

MIT Environmental Solutions Initiative

The [MIT Environmental Solutions Initiative \(ESI\)](#) advances science, engineering, policy and social science, design, the humanities, and the arts toward a people-centric and planet-positive future. ESI's research, education, convening, and resource development continued to expand in academic year 2018. Notable accomplishments included launching a new undergraduate minor in environment and sustainability, establishing four interdisciplinary research focus areas, securing four major gifts, and convening the first ESI External Advisory Board meeting.

AY2018 also saw a continuing and troubling shift of US federal policy on environment and climate. The accelerated unraveling of US regulatory frameworks for environmental protection continued unabated and will likely proceed. In response, a variety of organizations and others across the US are bringing hope to a dispersed commitment to the environment, to the mitigation of carbon emissions, and to actions that push forward adaptations of the ever-stronger signals of climate change consequences. ESI has been building alliances across these various actors in today's complex and challenging times. In this context, the relevance of ESI's mission to the MIT community and beyond has only increased.

Research

In AY2018, ESI's research activity included the development of four new research focus areas, ongoing seed grants, and the deepening of several international collaborations.

Research Focus Areas

Responding to a combination of MIT faculty interest and emerging environmental concerns by the public and the business sector, ESI initiated research and convening efforts in four cross-disciplinary, cross-sectoral topics.

Plastics and the Environment

In coordination with the Industrial Liaison Program and Patagonia—a program member—ESI held a workshop in January 2018 to explore opportunities for MIT faculty to participate in the emerging area of microfiber and microplastic research. Three particular areas of interest emerged. ESI has provided modest funding to support the following teams as they develop white papers to establish the foundation for future empirical work.

- Team 1: Professor Desiree Plata (Department of Civil and Environmental Engineering [CEE]), Jeremiah Johnson (Department of Chemistry), and Jeffrey Grossman (Department of Materials Science and Engineering) will investigate new polymer designs.
- Team 2: Brian Anthony (MIT.nano) and Professor Admir Masic (CEE) will explore the development of sensing technology tailored to micro- and nano-scale plastic particles.

- Team 3: Professors Pierre Lermusiaux (Department of Mechanical Engineering [MechE]), Glenn Flierl and John Marshall (Department of Earth, Atmospheric, and Planetary Sciences [EAPS]), and Tom Peacock (MechE) will seek to improve modeling of the distribution and dispersion of microplastics in the environment.

Mining and the Environment

ESI's 2015 seed grant on mining and the environment, with Principal Investigators Antoine Allanore (MechE) and T. Alan Hatton (Chemical Engineering), led to the development of an industrial consortium model and significant relationships with global mining companies. ESI is exploring research sponsorships with two companies.

Future Cities

ESI is pursuing work in various urban contexts that are in critical need of MIT expertise in improving the human–nature interface. This includes prospective projects in Argentina and Colombia, a continuing relationship with the MIT Metro Lab, and discussions with several companies interested in sustainable infrastructure, resilience, and the adaptation of cities within a context of continuing climate change.

Nature-based Solutions

In cooperation with Conservation International (CI) and supported by the MacArthur Foundation, ESI hosted a workshop in September 2017 on the opportunities to deploy cutting-edge artificial intelligence science and engineering to enhance the use of nature-based solutions to climate change and other environmental challenges. Workshop outcomes included five draft project proposals, two of which received modest CI support to advance the work. A third project proposal was adapted into the Peru drone research project described in the Undergraduate Research Opportunity Projects (UROP) section.

Seed Grant Program

Since 2015, ESI has supported 15 research [seed grant projects](#). Several notable publications have emerged from this work.

- Cobb, AR, Hoyt AM, Gandois L, Eri J, Dommain R, Salim KA, Kai FM, Su'ut NSH, and Harvey CF. How temporal patterns in rainfall determine the geomorphology and carbon fluxes of tropical peatlands. *PNAS*, 5 May 2017, pp. E5187–E5196.
- Edwards MR, Klemun MM, Kim HC, Wallington TJ, Winkler SL, Tamor MA, and Trancik JE. Vehicle emissions of short-lived and long-lived climate forcers: trends and tradeoffs. *Faraday Discussions*, 28 Mar. 2017, pp. 453–474.
- Edwards MR, McNerney J, and Trancik JE. Testing emissions equivalency metrics against climate policy goals. *Environmental Science & Policy*, 26 Aug. 2016, pp. 191–198.
- Kwon SY, Selin NE, Giang A, Karplus VJ, and Zhang D. Present and future mercury concentrations in Chinese rice: insights from modeling. *Global Biogeochemical Cycles*, 26 Feb. 2018, pp. 437–462.

- Peacock T and Alford MH. Is deep-sea mining worth it? *Scientific American*. May 2018, Volume 318, issue 5, pp. 72–77.
- Pollans LB, Ben-Joseph Eran, and Krones JS. Patterns in municipal food scrap programming in mid-sized U.S. cities. *Resources, Conservation and Recycling*, 1 July 2017, pp. 308–314.

Undergraduate Research Opportunity Projects

ESI received a generous gift from the Tang family to support the involvement of MIT undergraduates in research at CI's international field sites. The first project involves three students working at MIT and in the Peruvian Andes during summer 2018 developing and testing solar-powered drone technology to aid monitoring of deforestation in the Amazon rain forest.

Fellowships

In summer 2018, ESI provided partial support for three doctoral students pursuing environmental and sustainability research in the Program in History, Anthropology, and Science, Technology, and Society. The students and their research topics are:

- Richard Fadok—From Sustainability to Regeneration: Changing Paradigms within the Field of Ecological Design
- Gabrielle Robbins—The New Face of Morocco: Sustainability, Faith, and Class in the Zenata 'Eco-City'
- Elena Sobrino—The Flint Water Crisis

Martin Fellowships for Sustainability

Ten doctoral students from eight departments were selected as Martin Fellows for Sustainability for AY2019. Faculty oversight for the Martin Family Society of Fellows for Sustainability rests with the governance committee, which includes Professors Jennifer Light (Science, Technology, and Society [STS], and Department of Urban Studies and Planning [DUSP]); Leslie Norford (Architecture); J. Taylor Perron (EAPS); John Sterman (Sloan School of Management); and Heidi Nepf (CEE). ESI Director John Fernández is an ex officio member of the governance committee. Susan Solomon, the Lee and Geraldine Martin Professor of Environmental Studies (EAPS), was the featured speaker at the annual induction dinner in October 2017. The annual weekend retreat took place in September, with fellows and alumni traveling to Endicott House for a program focused on sustainability in operations and entrepreneurship.

Education

ESI's main educational priorities in AY2018 were to launch the environment and sustainability minor and support the development and initial delivery of the two required subjects for the minor. Other priorities were to collaborate with MIT Career Fair planners and to expand the integration of climate, environment, and sustainability topics into the General Institute Requirements (GIRs) and other introductory subjects.

Environment and Sustainability Minor

The [minor](#) was launched in September 2017. Ishan Meswani '18 (MechE) was the first student to earn and graduate with the minor.

Two multidisciplinary faculty teams developed the new integrative core subjects for the minor, with the generous support of the Dirk ('75) and Charlene ('79) Kabcenell Foundation. These core subjects were:

- 12.387J/15.874J/IDS.063J People and the Planet: Environmental Governance and Science, taught by Noelle Selin (EAPS and Institute for Data, Systems, and Society [IDSS]), Susan Solomon (EAPS), and John Sterman (Sloan School of Management)
- 11.004J/STS.033J People and the Planet: Environmental Histories and Engineering, taught by Brian Anthony (MIT.nano and MechE), Janelle Knox-Hayes (DUSP), Robin Scheffler (STS), and Jessika Trancik (IDSS)

General Institute Requirement for the Environment

In February 2018, the Arthur Vining Davis Foundations awarded a \$250,000 grant to ESI to expand its efforts to infuse environmental content into introductory undergraduate subjects at MIT. The project will engage both the traditional GIRs—science, mathematics, and the humanities—as well as the introductory subjects in Course 6, Electrical Engineering and Computer Science, which is MIT's largest undergraduate major.

First-year Student Activities

Student participation in ESI Director Fernández's fall 2017 First-Year Advising Seminar: Solving Climate Change and Environmental Challenges in the US and Abroad was enthusiastic and continued through spring 2018. Campus Preview Weekend 2018 activities included a social media-based scavenger hunt and a faculty-led research seminar.

Convening

ESI's convening activities in AY2018 expanded significantly, both at MIT and elsewhere.

Major Public Engagement Initiative on Regional Climate Issues

In March, an anonymous donor granted \$500,000 to ESI to support Phase I of the Here and Real Project, which will join two to three localities that are facing different climate challenges with MIT students and researchers. The project will test how best to reconcile local experiences with extreme weather events, flooding, drought, and other environmental disruptions with localized climate science and projections.

Partnerships Beyond MIT

ESI's partnership with CI remains strong. In the US, ESI is involved in a science integrity initiative led by US Senator Sheldon Whitehouse, and is exploring collaborative opportunities with the X Company (formerly Google X), the National Council on Science and the Environment, EcoAmerica, and the Center for Coalfield Justice, among

others. Internationally, ESI is a key participant in MIT's renewed research and education partnership with Portugal and is holding conversations about future research and educational initiatives with governmental and other partners in Argentina and Colombia.

People and the Planet Lecture Series

Since September 2016, ESI has hosted six People and the Planet lectures. Campus and community attendance have increased significantly, and the series has become a fixture in the environment/energy/climate/sustainability community at MIT. Each event, if the speaker's schedule permits, includes a student roundtable discussion, a major public presentation with questions and answers, and a salon-style dinner with faculty and local thought leaders. Fall 2017 speakers included Johan Rockström of the Stockholm Resilience Centre and Rhode Island's US Senator Sheldon Whitehouse.

Lunch Seminar Series

ESI held nine lunch seminars throughout the academic year. The informal seminars were held on MIT's central campus over lunch and featured faculty and graduate students from six departments describing current research and education initiatives. Conversations were lively and cross-disciplinary.

Additional ESI events in AY2018 included a second annual "welcome back" party for students, faculty, and staff in the first week of September and an Earth Day celebration on McDermott Court that was part of the Cambridge Science Festival. ESI supported the successful student-led Climate Changed initiative—for which Director Fernández was the faculty advisor—that included an exhibit and a design competition with awards sponsored by the Leonardo DiCaprio Foundation. The initiative culminated in a major symposium in April 2018. ESI assisted Institute Events in planning the May 2018 One Sustainable World dance party, which was attended by an estimated 13,000 guests.

ESI also sponsored a number of student-led events. These included the MIT Energy Hackathon, a Graduate Student Council sustainability policy survey, the Trashion Show, and a lunch following a screening of the documentary *Chasing Coral*. Other such events included the Sustainability Summit, the Association of Computational Science and Engineering Students Computational Materials Seminar and travel to and from the Students for Zero Waste Conference 2017 for 10 students.

Digital and Online Presence

Continuing upgrades have transformed the ESI website into a dynamic, easy-to-use resource. An e-newsletter is distributed several times each semester to more than 1,500 recipients. In January 2018 MIT released a four-minute introductory video, which has had more than 1,000 views, and published an updated ESI Agenda and a new overview brochure. Facebook, Twitter, and LinkedIn accounts round out ESI's social media presence. In spring 2018, ESI became the new home for MIT's climate portal, starting with the transition of the alumni-crafted ClimateX resource.

Governance

A planning meeting of ESI's External Advisory Board core group was held in April 2018. Core group members include:

- Cherry Murray, professor of physics and Benjamin Peirce Professor of Technology and Public Policy, Harvard University
- The Edge, musician, U2
- Bob Inglis, founder and executive director, republicEn.org
- Nathaniel Stinnett, founder and executive director, Environmental Voter Project
- Barbara Kates-Garnick, professor of practice, the Fletcher School, Tufts University
- Johan Rockström, director, Potsdam Institute for Climate Impact Research

ESI's Student Advisory Council meets once per semester and serves as a critical sounding board for ESI leadership. ESI's Faculty Advisory Committee is co-chaired by ESI Director Fernández and Claude Canizares, formerly MIT vice president for research. The Faculty Advisory Committee is being expanded to include 12 to 15 junior and senior faculty members from across the Institute.

Resource Development and Corporate Engagement

ESI received four major grants in AY2018. Fundraising remains a high priority.

Plastics and the Environment

A half-dozen materials companies played an active role in ESI's January 2018 kickoff workshop. Their input helped ESI define the objectives of the three research teams described earlier. ESI is proceeding with a funding membership model to fund Stage II of this program and to help define future stages that the companies might sponsor individually or in groups. ESI is in discussions with those materials companies, some of which are also members of the MIT Energy Initiative. In collaboration with MIT.nano, ESI is also talking with sensing companies. In collaboration with the Computer Science and Artificial Intelligence Laboratory and other MIT groups, ESI is also talking with artificial intelligence and "big data" companies for the modeling team.

Mining and the Environment

ESI has signed a letter of intent with the Brazilian mining company Vale to design and deliver a company-wide environmental sustainability program with educational, research, and convening components. This program will eventually be expanded to other Brazilian industrial companies. ESI is also in active discussions of similar programs with Rio Tinto (Australia) and separately with a consortium of South African mining companies, in collaboration with the University of the Witwatersrand (Johannesburg), and with [MIT-Africa](#).

Future Cities

ESI has signed a letter of intent with the Argentinian state-run water company, Aguas y Saneamientos Argentinos S.A., to design and deliver an MIT program as part of a river basin industrial remediation program in the Buenos Aires region. ESI is pursuing several options for matching funds from Argentinian partners and from the World Bank.

Administration

ESI added two new staff positions in AY2018: an education program manager to expand and enrich undergraduate and graduate learning experiences, and a program director to manage the two public climate communication initiatives described above. Northeastern University “co-op” students continued to serve as vital supplements to permanent staff.

Director Fernández continued to serve on the advisory committee of the [Sustainability Initiative at MIT Sloan](#), MIT’s Climate Action Advisory Committee, and the [Campus Sustainability Task Force](#). Fernández supported the planning of, and participated in, several major climate and environment events as a presenter and moderator of discussions and panels. These included “Nature-based Solutions to Climate Mitigation and Resilience” at the MIT Together in Climate Action: Northeastern North America Policy Summit and a discussion on the environment at the inaugural [SENSE.nano](#) symposium. He made a presentation and moderated the discussion of visiting artist Tomás Saraceno’s (Center for Arts, Science, and Technology) work with EAPS faculty, [Aerocene](#). Fernández also served as the moderator of the workshop on the Defense of Science convened by US Senator Sheldon Whitehouse in Washington, DC.

ESI Executive Director Amanda Graham left MIT in summer 2018 for a new position at Dartmouth College. Graham’s service to ESI was formative and invaluable. ESI appointed Gabriel Lanfranchi, founder of the Metro Lab at MIT, as an ESI research affiliate and continued to add to its growing group of faculty affiliates.

John E. Fernández, ESI Director
Professor of Architecture