessment to drive systemic curricular change in engineering education and culture.
5. Modify the engineering licensure process to more strongly emphasize sustainability and train students accordingly.
6. Connect student organizations with professional organizations and/or industry working toward sustainability.
7. Higher education institutions develop long-term vision on sustainability-related investments and supporting systems.
8. Development of national inter-collegiate collaborations and competitions.
9. Higher education institutions develop a cross-campus, multidisciplinary university-based committee to promote sustainability.
10. Engineering faculty use a student-centered approach to match students' needs/demands for sustainability with opportunities to practice via internships, capstones, or special projects.
11. Engineering departments and faculty have early required coursework in sustainability.
12. Creation of new courses and modification of existing courses to include sustainability-focused competencies (vertical and horizontal integration, broadly).



FIVE-YEAR STRATEGIC VISION

To date, faculty and staff at 33 institutions have been engaged in the initiative through grants from The Lemelson Foundation and the American Society for Engineering Education (ASEE), and hundreds of stakeholders have participated in strategic conversations and the development of resources. In scaling the Engineering for One Planet initiative, efforts should be focused on three outcomes. In each of these areas, it will be valuable for leading organizations to establish ambitious yet achievable goals to inspire and galvanize action.

Three Outcomes in Scaling the EOP Initiative

- **Expand participation and impact**

Greatly expand the number of individuals, schools, corporations, and organizations involved in the initiative at every level—from base-level participation (signatories) to leadership roles. It will be important to create a big tent that can engage all engineering programs that are currently fostering sustainability literacy in some way, and it will be important to engage corporations as advocates for sustainability literacy in the engineers that they hire.

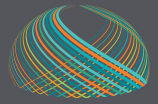


- **Increase understanding of change**

Increase understanding of how to measure the integration of sustainability in engineering education, both to assess the current state and to measure progress at an individual institution and across institutions. Equally important is increasing the understanding of effective approaches to driving this change so as to develop evidence-based strategies, case studies, how-tos, and curricular resources.

- **Raise the profile of the opportunity**

Increase awareness of the need for sustainability-focused engineering within higher education broadly, within the engineering field in particular, within industry, and within policymaking circles. This outcome will be a natural consequence of the other outcomes, but care should be taken to amplify efforts and reach these audiences. This work should be pursued in collaboration with a growing number of similarly aligned efforts to maximize impact.



Strategies for Advancing the Initiative Nationally

Community Building

Invite wider participation and provide a variety of ways to increase communication, awareness, peer learning, resource sharing, and relationship-building to support individuals and institutions tackling change.

Actions:

- Create a centralized platform that provides easy access to relevant information, including a curated listing of resources, funding opportunities, training, and other professional development opportunities.
- Enable multi-directional communication for people engaged in the initiative.
- Foster and support communities of practice.
- Implement national and regional collaborations and competitions.

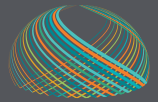
Resources and Professional Development

Provide a variety of opportunities for participants to access resources and increase their skill and knowledge related to integrating sustainability in engineering education.

Actions:

- Offer professional development opportunities for faculty and administrative leaders to build knowledge and skill related to sustainability, leadership development, and change management.
- Curate and facilitate the development of additional curricular resources to support the implementation of the Engineering for One Planet Framework, complementing the three companion teaching guides.
- Revise and refine the Engineering for One Planet Framework based on feedback and input, at regular intervals.
- Promote other aligned resources, tools, and opportunities.





Strategies for Advancing the Initiative Nationally continued

Partnerships

Enlist and expand the support and partnership of relevant national organizations and industry.

Actions:

- Expand partnerships with associations, accrediting bodies, and other relevant entities (ASEE, ABET, and others).
- Establish a national corporate leadership group and encourage university-industry collaboration.

Advocacy

Engage with funders, policymakers, and other influential stakeholders to build awareness and alignment with existing strategies, programs, regulations, and incentives.

Actions:

- Engage in a variety of outreach campaigns to build awareness of the initiative with key audiences.
- Convene a working group to explore the integration of sustainability in engineering licensing.

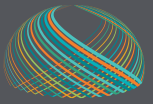
Research and Measurement

Develop a greater understanding of how to measure the integration of sustainability in engineering education and effective approaches for achieving that integration.

Actions:

- Identify an entity that will coordinate and lead research efforts.
- Develop a shared measurement system for measuring (a) change within an individual institution and (b) change across all institutions nationally.





Key Levers of Change Within Higher Education Institutions

Curricular Change

Engineering education cannot change without broad, meaningful curricular change, in particular:

- Integrating sustainability-focused competencies in new and existing courses, with both vertical and horizontal integration.
- Requiring coursework in sustainability early on in degree programs.
- Integrating sustainability-focused student projects (such as internships, capstones, or special projects) into engineering curriculum.

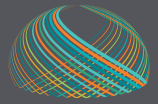


Institutional Change

While curricular change at the department and faculty level is critical, it is also important that institutions integrate and prioritize sustainability, in particular by:

- Supporting schools, departments, and faculty in accessing professional development and implementing curricular change.
- Develop partnerships with companies and organizations to change their culture around sustainability-focused engineering and create co-curricular and employment opportunities for students.
- Creating cross-campus committees focused on promoting sustainability within the curriculum.
- Developing a long-term vision and strategic plan for sustainability-related investments and supporting systems.





Implementation Considerations

Center Diversity, Equity, Inclusion, and Justice (DEIJ)

The initiative has identified ways to integrate DEIJ, such as including members of marginalized communities in the development of content and recommendations around sustainability, and ensuring that a broad and diverse group of stakeholders is engaged in the initiative at all levels. It should continue exploring ways to center these aims within all activities.

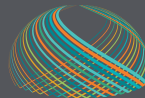
EOP Efforts Should Continue to Engage a Variety of Institutions and Stakeholders

EOP should prioritize reaching diverse schools and programs, including Minority Serving Institutions and emerging research institutions. Within institutions, it is important to engage a variety of stakeholders and for them to work together (for example, on “institutional change teams” that include multiple roles). Specifically:

- Deans and other administrative leaders can envision and effect changes at the programmatic, departmental, college, and institutional levels.
- Faculty can integrate sustainability content and learning objectives into existing and new courses and programs.
- Students can speak to the experience of curricular and extracurricular changes and to their decision processes for selecting graduate engineering programs.
- Career counselors and workforce development leaders can engage with industry to develop internships, apprenticeships, cooperative education programs, and other aligned opportunities for students.

Nationally, it would be valuable to facilitate networking among these and other stakeholder groups and to leverage their expertise and ideas.





Foster Regional Collaboration

While enabling collaboration at the national level is important, it is worth considering how to offer support for regional collaboration. Regionally coordinated efforts—a set of geographically related institutions, companies, and other organizations that are working together to create not only change at each participating entity but pathways across entities—can incorporate region-specific contexts and ensure the inclusion of all types of institutions, whether they offer fully accredited engineering degree programs or single pre-engineering courses. This approach may help to increase engagement with groups that are underrepresented in engineering. In-person convenings held regionally would also decrease the travel-associated cost and carbon footprint.



Include All Relevant Efforts

The Engineering for One Planet initiative has taken a thoughtful and collaborative approach to date in defining the challenge and developing the Engineering for One Planet Framework. As the initiative expands, it should seek to continue to include and engage all current efforts to integrate sustainability into engineering education, whether those efforts are specifically guided by the Framework or not.



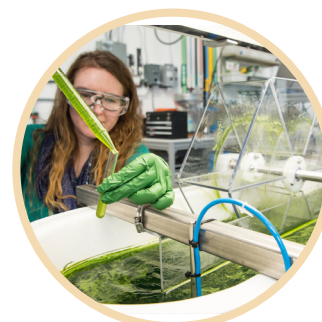
Learn From Successful Change Initiatives in Education and Beyond

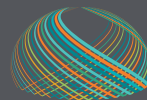
Catalyzing change across hundreds of institutions, organizations, and companies—with different priorities, incentives, and values—is a complex undertaking, and it will be useful to continue to look to other examples of successful large-scale change in a variety of fields such as education and healthcare.

Integrate Elements of the Collective Impact Model*

While the Engineering for One Planet initiative may or may not strictly follow the Collective Impact Model, key elements of the model have proven to be highly effective at facilitating large change initiatives and can serve as useful examples.

**For more information on Collective Impact, see Kania, J., & Kramer, M. (2013), *Embracing Emergence: How Collective Impact Addresses Complexity*.*





TAKING ACTION—WHAT ROLE CAN YOU PLAY?

Join the Initiative

We invite you to help transform engineering education by joining the Engineering for One Planet initiative. You can:

- Follow EOP on [LinkedIn](#).
- Sign up for updates via the [EOP newsletter](#).
- Add your voice by publicly [supporting EOP](#).



Academia

Students: Start or participate in a sustainability-focused engineering club on your campus. Voice your concerns and desire for more sustainability-focused courses and opportunities, such as internships at companies that care about sustainability.

Faculty: Share your best practices and challenges for how you are practically implementing student learning outcomes from the EOP Framework into your courses and at your institution.

Deans: Champion inclusion of environmental and social sustainability by supporting faculty change agents and advocating for sustainability in your core engineering curricula. Be an advocate for change amidst naysayers. Examine your current offerings and ensure DEIJ practices are enacted in your department.

Industry

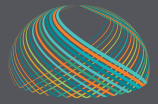
Offer internships, mentorships, jobs, and other professional development opportunities for engineering students and graduates focused on sustainability. Provide scholarships to under-resourced and under-represented students. Participate in advisory committees at your local university. Stand up for EOP ideals in your place of work.

Philanthropy

Financially support environmental and social sustainability curriculum updates. Provide thought leadership in your sector on why it is important to support the EOP initiative. Network and bring others to the table to continue to advance funding opportunities.

Government

Provide funding for environmental and social sustainability opportunities. Prioritize sustainability in educational regulations. Collaborate and participate in future EOP events.



About VentureWell

VentureWell supports the cultivation of an emerging generation of science and technology inventors and the innovation and entrepreneurship ecosystems that are critical to their success. Since its founding in 1995, VentureWell has funded or trained over 16,000 science and technology inventors and innovators, resulting in the emergence of over 3,600 ventures with groundbreaking technological advancements in fields like biomedicine and healthcare, sustainable energy and materials, and solutions for low-resource settings.

The startups they have supported have raised subsequent funds totaling more than \$5.4 billion and are reaching millions of people in 48 countries. Visit venturewell.org to learn more.

About The Lemelson Foundation

The Lemelson Foundation uses the power of invention to improve lives. Established by prolific U.S. inventor Jerome “Jerry” Lemelson and his wife Dorothy in the early 1990s, and guided today by the Lemelson family, the Foundation believes invention can solve many of the biggest economic, social, and environmental challenges of our time. A private philanthropy located in Portland, Oregon and operating globally, The Lemelson Foundation has provided over \$300 million in grants and other investments to hundreds of organizations around the world. For more information, visit www.lemelson.org.

About Engineering for One Planet

Engineering for One Planet (EOP) is a collaborative initiative –powered by The Lemelson Foundation – that aims to transform engineering education to equip future engineers with the skills and knowledge they need to protect and improve our planet and our lives. Recognizing the growing professional demand for engineers with expertise in climate action, social equity, and environmental sustainability, EOP works with educators, students, industry, and other funders to integrate sustainability principles and practices across engineering curricula. By fostering a new generation of engineers who are not only technically skilled but also socially and environmentally conscious, EOP is paving the way for a more sustainable and equitable future for all. Learn more at www.engineeringforoneplanet.org.

