

Civil and Environmental Engineering

In MIT's [Department of Civil and Environmental Engineering \(CEE\)](#), we utilize innovative science and engineering in order to maintain a strong focus on fundamental issues related to infrastructure and the environment to achieve sustainability at scale. CEE strives to create a better world by conducting research that starts with having a fundamental understanding at the micro-level: knowledge needed to achieve solutions to benefit society at the macro-scales. We work in and out of the classroom every day in order to expose our students to small-scale change that produces large-scale global impacts.

The department continued to grow during AY2019, with notable advancements in research, newly enriched educational programs and subjects, as well as local, regional, and global gains in recognition. Through new faculty hires, we continue to enhance our leadership in the fields of structural engineering and the environment. Together, our new and current faculty collaborate to provide the inventive, intradisciplinary research, experiences, and skills necessary to redefine and challenge the boundaries of civil and environmental engineering in the 21st century.

Our CEE students seek to rework traditional problems and discover unconventional solutions that include new approaches and insights to existing challenges. Whether the students are in the classroom, out in the field, or in the labs, they are at the core of the department initiatives. Through scaling and innovating from the nano- to the macro-level, our students strive to focus on improving human lives and conditions, across the globe.

In AY2019, we have made efforts to further reach and interact with the MIT undergraduate student population. From new major opportunities and increased outreach for potential students through events, posters, email campaigns, new events, symposia, and other initiatives, such as the CEE blog and social media outreach.

CEE is motivated to understand and solve the big engineering and scientific challenges that were once out of reach. We have made continuous efforts through AY2019 to enhance and maintain the department website, making the content accessible and appealing to all members of the community. At CEE, we strive to create an inclusive and diverse community that provides the resources necessary for success. We appreciate and welcome people from various backgrounds, cultures, and ideas.

In AY2019, the Academic Programs Office and Communications worked together to create cohesive marketing campaigns across print and digital mediums that are consistent with the visual aesthetic of the CEE website. In addition to communications campaigns for new subject offerings, events, and majoring in the department, we have also increased our social media presence across numerous platforms, allowing for increased engagement and followers. The Academic Programs Office and Communications continued to create a series of recurring email campaigns, targeting MIT first-years, with specific outreach and events designed to strengthen interaction, engagement, and understanding of our goals and mission.

The effects of this increased emphasis on communications in the department have been highlighted across several significant research areas. For instance, the faculty in the Parsons Lab have expanded our understanding of complex atmospheric and ocean ecological systems, offering insight into these dynamic ecosystems.

Research conducted in the Pierce Lab has contributed to groundbreaking methods and is actively designing impressively strong materials, which are often inspired by nature. These materials will alter the landscape of civilizations forever, creating more sustainability and eco-friendliness. In addition, CEE has continued to offer fieldwork opportunities to undergraduate students that emphasize the importance of receiving the full context of research projects. This hands-on research puts students directly in touch with the problems they seek to solve.

Our cross-disciplinary research culture also links seemingly dissimilar projects, such as Professor Benedetto Marelli's application of silk fibers to preserve fresh fruit, to optimal mechanical devices that effectively coat the fruit. A community working across boundaries toward broadscale solutions has been a successful way to continue innovating and keeping up with the immediate and emerging needs of society.

Appreciating a broadly empowered vision, the civil and environmental engineering profession continues to require extraordinary efforts. As educators, our role requires that we anticipate these shifts to improve and provide students more holistic and in-depth learning experiences, providing students with a strong foundation to contribute to the world's demands. This commitment is reflected in our core mission of the department, to educate at all levels, ranging from undergraduate to postdoctoral.

The forward-thinking and constantly evolving Course 1 undergraduate program, updated in 2014, integrates civil, environmental, and systems engineering into one single program. The program features increased flexibility by design, allowing students to fulfill Institute and departmental requirements while encouraging personalization of tracks that best match their career and research interests.

In AY2019, the department has made headway in highlighting the diverse field of civil and environmental engineering. The Undergraduate Education Committee put together new roadmaps to demonstrate subject sequencing to complete a CEE degree in each core, while satisfying requirements in both a computer science or design (School of Architecture) minor.

The Academic Programs Office collaborated with the Undergraduate Education Committee, CEE Student Association, and Communications to promote and publicize the Course 1-ENG undergraduate program through countless channels, such as posters and email campaigns, student blog posts, career-oriented brochures, social media campaigns, photo and video projects, and department events. The department also continues to provide three minors: Civil Engineering, Environmental Engineering Science, and Civil and Environmental Engineering Systems, which were introduced in fall 2016.

Goals, Objectives, and Priorities

The Department of Civil and Environmental Engineering has made strides this past year toward realizing the full potential of a more integrated and enhanced department. It

is experiencing a transformation similar to the major disruptions of the 1960s with the introduction of computation, and then later in the 1980s when environmental science, genomics, and microbiology influenced the field's direction. Only now, the influences are around the earth and atmosphere, agriculture, and building sustainable cities.

Our students continue to change the world. From alumni entrepreneurs desalinating ocean waters to engineers designing more resilient, sustainable, and energy-efficient cities, MIT is redefining what it means to work in this increasingly comprehensive field. Working together across disciplines, education, and experience levels, our students, faculty, and researchers address the many questions and challenges civilization faces today.

As engineers, we continue to build, but our direction is now better informed by discovery and innovation of nature at the nano-level. Data characterization, modeling, and analysis also have lent new insights to our work, allowing design experimentation to be accomplished in hours, compared to what would have previously taken days, weeks, or months. New tools and instruments—such as high-powered Raman spectroscopy—plus renovated and newly created lab spaces increase capacities.

CEE's five strategic objectives remain the same as we continue our important work and build upon past accomplishments. This report articulates our advancements during AY2019:

- Renew, develop, and implement inspiring educational programs
 - Undergraduate and graduate level, postdoctoral program
- Establish an effective and diverse administration, facilities, and community
 - An effective administration, with transparency and driven by bottom-up initiatives that support our students, faculty, and staff
 - Renew and improve facilities and build new opportunities for exciting research and teaching programs
 - Establish and renew laboratories for new faculty hires and existing faculty
- Focus on the future of Civil and Environmental Engineering—accelerated faculty hiring and junior faculty development
 - Faculty renewal continues to be a top priority
 - The department has so far made approximately 23 hires over the past 12 years
- Leadership at MIT and beyond—outward focus and initiatives
 - Define a clear positioning of CEE at MIT
 - Serve as a strong contributor to MIT initiatives, including the Environmental Solutions Initiative, the J-WAFS Center for Food and Water, and the MIT Energy Initiative, among others
- Alumni engagement and resource development

- We aim to improve the engagement with alumni through a variety of mechanisms, to share the work we are doing today at MIT and CEE, to make connections between alumni and students, and to gather input from our alumni as the department continues to evolve
- Developing resources to further the mission of CEE

The Visiting Committee meeting in fall 2018 continued to support the vision and activity during AY2019 under the leadership of McAfee Professor of Engineering Markus Buehler, department head. It was recognized that the department is energized and fast moving, that it has been a period of great change. All recognize that the vision and execution of vision are works in progress, and almost all are energetically embracing the directions taken and all of the changes that have taken place.

Objective 1: Renew, Develop, and Implement Inspiring Educational Programs

Over the past academic year, 198 students were enrolled in CEE (51 undergraduates and 147 graduate students/doctoral candidates).

CEE awarded 38 PhDs, 16 SMs, 22 MSTs, and 11 MEng degrees in the graduate program and 17 SB degrees in the undergraduate program (for bachelor of science degrees). Of the 38 PhD graduates, approximately two thirds are typically proceeding to careers in academia.

Undergraduate program academic highlights

AY2019 saw the fifth full-year cohort of students in the department's new Course 1-ENG (general engineering), which is an accredited bachelor of science degree program. The new undergraduate program is a comprehensive curriculum that better prepares graduates for their professional, post-MIT lives, while emphasizing a strong foundation in math, computation, probability and statistics, data analysis, and design.

The department was reviewed by the Accreditation Board for Engineering and Technology (ABET) in AY2017, and the positive outcome of accreditation, retroactive to 2014, was communicated to the CEE community in September 2017. As the department revised and made significant improvements to the undergraduate program a few years ago, the new accreditation was well-received and is a tremendous opportunity for CEE students to further their careers. When reviewing academic programs, the ABET Engineering Accreditation Commission takes into consideration the curriculum and subjects offerings, student outcomes, educational objectives, and signs of continuous improvement. In January 2019 the department initiated our reaccreditation process through ABET such that the timing of program review is on cycle with our peer departments in the School of Engineering.

The Undergraduate Education Committee (UEC), led by Professor Ali Jadbabaie and composed of faculty from each core in CEE (environment, mechanics and materials, and systems) made significant strides in AY2019, improving the undergraduate curriculum through strategic partnership with Course 6, and creating new first-year discovery subjects. The UEC also refined policies to assess undergraduate students' degree progress (now documented in our advising guide) and continued to worked with the

Academic Programs Office (APO) to optimize the subject schedule to minimize teaching conflicts with General Departmental Requirements and core subjects. The UEC also reviewed the capstone subject to identify areas of improvement.

The undergraduate officer also continued the engagement of CEE in the Institute-wide New Engineering Education Transformation (NEET) initiative. CEE's faculty engaged in the development of NEET tracks that aim to recruit new students to the department through project-centered learning. One of the CEE proposals (Low Carbon Energy) was selected and is a collaboration of Course 1 with Courses 2 and 22. The Low Carbon Energy NEET thread introduces students to the rapidly developing and increasingly vital field of energy production and distribution without generating greenhouse gases, thus postponing or avoiding climate change.

Broadly, the Course 1-ENG program prepares students for today's jobs and emerging new ones, such as chief resilience officer, 3D infrastructure engineer, urban agriculturist, and global system architect. Class discussions in 1.007 Big Engineering: Small Solutions with a Large Impact showed that students studying civil engineering leaned toward careers in innovating structures, architectural design, material testing, promoting net-zero energy buildings, sustainable infrastructure, and geotech. Environmental engineering students expressed interest in exploring bioremediation, atmospheric modeling, hydrology modeling, pollution control, enhancing food security, and mitigating climate changes. Finally, systems engineering cohorts gravitated toward applications in biological networks, traffic and transportation engineering, carbon sequestration, city planning, and in mitigating infectious diseases.

To provide students with more accessible opportunities to advance their careers the department grew the CEE internship program that utilizes connections with CEE alumni in industry to acquire high-level internships for current students. The Academic Programs Office also works to maintain an alumni mentorship network to connect current students with a meaningful mentorship experience. In AY2019, the APO met with 24 students regarding internship and summer UROPs. Students were placed in prominent companies, such as Skanska, Transurban, Thornton Tomasetti, and Kimley-Horn.

Also new in fall 2018, with the guidance of Buehler, the department organized the first annual Young Alumni Panel, bringing in recent graduates to campus to connect first-year students and undergraduates in CEE to the great professions they can pursue upon completion of a CEE undergraduate degree.

Assistant Professor Admir Masic was excited to lead the fourth annual Materials in Art, Archaeology, and Architecture (ONE-MA3) program, a fieldwork experience for undergraduates to learn first-hand about the sustainability of art, archeology, and architecture over time and against the threats of nature. The program was held in Italy from June 16 to July 10, 2019, with 15 undergraduate students, who will continue their research through the subject 1.057 Heritage Science and Technology. The students traveled to Sermoneta, Pompeii, and Turin for this unique in-field, hands-on opportunity to research the complexities of long-term preservation strategies and techniques. Further, students received exclusive access to private research laboratories in the Vatican and were able to access areas of Pompeii that are closed to the public.

The CEE Student Association's (CEESA) new leadership continued to work constructively with the APO and the department leadership. The CEESA president meets regularly during the academic year with the Academic Programs Office to discuss upcoming events, provide feedback on the undergraduate curriculum and printed materials, and serve as a voice for the undergraduate student body.

CEESA hosts numerous events throughout the year, including game nights, a career fair, and study sessions. Building on success in years past, CEESA hosted monthly faculty luncheons where they invite the undergraduate student body to have lunch with a CEE faculty member. The lunches serve as a great way for the students to get to know the faculty on a more personal level and also gain exposure to areas of research that they may not have otherwise considered.

AY2019's senior capstone class, 1.013 Senior Civil and Environmental Engineering Design, focused on diverse research projects supported by multiple CEE faculty. Students enrolled in the class were invited to present their research to members of the community at the CEE Senior Celebration and Awards Banquet through an electronic poster session. Faculty in attendance heard from the students at their posters and voted on the presentations to award first-, second-, and third-place Capstone Poster Prizes. Apisada Chulakadabba won the first place prize for her project focused on comparing global climate models to the MIT regional climate model and examining projected climate change impacts on hydrological cycles in China. Tim Roberts won the second place prize for his project focused on designing a screening process for synthetic silk production that uses cell-free protein expression to assess the feasibility of producing proteins in live cell expression. David Wu received the third-place prize for his project using data analysis to evaluate the effect that Red Sox baseball games have on MBTA congestion, specifically at the Kenmore MBTA stop in Boston.

Building on the success of the department's unique, mini-UROP program, the department again hosted 20 first-year students during the 2019 Independent Activities Period (IAP). Spearheaded by Course 1 students, graduate students and postdocs are paired individually with first-year students, the mini-UROP students work at least 30 hours per week in direct research over IAP. As a result of the students' interest and progress in their projects, a number of the students continued on as full UROP students during the spring term.

Through the growth of the program, the organizers realized there were opportunities to extend the program benefits to include not only course credits, but also community building. New projects were added to not only build the students' hard science and engineering skills, but also to develop soft skills like collaboration and networking for undergraduate students, and improve mentoring skills for the graduate students. During AY2019's IAP, to honor the mentoring and time commitment by the graduate student the department offered subject credit for graduate students for the first time. The Academic Programs Office also coordinated with faculty to host weekly luncheons to give first-years a glimpse of the wide variety of research topics and opportunities available in the department.

The department continues to offer three undergraduate minors, which debuted in fall 2016. The minors are intended to attract MIT students majoring in disciplines outside of CEE, but

who want to enhance their career path with complementary knowledge and experience. The three minors are civil and environmental systems, environmental engineering science, and civil engineering. CEE also endorsed and participates in the environment and sustainability minor offered by the MIT Environmental Solutions Initiative.

AY2019 graduate and other advanced degree programs academic highlights

New ways to support graduate student and doctoral candidate initiatives were introduced, including increased departmental sponsorships of, and providing faculty speakers at, their events and activities. Staff and faculty also volunteered to serve as judges at their competitions.

As mentioned in the undergraduate academic highlights section of this report, the successful reprisal and enhancement of the mini-UROP program held over IAP would not have been possible without the leadership of the graduate students who set up the program working with the assistance of the CEE APO administrators.

In AY2019 the Graduate Education Committee presented to the faculty, and the CEE faculty agreed to have a reduction in units for the doctoral program, moving the requirement from 120 to 96. The committee and faculty, responding to student feedback, also approved a roll out of 1.976 Graduate Professional Development Seminar, to be offered in fall 2019.

AY2019 also saw the introduction of a new graduate subject. Professor Dave Des Marais launched 18.37 Resilience of Living Systems to Environmental Change in the spring term, a subject looking at natural and managed ecosystems, focusing primarily on the terrestrial environment.

In summary, our graduate committee, referred to as GradCom, along with other graduate students in the CEE community, and CEE faculty and staff worked closely together during this past year, including investing excitement and energy into the graduate recruitment process through participating in webinars and organizing social events during the graduate open house, developing stronger relationships with the department head, and then tapping mutual resources for improved program delivery and support.

Postdoctoral program

The department's postdoctoral committee has continued its path of success, providing a forum for discussion and involvement with the approximately 65 postdoctoral researchers in the department. The committee has made great progress in understanding and addressing the professional and career development needs of the postdoctoral researchers, identifying and improving mentoring, providing them with opportunities to contribute to the department's educational programs and overall enhancement of their MIT and CEE experience. Professor John Williams serves as the postdoc committee chair, together with three more CEE faculty at different stages in their faculty careers, which includes an Institute Professor. Postdoctoral liaisons selected by the CEE postdoc committee each year ensure that there is ongoing communication between the postdoctoral community and the department leadership.

Specific activities included town halls with the department head once a semester; availability of teaching fellowships to allow for postdoctoral involvement in teaching and education as part of their career development; a half-day, job search boot camp with CEE postdoc alumni who successfully secured jobs in academia and industry after their postdoc in the department, opportunities for CEE postdocs to give short talks and be critiqued by CEE faculty, mini-UROP mentoring, a half-day leadership workshop for academicians, and so forth; networking events for CEE postdoctoral researchers and faculty members with a focus on enhancing the mentoring network of CEE postdocs beyond their immediate faculty supervisors and research groups have been very well received and continue on a regular basis. On February 15, 2019, the department held a [CEE Research Speed dating event](#) where a number of CEE postdocs had a chance to present their research via electronic posters and short talks. New to the event this year was a panel discussion on the future of research in infrastructure and environment, moderated by Leon and Anne Goldberg Professor of Humanities, Sociology, and Anthropology Susan Silbey. Silbey serves as chair of the MIT faculty and is also a professor of behavioral and policy sciences within the MIT Sloan School of Management. We are moving forward with the establishment of the CEE Communications Lab, where postdocs will serve as communication fellows teaching others how to write for science and engineering. The communications fellow position is a special opportunity for a select group of CEE postdocs interested in scientific writing as part of their career development. Two consecutive workshops on hands-on grant writing are planned for September 2019.

There has been a steady increase in the number of women postdocs completing their appointment in the department (a 7% increase from 2018 and a 12% increase from 2016). The postdoctoral committee is working on a postdoc certificate to be provided to all postdoctoral scholars as they leave the department to pursue next steps in their careers. Postdocs continue to contribute to the teaching activities in CEE, through the postdoctoral teaching fellows program. This program has been very successful for postdocs, faculty, and students and continues to provide valuable training for our postdocs. We keep track of the career paths and feedback of the exiting postdocs and continue to customize our offerings to the CEE postdoctoral community and to their current needs.

Objective 2: Maintain Success within the Administration, Facilities, and Community

The administrative staff continues to evolve and engage with all communities, including current and prospective students and their parents, MIT faculty and staff, external peers, alumni, and news media. We accomplish this outreach through workshops, seminars, the dissemination of stories in print, online, social media, speaking engagements, and other activities. Additional accomplishments and events are listed in subsequent highlights and accomplishment sections of this report.

The department strengthened the collaboration between its two laboratories—the Ralph M. Parsons Laboratory for Environmental Science and Engineering (Building 48) and the Henry L. Pierce Laboratory for Infrastructure Science and Engineering (Building 1). The Parsons Lab focuses on what exists as natural systems, and understanding and engineering human adaptation to a changing environment. The Pierce Lab advances science and engineering research critical to improving living conditions for humankind,

advancing the innovation of materials, transportation systems, cities, and energy resources. The increased cross-research interaction and collegiality continue to bind the disparate locations and was apparent at many formal and informal gatherings through the year. Some examples included CEE Research Night and the continuation of the CEE Band, an inclusive department-sponsored ensemble featuring students and researchers from both labs.

To better serve the department and its communities, and to increase cohesion and cross-interactions, the administrative officer, human resource officer, and academic administrator sit in Parsons Laboratory one day a week. This new initiative has been a great success.

CEE continued to refine its strategic focus around five strategic challenge areas: ecological systems; resources and sustainability; structures and design; societal systems; and global systems. Our research and education within, and across, these strategic objectives are imperative to help create a better world and improve lives.

MIT context for the role of CEE

The department's intellectual focus is discovery and innovation to sustain life and society in changing conditions. Our department's two research labs, Pierce and Parsons, enable research to better understand and solve the grand challenges of our time, from problems created by human activity to those that exist as natural systems. Our contributions are at the core of new products and applications that are being developed today in agricultural innovation, wetlands management, renewable energy, sustainable structures, and large-scale systems design. The Department of Civil and Environmental Engineering is committed to playing a central role to support MIT's leadership in these domains.

Our long-term objective in the area of infrastructure, implemented in the Pierce Laboratory, is to become the center of excellence in the design, manufacturing, and operation of infrastructure. Pierce Lab pushes the frontiers of infrastructure science and engineering by addressing the fundamental issues critical to society and the environment. Using faculty's diverse expertise and collaborations with others, CEE addresses issues that are critical to society and the environment, such as infrastructure sustainability, resilience to catastrophic events, durability, and improved energy management.

Our long-term objective in the area of the environment, implemented in the Parsons Laboratory, is to engineer human adaptation to a changing environment. Human activities are affecting the global environment at historically high rates, with outcomes and influences of these changes on people and the environment not yet totally known. Global environmental changes on water, agriculture and food, species evolution and co-existence, environmental quality (water and air), natural hazards, and public health are the types of challenges researchers in Parsons aim to better understand, working from very small discoveries to large-scale solutions.

Space renovations

The department's efforts to improve laboratories and other departmental space over the past year, and over the past several years have been extraordinary. With our faculty renewal efforts come new faculty laboratories and we have a constant flow of

renovations to include state-of-the-art laboratories and workspaces in both Pierce and Parsons. In addition to technical laboratory space, space for computation, offices, and general teaching space are being renovated at a pace commensurate with the growing needs of CEE.

AY2019 space updates are as follows:

- New Environmental Chemistry Laboratory, Professor Desiree Plata—Building 48
- An expansion of the Advanced Biopolymer Laboratory, Professor Benedetto Marelli—Building 1
- Instrument Room—Building 1 (anticipated to be completed by early 2020)
- A new student lounge—Building 1 (completed and officially opened in April 2019)
- A new space for the MEng program—Building 1 (completed and officially opened in April 2019)
- Faculty space and improvements
- Student office renovations

Objective 3: Focus on the Future of CEE: Accelerated Faculty Hiring and Junior Faculty Development

Using the momentum of the visiting committee recommendations the department embarked on aggressive faculty searches these past few years.

Our future success depends, in large part, on internalizing our new vision across our two research labs (Pierce and Parsons), developing our junior faculty, and attracting top new faculty. The following are associated highlights and accomplishments in these critical areas. Our strategic priorities further include fueling emerging frontiers of innovation and creative design, and empowering our students and faculty to lead Institute-wide, cross-cutting initiatives. Hiring excellent faculty is arguably the most critical component to support these activities.

The faculty search process was changed this past year, focusing on several necessary criteria that differ from the previously used best-in-class search:

- Identify high-caliber candidates in compelling intellectual frontiers
- Relevance to our vision and domains of CEE, especially those identified as critical needs
- We aim to build on the strengths we have, and in areas we can lead; candidates should be dedicated to educating our students such that they are best equipped as scholars and academic leaders, professionals, and entrepreneurs
- Candidates should support and be supported by intellectual communities

Results from CEE faculty search: New faculty hires

In AY2019, Professors Desiree Plata and Tami Lieberman were appointed professorships in the department.

Desiree Plata joined as an assistant professor in July 2018. She earned her bachelor's degree in chemistry from Union College in Schenectady, New York, in 2003, and her PhD in chemical oceanography and environmental chemistry from the MIT-Woods Hole Oceanographic Institution's joint program in oceanography in 2009. Plata previously held the position of the John J. Lee Assistant Professor of Chemical and Environmental Engineering at Yale and associate director for research at the Center for Green Chemistry and Green Engineering at Yale. Prior to Yale, she was in the Civil and Environmental Engineering department at Duke, where she was active in several international research networks, such as the EPA-funded LCnano (studying the environmental implications of nanomaterials across the life cycle) and the NSF-funded Partnership for International Research and Education, studying water and commerce as related to the energy sector. Plata's work is in the area of environmental chemistry, with applications in minimizing the environmental impact of emerging industries—with a particular focus on nanotechnologies across the energy sector. She has made fundamental contributions to the field of heterogeneous catalysis with respect to the bond-building mechanisms in carbon nanotube synthesis, which can be leveraged to lessen environmental impacts. Her work continues to illuminate novel chemistries that occur during environmental transformation processes of organic molecules. Plata is an NSF CAREER awardee, a National Academy of Engineers Frontiers of Engineering fellow, a two-time National Academy of Sciences Kavli Frontiers of Science fellow, and was recently recognized for excellence by Caltech's Resnick Sustainability Institute.

Tami Lieberman joins MIT as an assistant professor with dual appointments in the Department of Civil and Environmental Engineering and the Institute for Medical Engineering and Science in January 2018. Lieberman earned a BA in molecular biology and genetics at Northwestern University, where she was awarded a Barry M. Goldwater Scholarship. She earned a PhD in systems biology from Harvard, where she developed new genomic approaches for understanding how bacteria evolve during infections of individual people. Lieberman was previously a postdoc in Eric J. Alm's lab at MIT, where she further developed and applied genomic approaches to understand the microbes that colonize the human body. She leads a computational and experimental research group focused on uncovering the principles governing colonization, niche range, and personalization in the human microbiome. Lieberman has also made contributions to our understanding of antibiotic resistance, including the co-invention of a new platform for visualizing evolution in real time.

Faculty promotions

Colette Heald was promoted to full professor. Heald's research is focused on atmospheric composition and chemistry. She studies particles and gases in the troposphere, their sources, sinks, transformations, long-range transport, and environmental impacts.

Ruben Juanes was promoted to full professor. Juanes’s research focuses on advancing the fundamental understanding and predictive capabilities of the simultaneous flow of two or more fluids through rocks, soils, and other porous materials. His lab combines theory, simulation, and experiments that elucidate fundamental aspects of multifluid flow, which can be applied for prediction of large-scale earth science problems in the areas of energy and the environment.

Faculty professorships

Desiree Plata was named Gilbert W. Winslow Career Development Assistant Professor, effective July 2018 by the Department of Civil and Environmental Engineering. The award reflects potential great future contribution to research and education at MIT. Plata’s work is in environmental chemistry, with applications in minimizing the environmental impact of emerging industries—with a focus on nanotechnologies across the energy sector.

Professor Tami Lieberman was named Hermann L. F. von Helmholtz Career Development Professor, effective 2018 by the Institute for Medical Engineering and Science. Lieberman leads a computational and experimental research group focused on uncovering the principles governing colonization, niche range, and personalization in the human microbiome.

Annual research event

After a revised format of the annual CEE Research Speed Dating event in 2018, the 2019 event, hosted on February 15, returned to its original style of lightning research presentations by members of the CEE community. Now in its ninth year, the event brought a full day of presentations from faculty, postdocs, and grad students, hosted a faculty panel on the future of research in infrastructure and environment, moderated by Professor Susan Silbey, and concluded in a digital poster presentation where more students were able to participate, including undergraduate students. At the end of the night, prizes were awarded to the top three digital posters and to the top lightning presentation.

Postdoc Fabiola Sanchez won honorable mention for her poster about the dynamics of the active-growing bacterial community in the estuarine environment during a 24-hour period. Her poster explains that the active community is different from the total, and its abundance exhibits a strong correlation with the chlorophyll levels and the day-night cycle.

Senior Stephanie Chin won runner-up for her poster about analyzing noisy data with limited training data—based on a convolutional neural network approach—for the specific application of a traffic surveillance camera. This approach could help adapt general-purpose models for domain-specific content and applications, such as traffic surveillance images.

PhD student Isabelle Su won the top award for her poster, “Exploring a Spider Web’s Structure with Sound,” explained the use of sonification in order to visualize complex 3D spiderweb data through sound. Su created an interactive sonification model that can be used as a versatile data exploration tool, for instance, to find spiderweb patterns, as a creative platform or recreated for similar data networks.

Graduate student Andrew Feldman received the best lightning talk award for his presentation on water exchange patterns in the soil-plant continuum based on Nasa's Soil Moisture Active Passive (SMAP) microwave satellite measurements. Feldman works with Bacardi Stockholm Water Foundations Professor Dara Entekhabi's lab to study soil moisture and vegetation water content observations from NASA's SMAP satellite in order to evaluate plant water storage changes following rainfall.

Cross-disciplinary seed funding for new faculty research

In May 2019, the MIT Abdul Latif Jameel Water and Food Systems Lab (J-WAFS) announced [seven new seed grants](#). Among the seven professors receiving grants was Edmund K. Turner Professor in Civil Engineering Andrew Whittle. Professor Whittle and a team of researchers will be working together to better understand the effects of intermittent flow on drinking water quality. They will perform tests in a section of an abandoned pipe in Singapore, which is still connected to the urban water pipe network.

Objective 4: Leadership at MIT and beyond—Outward Focus and Initiatives

Over AY2019, efforts were made to maintain and improve the CEE website, maintain active social media platforms, and curate a popular student blog initiative, which invites current CEE undergraduate and graduate students to write about their experiences in the department, including studying abroad, extracurricular, internships, and innovative classes. On and offline, we are empowering the department to share new research and happenings and start new conversations.

CEE Communications and the Academic Programs Office collaborated to recruit undergraduate students to write about their experiences being a Course 1 major. The blogs share the undergraduate experience in a casual setting and encourage students to share how they use principles of CEE around the world. Topics ranged from watching a [total solar eclipse](#) while traveling Santiago, Chile, and getting a student's perspective on fieldwork experiences, such as [Traveling Research Environmental eXperiences \(TREX\)](#) and the [Materials in Art, Archaeology, and Architecture \(ONE-MA3\)](#) program. Through this new initiative, Communications and the Academic Programs Office have strengthened their connection with the undergraduate students.

The department also placed an emphasis on documenting and creating videos for two undergraduate subjects, [1.101 Introduction to Civil and Environmental Engineering Design I](#) and [1.007 Big Engineering: Small Solutions with a Large Impact](#). In addition to the subject related videos, a [recruitment video](#) for the structural mechanics and design masters of engineering track was produced. The videos were created to accurately communicate to prospective students the exciting opportunities that can be found in CEE subjects and degree offerings.

This investment in CEE's online presence enhances our ability to connect with alumni, potential students, industry leaders, and news media outlets.

Social media outreach and statistics

The following statistics reflect continued growth in awareness and engagement of CEE online. Note the statistics do not include any staff or faculty online accounts. For example, Department Head Markus Buehler also has significant growth in followers on his professional LinkedIn and Twitter accounts.

The increase in followings reflects international industry trends, with Facebook receiving less interaction and Instagram, LinkedIn, and Twitter increasing in following and interaction.

Department Facebook page

June 30, 2018–June 30, 2019: In June 2018, our Facebook page had 12,444 likes, people who subscribe to CEE posts. This increased by 2% by June 2019 to 12,683 page likes.

Department Instagram page

June 2018–June 2019: CEE has a strong presence on Instagram, a social media platform primarily used for sharing photos and videos that caters to millennials. CEE had 1,340 followers in June 2018 and reached 1,715 followers by June 2019, a 28% increase, a large increase from the 19% following increase in AY2018. Throughout the year, CEE hosts two photo competitions, one in winter and one in summer, which encourages CEE community members to interact with the department and share their adventures using the hashtags #CEESummer or #CEE_IAP with the chance to win prizes. The competitions are always well received and receive a vast number of submissions.

Department Twitter activities

June 2018–June 2019: As of June 2018 we had 3,300 followers, and by June 2019 the MIT_CEE account had reached 4,012 followers, a 22% increase. In AY2018, on average we received 252 likes on our tweets per month. This increased by 9% in AY2019 to an average of 274 likes per month. We primarily share research news on Twitter, which means the amount of clicks our links receive is an important and valuable metric to note. In AY2018, on average we received 271 clicks on our tweeted links per month. This increased by 11% in AY2019 to an average of 302 clicks on links a month.

	June 2017–2018	June 2018–2019	Increase (%)
Average Likes Per Month	252	274	9%
Follower Count at End of Term	3,300	4,012	22%
Link Clicks	271	302	11%

Department LinkedIn page

In June 2018, the MIT CEE LinkedIn page had attracted 1,123 followers. By June 2019, our followers increased to 1,990, a 44% increase.

Objective 5: Alumni Engagement and Resource Development

In 2017, CEE Resource Development changed the format of the previously annual fall New Research Alumni Breakfast and hosted the first-ever New Research Reception. The new format proved successful, and on October 18, 2018, CEE hosted its second [New Research Reception](#). Breene M. Kerr Professor Elfatih Eltahir, Professor John Williams,

and Associate Professor Caitlin Mueller shared updates on their innovative research projects to an audience of over 50 alumni and community members.

On September 20, 2018, the department hosted its first Young Alumni Panel and Network Reception, at which recent Course 1 undergraduate alumni shared their career experience and provided insight to current students. The event was very successful and will be repeated in fall 2019.

CEE again hosted the annual alumni breakfast before commencement on June 6, 2018. The event unites alumni with current students and faculty and allows for networking.

Development and fundraising

In partnership and collaboration with central Resource Development, the Alumni Association, and friends of MIT, CEE has continued to strive to increase philanthropic support for its students, faculty, and research priorities. Department fundraising efforts helped support our mission of providing faculty and students with innovative education and research programs to develop real-world applications that have a large-scale impact on people and sustainability.

Highlights from this year include a renewed commitment to our students through a newly renovated student lounge, located in Building 1 and dedicated to the revered late Professor Joseph Sussman. Through fundraising efforts, the department was also able to help in the recruitment and retainment of some of our brightest and most talented faculty.

School-based Resource Development has worked to increase the visibility of the department's central themes, as well as faculty research, in order to inform and engage both alumni and friends of CEE, and coincidentally increase philanthropic support. Departmental faculty and their work have been showcased through a variety of speaking engagements, including, but not limited to, resource development events, campus visits, and lab tours, as well as Campaign and Corporation engagement opportunities.

Accomplishments of Students, Staff, and Faculty

Faculty Recognition and Initiatives

In July 2018, a [TED Talk from Institute Professor Sallie "Penny" Chisholm](#) on "the tiny creature that secretly powers the planet," *Prochlorococcus* was made available online.

In August 2018, Professor Charles Harvey and Donald and Martha Harleman Professor Heidi Nepf were newly elected as [2018 American Geophysical Union \(AGU\) Fellows](#). Awarded to only 1% of members a year, AGU Fellows are AGU members whose "visionary leadership and scientific excellence have fundamentally advanced research in their respective fields." Professors Harvey and Nepf will be honored at the AGU's fall meeting in December 2018.

In September 2018, Assistant Professor Dave Des Marais was [profiled by the Society for the Study of Evolution](#) as a new faculty member. Professor Des Marais discussed how his research is focused on how the physical environment impacts the evolution and ecology of natural plant populations.

In September 2018, Professor David Simchi-Levi, leader of the Alliance for Business Analytics, [discussed his research](#) and where it applies. He works with students and postdocs who collaborate with various companies to take advantage of three technology trends: digitization, analytics, and automation, in order to improve business performance.

In October 2018, Professor John Williams was one of 14 invitees to attend Lord Norman Foster's brainstorming session regarding an initiative on autonomous communities. The goal of the meeting was to design a program that will rely on advanced science and engineering in order to build autonomous communities.

In October 2018, Esther and Harold E. Edgerton Career Development Assistant Professor Admir Masic and McAfee Professor of Engineering Markus Buehler presented at the MIT.nano grand opening. Professor Buehler presented on making nano big with materiomics, while Professor Masic spoke about exploring the past for a more sustainable future.

In November 2018, Professor John Williams, and research scientist Abel Sanchez, introduced a new two-month online course, called [Digital Transformation: From AI and IoT to Cloud, Blockchain, and Cybersecurity](#), which offers an MIT certificate issued by the Professional Education Program upon satisfactory completion. The course is targeted at industry executives and managers who need to understand the technologies driving the digital revolution, and how they can transform their business operations. The first cohort of students studied modules about AI and the future of work, cloud computing, the internet of things, blockchain, and cybersecurity.

In November 2018, Professor Elfatih Eltahir presented in China for the MIT Club of Beijing about the regional impacts of climate change in Asia. He also presented at a forum organized by the MIT Industrial Liaison Program about the regional impacts of climate change in China.

In November 2018, Assistant Professor Lydia Bourouiba, the director of the Fluid Dynamics of Disease Transmission Laboratory, and graduate student Stephane Poulain received the *Physical Review Letters* Editors' Suggestion for a paper entitled "Biosurfactants Change the Thinning of Contaminated Bubbles at Bacteria-Laden Water Interfaces."

In December 2018, Professor Markus Buehler and his Laboratory for Atomistic and Molecular Mechanics, (LAMM) were highlighted in the article ["How AI and 3D Printing are Revolutionizing Materials Design,"](#) in *R&D World*.

In January 2019, the [first cohort of students](#) graduated from Assistant Professor Admir Masic's MIT Refugee Action (ReACT) Certificate Program. The graduation ceremony took place in Amman, Jordan, and was hosted by ReACT and the MIT Enterprise Forum Pan-Arab region. Fifteen students graduated from the program.

In February 2019, Associate Professor Lydia Bourouiba published an episode on the *Live Long and Master Aging* podcast, titled ["How Did I Get This Cold?"](#) Recorded during her TEDMED interview, she discusses how colds are transmitted, our vulnerability to infectious diseases, living in dense populations and the implications for the spread of disease, and the mechanics of sneezing.

In February 2019, Professor Martin Polz edited a new book titled *Population Genomics: Microorganisms*. The book discusses advances that have been made, promises of population genomics in microorganisms, and key theoretical and practical challenges for microbial population genomics.

In February 2019, Professor Elfatih Eltahir [hosted a workshop](#) at MIT, organized by the Lincoln Laboratory in collaboration with CEE, to examine national security repercussions of climate change. The workshop was attended by MIT researchers and policy experts, the US Geological Survey, the World Bank, and the US Agency for International Development.

In February 2019, Professor Markus Buehler presented at the MIT.nano Frontiers in Science, Technology, and the Arts symposium. Buehler's talk discussed the nexus of materialized sound and sonified material which is at the intersection of advanced technology and artistic practice.

In March 2019, Professor Oral Buyukozturk delivered the plenary lecture at the 2019 Gulf Conference in Kuwait entitled "Roadmap for Sustainable Built Environment: A Science-Based Multidisciplinary Research." The conference was the result of the successful completion of the first MIT-Kuwait multidisciplinary signature project in which Buyukozturk was the principal investigator involving a total of 61 researchers (24 from MIT and 37 from Kuwait). Buyukozturk led a group of three faculty members and five postdocs and students who presented eight technical papers in the conference. The group held three international workshops on sustainable materials, energy, and infrastructure sensing and monitoring. The conference also featured MIT associate provost Professor Richard K. Lester, who presented the opening plenary talk.

In June 2019, Professor John Williams hosted an intensive, one-week course on computational thinking for 50 high school students in Santiago, Chile, through a collaboration between MIT Sloan Latin America Office, the Everis Foundation, and the Municipality of Santiago. The course was the idea of Abel Sanchez, who started a similar course in Mexico three years ago called Beautiful Patterns, which now runs in 21 Mexican cities. The goal is to promote new interest among high school students, with an emphasis on inspiring women students, to encourage a new perspective on technology, and to learn and apply computational strategies that will open doors to new job opportunities. The students received certificates of completion, presented to them by the Mayor of the Municipality of Santiago.

Student Outreach

In August 2018, the department hosted its second annual CEE Kids Camp, inviting children, friends, and neighbors of CEE community members of all ages and abilities to come to campus for a day to experience what it is like to be a civil and environmental engineer at MIT. Students, faculty, postdocs, and researchers came together to host activities for children to learn about the wide range of research in the department. About 20 visitors attended the camp, and many of the hosts noted how much fun it was to share their work with students. CEE is planning to host another Kids Camp in July 2019.

Also in August 2018, the week before first-year orientation, CEE hosted 20 incoming first-years for a first-year pre-orientation program, called Discover Course 1. Discover Course 1 allowed students to participate in hands-on modules focusing on the three cores of CEE: systems, mechanics and materials, and environmental engineering science. Modules included creating transportation maps of Boston, air quality monitoring on campus, conducting 3D printed materials strength tests, and learning about water diversion for urban planning. The week closed with a presentation of projects from the students, using their newly acquired knowledge to propose a solution to a hypothetical floating city.

During the fall and spring semesters, CEE hosted Grilled Cheese Study Breaks, encouraging students to take some time to relax amid stressful exam periods. Professors volunteered a few hours to cook grilled cheese sandwiches for students and members of the community. On December 17, 2018, Professors Buehler and Bourouiba served grilled cheese sandwiches. At the spring event on May 20, 2019, Professors Masic, Nepf, and Tal Cohen served grilled cheese sandwiches. The study break offered CEE students a rest during final exams.

The department hosted its annual CEE Holiday Party on December 7, 2018, bringing together faculty, researchers, and students. The event featured ornament decorating and a canned food drive.

In March, CEE again participated in the Institute's MindHandHeart Random Act of Kindness initiative, CEE hosted a Random Act of Kindness luncheon for members of the CEE community. Held in the Parsons and Pierce Labs, CEE students, faculty, postdocs, and researchers were invited to enjoy a taco bar, make their own so-called dirt cups (including pudding, Oreos, and gummy worms), and create a happygram—a handmade card meant to thank someone or show appreciation. Staff members were also given gift cards to give to students, encouraging them to treat themselves.

During April 4–6, 2019, newly admitted graduate students came to campus to learn about the department. The open house was expanded to run from Thursday through Saturday and kicked off with a reception featuring a Taste of Cambridge on Thursday night. Friday was a full day of departmental talks, student panels, and lab visits. Friday evening was hosted by GradCom and current students and included dinner and bowling. Saturday morning included a campus architectural tour by John Ochsendorf and was followed by brunch with current students and a visit to the Boston Aquarium.

During the spring 2019 Campus Preview Weekend, starting on April 11, the CEE Academic Programs Office and members of the Civil and Environmental Engineering Student Association hosted a variety of activities. The APO invited prospective first-years to join the department for brunch, and also invited students to tour Professor Admir Masic's lab. CEESA hosted a plant night that drew a large attendance of around 30 prospective first-years. On April 12, the APO attended the academic expo along with current students and hosted a booth for prospective first-years to learn about the department.

The department continues to host photo competitions on social media for students and members of the CEE community to interact with CEE when they are off campus and to show how their activities reflect CEE's vision. The summer-themed photo contest encourages students to use the hashtag #CEESummer on Twitter and Instagram. In the winter, CEE hosts the IAP photo contest with the hashtag #CEE_IAP. Prizes are awarded to the student who submits the most photos, and to the student who posts a picture that accurately reflects CEE's mission and vision.

CEE C. C. Mei Distinguished Speaker Series

Professor Lydia Bourouiba expanded her C. C. Mei Distinguished Speaker Series in AY2019 to include more speakers, further raising visibility for CEE and its vision beyond MIT audiences. Topics and speakers included the following:

- [“Fear, Greed and Financial Crisis 10 Years Later”](#) by Professor Andrew Lo from MIT
- [“The Interaction between Gravity Currents and Breaking Internal Waves”](#) by Professor Jeffrey Koseff from Stanford University
- [“Progress and Challenges in Combustion Dynamics”](#) by Professor Sébastien Candel from Ecole Centrale Paris

Samples of Current Research Highlights

The department's research is diverse and crosses many disciplines. CEE had 104 research proposal submissions and had a research volume of 13.4 million.

In July 2018, Professor Heidi Nepf and a multidisciplinary team of MIT researchers have created a solution for urban storm flooding: engineered green spaces. The researchers detailed their study in a report freely available to the public, in hope that cities will utilize the approach.

In July 2018, Assistant Professor Otto Cordero and researchers from his lab published new research that suggests that ecological interactions between bacteria on particles' surfaces can impact the rates of carbon turnover in the ocean. The [results were published](#) in *Nature Communications*.

In July 2018, research from Professor Elfatih Eltahir shows that China's most populous and agriculturally important region could face deadly heat waves unless significant measures are taken at the global scale to limit greenhouse gas emissions and mitigate climate change. The [findings were published](#) in *Nature Communications*.

In August 2018, Professor Markus Buehler and members from the Laboratory for Atomistic and Molecular Mechanics [published a paper](#) in *ACS Nano* that highlights their perspective on the manufacture of hierarchical nanostructured materials from sustainable sources, assembly techniques, and potential applications.

In September 2018, Professor Elfatih Eltahir and former CEE graduate student Noriko Endo [published a study](#) on how wind direction directly effects the spread of malaria at the village scale. The findings were published in *The Lancet Planetary Health* and are based

on three years of fieldwork in Ethiopia and coordinated numerical experimentations using HYDREMATS, a disease transmission model developed by CEE researchers.

In September 2018, Professor Markus Buehler, graduate student Isabelle Su, research scientist Zhao Qin, and their collaborators developed an innovative, experimental method that [captures the sophisticated architecture of three-dimensional spiderwebs](#). Their image analysis and 3D models of the web, demonstrated for the spider *Cyrtophora citricola* in their study, can help with the understanding of the structure and behavior of 3D webs, and enable the design of innovative, web-inspired structures.

In October 2018, Assistant Professor Otto Cordero, postdoc Gabriel Leventhal, graduate student Carles Boix, and research affiliate Tim Enke, [published a new paper](#) in *Nature Microbiology*, showing that replicate microbial communities assemble into different community types depending on the specific, fine-scale genetic strain identity of the individual community members. Their results show that strain-level differences in bacterial species can be important drivers of community organization and dynamics.

In November 2018, Assistant Professor Lydia Bourouiba and graduate student Stephanie Poulain [published a new study](#) in the *Physical Review Letters* that shows how contaminated bubbles act as tiny, microbial grenades, launching microorganisms and potential pathogens into the air.

In November 2018, Professor Charles Harvey and researchers [confirmed through radiocarbon measurements](#), that the severe haze in Singapore and neighboring countries, is caused by burning peatlands in Indonesia, and not the popular belief of deforestation and waste burning. Harvey and researchers are currently experimenting with the replanting of native trees on a new field area that was deforested and burned.

In December 2018, Bacardi and Stockholm Water Foundations Professor Dara Entekhabi, graduate student Andrew Feldman, and colleagues [published new research](#) in *Nature Plants*. They used NASA's Soil Moisture Active Passive satellite mission measurements and evaluated short-term, simultaneous changes of surface soil moisture and vegetation water content in the soil-plant continuum.

In December 2018, Professor Markus Buehler and research scientist Zhao Qin [created music](#) by overlaying vibrations of protein structures. The protein synthesizer can be used for educational purposes, allowing participants to create their own sound combinations. It exemplifies how a complex harmony can be reduced to a simple melody and basic notes. Similar to science, any material can be broken down to just a grain and then again to individual atoms. This analogy provides a unique way to communicate science through music.

In December 2018, Professor Eric Alm was [featured in an MIT News 3Q](#). Alm is studying the human microbiome in various populations and investigates the differences in microbial diversity among each community. Professor Alm found that there is greater diversity in populations with nonindustrialized lifestyles as opposed to North Americans, who are exposed to antibiotics and processed foods.

In December 2018, Assistant Professor Lydia Bourouiba's [research on fundamental fluid dynamics](#) was chosen to be highlighted in the Spotlight Video for the School of Engineering's December Newsletter. Professor Bourouiba's findings could elucidate how a range of diseases spread.

In January 2019, Professor Markus Buehler and CEE graduate student Isabelle Su collaborated with MIT's Center for Art, Science & Technology to [create an interactive spiderweb instrument](#) that was performed in Paris at MIT visiting artist Tomás Saraceno's art exhibit, *ONAIR*. Faculty director and Kenan Sahin Distinguished Professor Evan Ziporyn was a key contributor to the design of the instrument and the execution of the concert.

In January 2019, the results of real-time air quality research efforts in Hawaii during the Kilauea volcanic eruption in May 2018 by Associate Professor Jesse Kroll and Professor Heald were made public. Professor Kroll and researchers deployed low-cost sensors around affected zones in order to gain insight into the particles and toxic gas (known as vog) emitted into the atmosphere.

In February 2019, Professor Moshe Ben-Akiva and co-authors Daniel McFadden and Kenneth Train published "[Foundations of Stated Preference Elicitation: Consumer Behavior and Choice-Based Conjoint Analysis](#)," in *Foundations and Trends Econometrics*. It provides the reader with stated preference data collection methods, discrete choice models, and statistical analysis tools that can be used to forecast demand and assess welfare impacts for new or modified products or services in real markets, and summarize the conditions under which the reliability of these methods has been demonstrated or can be tested.

In February 2019, Professor Markus Buehler, research scientist Francisco Martín-Martínez, and research affiliate Jingjie Yeo from LAMM [published a paper](#) in *Nature Communications* on paraffin-enabled graphene transfer. The findings open the door to high-performance electronics based on large-area, two-dimensional materials.

In March 2019, Professor Markus Buehler and LAMM were [featured in the New York Times](#) for their research about the camouflaging characteristics of squid. Due to tiny pockets of pigment and reflectors made of protein, squid are able to rapidly produce a wide range of colors in their environment. These qualities can be found in peacocks and butterflies as well.

In March 2019, Professor Markus Buehler, former postdoc Anna Tarakanova, and Claire Hsu [published a paper](#) in *Science Advances* about the use of spider silk for robotics muscles. The spider silk's robustness and ability to contract and twist above a certain level of relative humidity in the air could assist in the creation of artificial muscles for soft robotics or smart fabrics.

In April 2019, Associate Professor Otto Cordero and researchers [published research](#) on the discovery of simple assembly rules for marine microbiomes, showing that species can be grouped into two functional modules. The guidelines can help researchers understand the diversity of microbes in the environment, predict community composition, and rationally design ecological systems in the lab.

In May 2019, Professor Heidi Nepf and recent PhD student Jiarui Lei [published research](#) in the *Journal of Fluids and Structures*, titled “Blade Dynamics in Combined Waves and Current,” and in *Coastal Engineering*, titled “Wave Damping by Flexible Vegetation,” that demonstrates seagrass’ strong potential for curbing erosion. By dissipating wave energy, the plants could help protect vulnerable shorelines in the face of rising sea levels. Through experiments and mathematical modeling, the researchers were able to quantify how large and dense seagrass meadows must be in order to provide sufficient damping of waves in a given geographic, climate, and oceanographic setting. The abundant seagrass could help prevent beach erosion, protect seawalls, improve water quality, and absorb carbon.

In June 2019, Professor Ruben Juanes and a team of researchers at MIT and Princeton, including former graduate student Amir Pahlavan, discovered a way to make gas bubbles develop with precise size, as a result of universality of bubble pinch-off in confined geometries. The findings, which were [published in the journal PNAS](#), could impact the development of microfluidic devices for biomedical research and can aid in understanding the way carbon dioxide is trapped in underground rock formations to help mitigate climate change.

Awards and Recognitions

Faculty awards and recognition

The faculty in CEE have received numerous significant awards, reflecting their excellence and impact within the Institute and beyond.

In July 2018, Assistant Professor Lydia Bourouiba was named a 2018 recipient of the Smith Family Foundation Odyssey Award for creative and innovative junior investigators working on high-impact ideas to generate breakthroughs and drive new directions in biomedical research.

In November 2018, Professor Markus Buehler was selected as a 2018 highly cited researcher by Clarivate Analytics, who runs the scientific index, Web of Science. Professor Buehler received this honor for producing multiple, highly cited papers ranking in the top 1% for a publication field and year throughout the last decade. The Clarivate Analytics list highlights scientists and social scientists for exceptional performance in one or more of 21 fields, or across multiple fields.

In December 2018, Assistant Professor Tami Lieberman won the Smith Family Award for excellence in biomedical research. The mission of the program is to launch the careers of newly independent biomedical researchers who are striving to achieve medical breakthroughs.

In December 2018, Cathy Wu received the Council of University Transportation Center’s Milton Pikarsky Memorial Award. This annual award is given to the best doctoral dissertation in the field of science and technology in transportation studies. Wu’s dissertation research examined mixed autonomy systems in mobility, which focuses on the complex integration of automation, such as self-driving cars into existing urban systems problems.

In January 2019, Institute Professor Penny Chisholm received the Crafoord Prize in Biosciences 2019 for her discovery and pioneering studies of *Prochlorococcus*, the most abundant photosynthesizing organism on the planet. The major prize circulates between different areas, and is awarded in biosciences by the Royal Swedish Academy every four years.

In January 2019, MacVicar Faculty Fellow Professor Heidi Nepf received the 2019 American Society of Civil Engineers Hunter Rouse Hydraulic Engineering Award. In honor of Hunter Rouse, a faculty member at MIT from 1929 until 1933, the award recognizes outstanding contributions to hydraulics and waterways. Professor Nepf was cited for her fundamental contributions to environmental fluid mechanics and her research on the impact of vegetation on flow and transport.

In March 2019, Professor Oral Buyukozturk received a Charles M. Vest Scholarship graduate student, Donghui Xu, who will be joining his lab come June. The scholarship provides opportunities for international graduate students to work and study at one of the leading research universities in the United States. It encourages a platform to exchange ideas, share problem-solving skills, and strengthen international relationships in order to address the global challenges of today.

In March 2019, Assistant Professor Desiree Plata and graduate student Andrew Sumner won best paper in the *Journal Environmental Science: Processes and Impacts* for 2018.

In March 2019, Assistant Professor Desiree Plata and her group members, postdoctoral associate Boya Xiong, PhD student Rebecca Brenneis, and recent PhD graduate Brian Drollette from Yale University, were [included in the *Environmental Science and Technology* virtual issue](#), which highlighted papers of high impact from early career scientists.

In March 2019, Professor Colette Heald was [profiled in an article](#) on the National Oceanic and Atmospheric Administration's (NOAA) Research Scientist Profiles website for Women's History Month. Heald is a principal investigator for the Atmospheric Chemistry Carbon Cycle and Climate program funded by NOAA.

In April 2019, JR East Professor Ali Jadbabaie won the Multiuniversity Research Initiative award from the US Department of Defense for a five-year, basic research program. The award aims to support research efforts that contain more than one traditional science and engineering discipline. Jadbabaie's project topic included the development of a unified theory of rational decision making with behavioral and computational constraints.

In April 2019, Professor Markus Buehler was named a 2018 Materials Horizons Outstanding Paper Prize winner, awarded by the Royal Society of Chemistry. The award was given for his paper titled "Bioinspired Hierarchical Composite Design Using Machine Learning: Simulation, Additive Manufacturing, and Experiment," that featured his former students Grace Gu, Chun-Teh Chen, and undergraduate researcher Deon Richmond. The papers are evaluated by various factors, such as article downloads, altmetrics, and citations, and shortlisted based on the science presented and potential future impact.

In April 2019, Professor Markus Buehler was elected as the chair of the Material Research Society's fall 2021 meeting, the world's foremost international scientific gathering for materials research. The meeting will be held in Boston and will include around 50 technical symposia as well as "broader impact" sessions that include professional development, government policies and funding opportunities, student activities, award talks and special events, and it is expected to be attended by approximately 5,000 to 6,000 materials scientists, researchers, and engineers.

In May 2019, Professor Heidi Nepf and former PhD student from the Nepf Environmental Fluid Mechanics Lab, Judy Yang (now a postdoc at Princeton), were [highlighted in EOS](#) for their study in which they created a new model that improves predictions for sediment movement in vegetated shoreline zones. Their findings reveal a universal predictor that could change the understanding of coastal landscape evolution.

In May 2019, Professor Andrew Whittle was one of seven recipients to receive a J-WAFS seed grant, which are awarded to support research that is solutions-oriented in the area of global food and water challenges. Professor Whittle and a team of researchers will be working together to better understand the effects of intermittent flow on drinking water quality.

In May 2019, the MIT master's in supply chain management, led by Professor Yossi Sheffi, was ranked the number one supply chain program in the world by Eduniversal. The MIT Center for Transportation and Logistics (CTL) focuses on advancing supply chain education and research through solutions-oriented approaches. The rating highlights CTL's international reach with its centers in Colombia, Spain, Luxembourg, China, and Malaysia. The program brings together over 75 faculty members from across campus to work with students to coordinate more than 100 supply chain research efforts.

In June 2019, *The Scientist* featured [Associate Professor Otto Cordero](#) in an article highlighting his background and research history. Professor Cordero started his lab at MIT in 2015 and studies the community ecology of microbes in their natural ecological contexts.

In June 2019, Assistant Professor Desiree Plata was [featured in a School of Engineering video](#) highlighting her background and research interests. Professor Plata's research is focused in the area of environmental chemistry, working to reduce the environmental impact of emerging industries. The video was the top story in the School of Engineering's newsletter, The Infinite.

Student awards and recognitions

In July 2018, graduate student Janelle Heslop was one of 20 students to be elected into the Switzer Fellowship Network. The Switzer Fellowship Program is a one-year fellowship for accomplished graduate students in New England and California with career aspirations directed toward environmental improvement.

In July 2018, graduate student Amir Pahlavan is one of two recipients to receive the Procter and Gamble Student Poster Award from the International Society for Porous Media (InterPore). Pahlavan's poster was titled "Forced Wetting Transition and Bubble Pinch-Off in a Capillary Tube" and he is a member of Professor Ruben Juanes's lab.

In September 2018, Rayna Higuchi and research scientist Kunal Kupwade-Patil had research published by the American Chemical Society that shows when combined, waste products from food production and power production waste can replace high-energy-input, hazardous cement. Higuchi started working with Kupwade-Patil and Professor Oral Buyukozturk's Laboratory for Infrastructure Science and Sustainability as a mini-UROP student in 2016.

In October 2018, postdoc Matti Gralka and graduate student Bennett Lambert were awarded the Simons Foundation Postdoctoral Fellowship for Marine Microbial Ecology. Gralka plans to use the fellowship in order to study the interplay of ecology and evolution in marine microbial communities, while Lambert will continue working to develop microfluidic techniques to study phenotypic heterogeneity in marine picoeukaryotes.

In October 2018, graduate student Samuel Raymond received the Shoji Award for Innovation in Information Technology in Civil Engineering.

In October 2018, Sid Pai, graduate student in Professor Colette Heald's lab won a best poster award at the International Atmospheric Chemistry Conference in Takamatsu, Japan. The conference had over 700 attendees, including several people from Professor Heald and Associate Professor Jesse Kroll's labs. Pai received a glass-blown trophy with the award.

In November 2018, [MIT News profiled René García Franceschini](#), who spent the 2018 Independent Activities Period traveling through southern Puerto Rico interviewing residents about their experience dealing with the aftermath of Hurricane Maria in 2017. He is now working with Solstice, a company that aims to expand solar energy access to all Americans, regardless of their income. García Franceschini is interested in combining renewable energy with social equity and social entrepreneurship.

In November 2018, PhD student Catherine Nikiel, working in Professor Elfatih Eltahir's Lab, was [featured in an MIT News 3Q](#). Nikiel is studying the impact of climate change on different aspects of the hydrological cycle. In particular, she is investigating the impact of land-use change on regional climate in the midwestern United States.

In January 2019, graduate student Bauyrzhan Primkulov, in Professor Ruben Juanes's group, received the best poster award by the Princeton Center for Theoretical Studies at the Transport in Disordered Environments workshop. The workshop unites experimentalists and theorists to consider fluid and solute transport in disordered environments.

In January 2019, first-year student Heidi Li, mentored by graduate student Fatima Hussain, won the grand prize for her mini-UROP research poster on viruses. Neosha Narayanan, mentored by graduate student Isabelle Su, won the people's choice prize for her research poster on three-dimensional spiderweb construction.

In January 2019, CEE PhD student Neha Mehta presented her work on sequestration of radionuclides by cyanobacteria, at the SOILS conference in San Diego, California. Mehta was awarded third place in the oral competition in the chemistry division.

In February 2019, graduate students Andrew Feldman and Isabelle Su, undergraduate Stephanie Chin, and postdoc Fabiola Sanchez were awarded prizes at the CEE Research Speed Dating event. Feldman was the recipient of the best lightning talk award. In the research poster categories, Su won best poster, Chin won runner-up, and Sanchez won honorable mention.

In February 2019, PhD student Isabelle Su performed the sonification of a digital spiderweb at the US premiere of Spider's Canvas at MIT with musicians from the Center for Art, Science & Technology.

In February 2019, Graduate student Jane Chui won the Outstanding Student Presentation Award at the American Geophysical Union conference for presenting quality research.

In February 2019, PhD student Josh Moss studying atmospheric chemistry in Professor Jesse Kroll's Lab was [featured in an MIT News 3Q](#). Moss examines the chemistry of gases and particles in the atmosphere that humans are releasing, and their interactions with existing particles in the atmosphere. Moss utilizes computer modeling in conjunction with the controlled atmospheric chamber in the lab to investigate the gas phase reactions originating from smog particles.

In March 2019, postdoctoral associate Sarah Fletcher received the 2019 American Water Works Association Academic Achievement Award for Best Doctoral Thesis, entitled "Learning and Flexibility for Water Supply Infrastructure Planning under Diverse Uncertainties." The award recognizes contributions within the field of public water supply.

In April 2019, Sarah Fletcher, a postdoctoral associate in Professor Dara Entekhabi's lab, published research in *Nature Communications* entitled "[Learning About Climate Change Uncertainty Enables Flexible Water Infrastructure Planning.](#)" The researchers designed a new planning framework that provides information about regional climate change over time in order to evaluate the necessity of the implementation of flexible approaches for water infrastructure planning in order to efficiently target a wide range of vulnerable communities.

In May 2019, Leaders for Global Operations student Audrey Bazerghi and PhD student Cherry Gao won first place in the Patagonia Case Competition. Patagonia, the sustainable apparel company, organizes an international case competition each year in order to solve pressing challenges within environmental sustainability. This year, teams of graduate students were asked to propose sustainable packaging solutions that can be implemented at scale by 2025. One hundred and twenty-four teams entered the competition and the top 10 finalists were invited to present in front of judges at the Haas School of Business, University of California at Berkeley.

In May 2019, undergraduate Tim Roberts was invited into the Xi Chapter of the Phi Beta Kappa Society for excellent academic records and commitment to the objectives of a liberal education. Known as the most prestigious academic honor society in the United States, this achievement is awarded to less than 10% of members in a graduating class. The society, which was founded in 1776, embraces principles of freedom of inquiry and liberty of thought and expression.

Department Awards

In February, QS World University Rankings released their [2019 rankings](#), and CEE was ranked among the top. The department was named number one for Civil and Structural Engineering and number two for Environmental Science, up from being ranked third for 2018. QS World University Rankings are intended to educate prospective students about the leading schools in their preferred field.

2019 annual CEE awards: Faculty, staff, and students

These [awards](#) celebrate all that is CEE. The awards were presented at the [Senior Celebration and Awards Banquet](#) in May.

Junior Zoe Lallas received the CEE Leadership and Community Award, which recognizes an undergraduate student who makes exemplary contributions to improve the CEE community, fosters excellence and diversity, and contributes to our inclusive culture.

Sophomore Chelsea Watanabe won the Best Undergraduate Research Award, which honors excellence in any area of research by a CEE undergraduate student, carried out in the context of either an Undergraduate Research Opportunities Program internship or through coursework, such as Traveling Research Environmental Experiences.

Senior Christine Langston won the Leo (Class of 1924) and Mary Grossman Award for her strong interest in transportation and impressive academic record. Langston has combined data from a variety of sources, such as state and local transportation agencies, Google Maps, and Trip Advisor to measure and model travel patterns within cities. Langston is recognized for her passion and drive to improve transportation systems.

Senior Tim Roberts earned the Juan Jose Herмосilla (1957) Prize for demonstrating exceptional talent and potential for future contributions at the intersection of mechanics, materials, structures, and design. Roberts was nominated for being well-rounded and for his many achievements in engineering.

Senior Amber VanHemel was awarded the Paul Busch (1958) Prize, given to an undergraduate student in environmental science and engineering for academic achievement and contributions to the CEE community. VanHemel is recognized by her peers and professors as an exceptionally bright, hardworking, outgoing, and ambitious scholar.

The Tucker-Voss Award winner was MEng student Andrew Novillo, who completed his thesis in experimental testing of cast-metal connections for complex loading conditions designed with topology optimization. The award was established in memory of professors Ross R. Tucker and Walter C. Voss, who were the first two department heads of the now extinct Course 17 (Building Construction). When Course 17 merged with the Department of Civil Engineering in the 1950s, the Tucker-Voss Award was established. Novillo earned this award for his use of innovative 3D printing technology in his thesis, which demonstrated the promising future he will have in the field of building.

Graduate student Hayley Gadol was awarded the Trond Kaalstad (Class of 1957) Fellowship, which recognizes an outstanding graduate student who has displayed

leadership, contributed significantly to the well-being of the CEE community, or both. Hayley took on the goal of improving graduate student life in the department and the Institute, serving as the head of CEE Student Graduate Committee and taking charge of organizing events for the community.

The Maseeh Annual Award for Excellence, which recognizes the most outstanding teaching assistant in the past academic year, was awarded to Hejian “Patrick” Zhu, who was an instructor for the subjects 1.361 Advanced Soil Mechanics and 1.364 Advanced Geotechnical Engineering. Through his commitment as a teaching assistant, Patrick has proved to be passionate about helping others deepen their knowledge and understanding of geomechanical topics.

The Best Doctoral Thesis Award was given to Simone Cenci, who worked under the guidance of his advisor, Mitsui Career Development Assistant Professor in Contemporary Technology Serguei Saavedra. This award honors scholarly and academic excellence and a high level of distinction of a CEE graduate student in any area of research. Cenci produced eight impressive research papers, and has significantly contributed to the area of theoretical ecology by expanding concepts and tools that can get us closer to a better understanding and prediction of population dynamics.

The CEE Postdoctoral Scholar Mentoring, Teaching, and Excellence Award recognizes mentoring, teaching, and other exceptional contributions by a postdoc, emphasizing high potential for future contributions. Ehsan Haghighat received the award for his extraordinary teaching and generous mentorship, displaying strong research in computational mechanics and more. Haghighat excelled in this teaching role by demonstrating an outstanding ability to communicate knowledge effectively to students, as well as earning top reviews in the student evaluations.

The Samuel M. Seegal Prize, which honors faculty members for inspiring students to pursue and achieve excellence, was awarded to William E. Leonhard Professor Harry Hemond. The CEE community noticed Professor Hemond for being a beloved teacher and mentor who leads by example, and who continues to inspire students long after their time at MIT.

Associate Professor Lydia Bourouiba received the Ole Madsen Mentoring Award, which honors faculty members for conspicuous contributions to mentoring and educating CEE students outside the classroom and inspiring them to pursue a career in the fields of civil and environmental engineering. Professor Bourouiba teaches students the skills, qualities, and critical thinking required to succeed in their studies and research; more generally, she prepares them to be successful in their professional lives. One student wrote: “Her dedication and genuine care to the education, professional development, and well-being of her students and mentees are truly remarkable and extraordinary.”

The Maseeh Excellence in Teaching Award, which recognizes the most outstanding faculty member in the past academic year, was presented to Assistant Professor Admir Masic. Professor Masic stood out to his colleagues for his enthusiasm and energy for research that sparks the students’ interest in the challenge of learning. He is known by his students for his ability to make learning fun, engaging, and exciting.

Two members of the CEE staff received the CEE Excellence Award, which recognizes staff for excellent contributions to the community and commitment to professionalism, dedication, and best practices, and for fostering a culture of diversity, inclusiveness, and innovation. The recipients were undergraduate academic assistant Sarah Smith and research engineer John MacFarlane.

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