MIT Energy Initiative

Overview and Mission

The MIT Energy Initiative (MITEI) is MIT's hub for energy research, education, and outreach. It helps develop technologies and solutions to deliver clean, affordable, and plentiful sources of energy. The Initiative's mission is to create low- and no-carbon solutions that will efficiently and sustainably meet global energy needs while minimizing environmental impacts, dramatically reducing greenhouse gas emissions, and mitigating climate change.

The Initiative's first pillar—research—pairs world-class research teams from across the Institute with MITEI's government and industry members to respond to specific energy challenges. Through MITEI's Low-Carbon Energy Centers, currently under development, companies and government entities can join to advance research through these multi-stakeholder consortia focused on key technology areas for addressing climate change. In addition, MITEI has two consortia studies currently under way: Utility of the Future (to be released in late 2016) and Mobility of the Future (officially launching August 2016). These studies are examples of MITEI research that brings together academia, industry, and government to explore pathways for meeting future needs of the electric grid and transportation sector, respectively.

MITEI's second pillar is education. The Initiative created and administers the multidisciplinary Energy Studies Minor for undergraduates. Through this program and other initiatives such as the Undergraduate Research Opportunities Program in energy and the graduate Energy Fellows program, MIT educates the next generation of innovators, entrepreneurs, and policymakers who will help solve global energy challenges. The MIT Tata Center for Technology and Design, housed within MITEI, provides real-world learning experiences for graduate students, who work with communities in India and other developing nations to address energy, environmental, and other issues. MITEI-sponsored graduates have gone on to exciting careers in the public, private, nonprofit, and academic sectors.

MITEI's third pillar—outreach—is provided through in-depth, high-quality analysis about current energy topics for policymakers, industry leaders, and the public. The "Future of…" series of studies and reports is produced by multidisciplinary teams of MIT faculty and researchers, and is an integral part of MITEI's outreach activities. Each report examines the role of a specific energy source in meeting future energy demand under carbon dioxide emissions constraints. The most recent study, The Future of Solar Energy, was released in May 2015. MITEI also produces an ongoing series of working papers synthesizing key results from ongoing research efforts for a range of relevant audiences. Additionally, MITEI publishes Energy Futures, a magazine covering energy research and other energy activities at MIT.

Within MIT, the Initiative fosters a sense of community among those interested in energy, and provides funding opportunities for faculty and students. MITEI also

supports student-led energy groups such as the MIT Energy Club and hosts events with thought leaders across the energy spectrum.

Accomplishments and Updates

In FY2016, MITEI launched a major new initiative—the Low-Carbon Energy Centers—provided funding for MIT energy research projects, expanded the MIT energy studies curriculum, welcomed new members, and hosted or played a key role in numerous research- and policy-focused conferences.

Since its inception in 2006, MITEI has helped raise more than $610 million to support energy research, education, and outreach initiatives.

Low-Carbon Energy Centers

In October 2015, MITEI announced the development of eight multidisciplinary Low-Carbon Energy Centers as a core element of MIT's five-year Plan for Action on Climate Change. Each Center has a distinct focus: carbon capture, utilization, and storage; electric power systems; energy bioscience; energy storage; materials for energy and extreme environments; advanced nuclear energy systems; nuclear fusion; and solar energy. Within each Center, MIT faculty experts from different disciplines will work with industry and government members to expand the portfolio of existing MITEI-facilitated research in these areas and continue to forge the path to a decarbonized energy future. Each Center will have a unique technoeconomic assessment program to provide insights regarding the bridge between energy markets and bench-level technology development efforts.

National energy provider Exelon joined as the first member of the Centers, and numerous other industry-leading companies are in the process of becoming members.

Research

MITEI's research portfolio reflects its core mission of enabling the low-carbon economy of the future through the adoption of renewable energy, energy efficiency, and carbon management technologies. The largest single area of funded research is solar energy technology and policy. The portfolio also includes projects geared toward meeting contemporary energy needs through the efficient use of conventional energy sources.

MITEI members have sponsored more than 800 projects to date, many involving collaborations between MIT researchers and member researchers. Approximately 30% of MIT faculty has engaged with MITEI's programs.

MITEI Research Program Highlights

Funding for Early-stage Research

In 2016, MITEI made $1.3 million in funding commitments for nine early-stage MIT energy research projects through the MITEI Seed Fund Program, made possible with support from MITEI members and donors. Including 2016 grants, the program has supported a total of 151 energy-focused research projects representing nearly $19.9 million in funding

over the past nine years. The program encourages researchers from throughout MIT's five Schools to collaborate in exploring new energy-related ideas, and attracts a mix of established energy faculty as well as many who are new to the field or to MIT.

Reports

MITEI published several major reports, including On the Road toward 2050: Potential for Substantial Reductions in Light-Duty Vehicle Energy Use and Greenhouse Gas Emissions (Heywood *et al*, November 2015) and Technology Improvements and Emissions Reductions as Mutually Reinforcing Effects (Trancik *et al*, November 2015).

Working Papers

The Initiative also released working papers written by MITEI staff, faculty affiliates, and graduate students on subjects ranging from optimal energy R&D technology portfolios to the economics of coal and renewable energy technologies under different carbon pricing scenarios.

Faculty Research Highlights

Following are selected energy research projects by MITEI faculty affiliates and researchers.

Solar Energy

Examining solar photovoltaic technologies: Vladimir Bulović of the Innovation Institute and the Department of Electrical Engineering and Computer Science, Tonio Buonassisi of the Department of Mechanical Engineering, and graduate students Joel Jean and Patrick Brown, along with their collaborators have performed a rigorous assessment of today's many commercial and emerging solar photovoltaic technologies and conclude that none should be ruled out.

Preparing for large-scale solar deployment: Measures to ensure a reliable future power system: Ignacio Pérez-Arriaga of the Sloan School of Management and the Instituto de Investigación Tecnológica-Comillas (IIT) in Madrid, Spain, along with a team of ITT-Comillas and MIT researchers are examining how the large-scale adoption of solar power may affect operations, costs, and other aspects of today's electric power systems going forward.

Energy Storage

Low-cost, long-lasting storage for the grid: Donald Sadoway of the Department of Materials Science and Engineering, David Bradwell MEng '06, PhD '11, and their collaborators have developed a novel molten-metal battery that is low-cost, high-capacity, efficient, long-lasting, and easy to manufacture—characteristics that make it ideal for storing electricity on power grids today and in the future.

Extending lifespan and improving performance of fuel cell electrodes: Bilge Yildiz of the Department of Nuclear Science and Engineering, former postdoc Nikolai Tsvetkov, graduate students Qiyang Lu and Lixin Sun, and Ethan Crumlin of the Lawrence Berkeley

National Laboratory are developing a way to treat the surface and strengthen perovskite oxides, materials which could be used as electrodes in fuel cells and electrolyzers.

Materials Science

Recovering material for novel solar cells from discarded car batteries: Angela Belcher of the Departments of Biological Engineering and Materials Science and Engineering, Paula Hammond of the Department of Chemical Engineering, Po-Yen Chen PhD '15, and others have shown that a novel, high-efficiency, low-cost solar cell can be made using lead recovered from an abundant source: lead-acid car batteries.

Light-emitting sensors that self-repair: Niels Holten-Andersen of Materials Science and Engineering, postdoc Pangkuan Chen, graduate students Qiaochu Li and Scott Grindy, and Rebecca Gallivan '17 and Caroline Liu '18 are creating fluorescent polymer gels that change color when they're disturbed—behavior that could make them effective sensors for detecting structural failure in energy-related equipment.

Designing climate-friendly concrete: Roland Pellenq and Franz Joseph-Ulm of the Department of Civil and Environmental Engineering, and postdoc Katerina Ioannidou of MITEI have developed a detailed understanding of the nanoscale forces at work as cement hardens—a critical step toward developing stronger, longer-lasting, less carbon-intensive concrete for "greener" construction in the future.

Nuclear Energy

A small, modular, efficient fusion plant: Dennis Whyte of Nuclear Science and Engineering, PhD candidate Brandon Sorbom, and others have designed a small, modular, and efficient fusion plant that could bring the technology closer to reality.

Explaining heat loss in fusion reactors: Research scientist Nathan Howard, doctoral student Juan Ruiz Ruiz, Cecil and Ida Green Associate Professor in Engineering Anne White, and 12 collaborators have found that turbulence at scales of electrons and ions accounts for the mismatch in theory and experimental results in fusion power research.

Electric Power Systems

Informing New York's electricity policies: As part of the Utility of the Future Study, MITEI is collaborating with IIT-Comillas and AVANGRID to create a model that could inform New York's Reforming the Energy Vision plan by simulating impact of distributed resources on the power system.

Addressing energy technologies and policies that shape future sustainability: Munther Dahleh of the Institute for Data, Systems, and Society, Sanjoy Mitter of Electrical Engineering and Computer Science, and research scientist Mardavij Roozbehani use data and models to design and predict technologies and policies for environmental sustainability.

Additional Low-Carbon Energy Research

Creating a citywide building energy model for Boston: Christoph Reinhart of the School of Architecture, PhD student Carlos Cerezo of the Building Technology Program, and their colleagues at the Sustainable Design Lab and the Lincoln Lab have created a citywide urban building model which can help city planners make more sustainable energy decisions and combat climate change.

Engineering microbes to create new materials: Kristala Jones Prather of Chemical Engineering arranges microbes to make new compounds that could eventually provide easily-adopted alternatives to petroleum.

Tapping geothermal energy with new drilling technique: Paul Woskov of the Plasma Science and Fusion Center attempts to advance drilling technology by melting or vaporizing hard rock using millimeter radio-frequency waves.

Energy and Climate Economics and Policy

Reducing emissions, improving technology: In an invited report and presentation at the White House ahead of the Paris climate negotiations, Jessika Trancik of the Institute of Data Systems and Society described an analysis demonstrating a mutually reinforcing cycle between emissions-reduction policies and renewable energy technology development and deployment. Trancik worked with colleagues at MIT and Tsinghua University.

Modelling the potential for wind energy in China: Valerie Karplus of the Sloan School of Management, postdoc Da Zhang, graduate student Michael Davidson, and colleagues at Tsinghua University have found that China has an opportunity to massively increase its use of wind power if it properly integrates wind into its existing power system.

Regulating particulate pollution: Noelle Selin and Susan Solomon of the Department of Earth, Atmospheric, and Planetary Sciences and graduate student Jareth Holt have developed new insights into how energy-related emissions form fine airborne particles damage human health, and they have demonstrated a new way to design emissions-control measures specially tailored to reduce particulate pollution in a specific location.

Advancing cost-effective energy-efficiency technologies: Christopher Knittel of the Sloan School of Management continues his work with colleagues at MIT, the University of California at Berkeley, and the University of Chicago through the E2e (Evidence for Action on Energy Efficiency) project. This past year, the E2e project awarded seed money to three teams that competed in the energy efficiency research design competition. With generous support from the Alfred P. Sloan Foundation, the winners each received $25,000 to help fund randomized impact and quasi-experimental evaluations on energy efficiency programs that can provide valuable insights for learning which policies work best and which are most cost-effective in achieving their goals.

Estimating reactions to changes in energy prices and regulations: Professor Knittel's other research focuses on estimating how firms and consumers react to changes in energy prices and energy regulations. One of his recent working papers looks at the local economic impacts of hydraulic fracturing. The paper finds that fracking leads to

increases in employment, income, and most notably housing prices. The authors also find limited evidence of an increase in criminal activity following fracking, and that there is an offsetting increase in local government incomes and expenses.

Energy in the Developing World

Cleaning water without the grid: Amos Winter of Mechanical Engineering, PhD candidate Natasha Wright, and their fellow researchers in the Tata Center for Technology and Design have developed a solar-powered electrodialysis desalination system that could significantly increase the groundwater available for drinking in Indian villages.

Bioreactor for converting organic waste to commodities: Gregory Stephanopoulos of Chemical Engineering, postdoc Devin Currie, and past fellow Jieun Shin have developed a new technology that uses anaerobic digestion of food waste from landfills and agriculture to produce valuable chemicals and fuels at community and industrial scales.

Low-cost, low-energy positive displacement pumps for irrigation: Alexander Slocum of Mechanical Engineering and PhD student Kevin Simon of Systems Engineering are developing more efficient and low-cost positive displacement pumps which can be used by smallholder farmers for irrigation.

Design and manufacturing of portable, lightweight solar cells: Vladimir Bulović, postdoc Selma Duhović, and PhD student Richard Swartwout are developing large-area, lightweight, flexible, and portable solar PV cells using emerging thin-film technologies at a low-cost for use in rural India.

Tackling rural electrification: Robert Stoner, deputy director for science and technology at MITEI, and Ignacio Pérez-Arriaga head a team of Tata Center researchers for the Universal Energy Access Project (UEA) to further rural electrification throughout the developing world. These researchers are exploring ways to extend electricity access to rural communities in India using microgrids, which may be economically viable in areas where it is prohibitively expensive to expand grid access. The team is developing a computational model known as the Reference Electrification Model, which is focused on providing vital information to stakeholders interested in promoting energy access, and helping to plan electricity networks in India and other developing countries. The UEA is funded, in part, by the Tata Center, the United Nations, and several MITEI members.

Multi-Stakeholder Research

In addition to developing the eight Low-Carbon Energy Centers, MITEI has been continuing multi-stakeholder research through the Utility of the Future Study and has laid the groundwork for the new Mobility of the Future Study.

Utility of the Future Study

The Utility of the Future Study brings together a diverse group of leading international companies to address emerging issues in the electric power sector. It also provides a neutral framework within which to evaluate the economic, regulatory, and technological impacts of the ongoing evolution of the power sector world-wide. The study team

from MIT and IIT-Comillas combines a breadth of skills in quantitative economic and engineering modeling, with a sophisticated understanding of the complex interactions in the electric power industry. The team includes faculty with decades of experience in advising governments, corporations, and institutions on regulation and market design. The consortium partners—industrial and other market participants—bring valuable real-world expertise and experience to the study.

MITEI has held workshops with the Utility of the Future members and the Advisory Committee since project initiation, as well as numerous bilateral conversations between the companies, MITEI, and IIT-Comillas. Study participants have developed models to enable the analysis of key aspects of the power system; preliminary results were presented at the most recent workshop in May 2016.

Research for this project has been under way for two years, and the team expects to issue a report in late 2016. The ultimate aim is to inform policy and future research by providing a model for utilities and regulators showing how the grid can adapt most efficiently to emerging technologies. This project will form the foundation of the MITEI Low-Carbon Energy Center for Electric Power Systems.

Mobility of the Future Study

This multi-year consortium research study, which officially launches in August 2016 after extensive preparations in FY2016, examines how mobility—the movement of people and goods—is changing in response to evolving demographics, consumer preferences, new business models, connectedness, technology, alternative fuels, and policy. Future changes are anticipated but there is great uncertainty about the pace of change and the mobility options that will be adopted. The study will explore these possibilities and examine how complex interactions between engine technology options, fuel options, refueling infrastructure, consumer choice, public transit options, new transportation modalities, and government policy might shape the future landscape for mobility.

A potential major driver of change is public policy related to climate change and environmental concerns. Among all the primary energy use sectors (electricity, transportation, industry, and buildings), transportation is the most challenging sector to decarbonize. Nevertheless, there are substantial opportunities to reduce greenhouse gas emissions and fossil-fuel consumption in the transportation sector. Many combinations of higher-efficiency vehicles, advanced engines, new fuels, and new modes of transport will be possible in the decades ahead.

Tata Center for Technology and Design

Now concluding its fourth year, the MIT Tata Center for Technology and Design provides holistic support—funding, education, and logistics—to MIT principal investigators applying their research to grand challenges in India and the developing world. Approximately 60 MIT faculty members from all five Schools have received support from the center, and the center has sponsored more than 100 graduate student Tata Fellows enrolled in master's degree and PhD programs across the Institute. These students, along with their faculty advisors, develop thesis projects that respond to large-scale opportunities to use technology and policy to improve the lives of people at the

bottom of the economic pyramid. They travel to India at least twice a year, generally during the Independent Activities Period and summer, to gather data, conduct field trials, and develop community connections. Researchers work closely with on-the-ground collaborators in the corporate, non-profit, and government spheres.

This year, the Center's project portfolio matured substantially, with several projects transitioning into commercialization or policy action and attracting follow-on funding. For example, in addition to the above-mentioned solar-powered water purification system using electrodialysis that is being piloted in India and Gaza with substantial support from the United States Agency for International Development, a team led by Professor James Wescoat has entered a formal collaboration with the government of India to improve water supply management. Khethworks, an agricultural company founded by graduates of the Tata program, is now headquartered in Pune, India.

The first annual Tata Center Symposium at MIT brought together the MIT community with influential visitors from India to explore areas of need and form new collaborations. The next symposium will be held in September 2016. The Tata Center will add 12 new projects to its portfolio in academic year 2017.

The main goals of Tata Center projects are to develop world energy and to expand access to modern energy at minimal cost for areas with low or no electrification. Projects for optimizing energy planning and regulation are critical to this effort, such as the above-referenced Universal Energy Access project and Reference Electrification Model.

Education

The world's energy and climate challenges require innovative problem solvers. Through its education programs, MITEI is training future energy leaders for meaningful careers. Working with world-renowned energy researchers, policy analysts, industry representatives, and thought leaders, MITEI has created an energy education ecosystem for all MIT undergraduate and graduate students interested in advancing a low-carbon energy future.

The energy studies minor, launched in September 2009, is a multidisciplinary curriculum that integrates energy science, social science, technology, and engineering. It is open to students from all majors. Undergraduate students can also benefit from special initiatives such as the Energy Freshman Pre-Orientation Program and summer Energy Undergraduate Research Opportunity Program (UROP).

MITEI's member-supported Society of Energy Fellows and sponsored research assistantships provide a framework for graduate students and postdoctoral researchers to deepen their knowledge and skillsets, along with opportunities to publish their work. Graduate students play an important role in the Initiative's intellectual and educational mission by cultivating a community with a wide range of disciplinary perspectives and talents focused on a common set of energy challenges. Students are involved in curriculum development and the mentorship of UROP students. The Society of Energy Fellows also runs various activities, including dinner meetings with sponsors at MITEI's Annual Research Conference and a range of informational gatherings.

Faculty associated with MITEI help shape energy education at both the undergraduate and graduate levels by way of teaching, advising, and developing new curricula.

Education Program Highlights

Energy Studies Minor Curriculum Expansion

MITEI expanded the energy studies minor curriculum with funding from the S.D. Bechtel, Jr. Foundation, which supports five new classes and new energy components for four existing classes.

New Milestone for Energy Studies Minor

More than 100 students have now graduated from the energy studies minor since its inception in 2009.

Undergraduate Energy Research

MITEI supported 31 students through its Energy UROP during Summer 2016. MITEI has now sponsored 370 UROP projects to date during all terms, including Tata Center and Center for Energy and Environmental Policy Research projects. This cohort's projects ranged from studying security scenarios on a floating nuclear plant to improving transparent solar cell design. Over the course of the summer, the education office conducted nine topical workshops designed to enhance skills and community among Energy UROPs. These students were supported by MITEI founding member Shell, sustaining members Chevron and Lockheed Martin, and several MITEI affiliate members.

Graduate Fellows

MITEI named 32 graduate students to the Society of Energy Fellows in fall 2015. The hundreds of fellows named since 2008 have come from more than 20 departments and all five Schools, and are sponsored by MITEI members.

Undergraduate at the 21st Conference of the Parties in Paris

The Initiative sponsored an undergraduate student to travel to and observe the Conference of the Parties (COP21) in Paris. Joseff Kolman, an MIT student majoring in physics and political science who is also a member of the Energy Education Task Force, was selected from a competitive MIT student applicant pool. He witnessed the negotiations firsthand and was able to meet with and learn from policymakers. He then gave a presentation on campus about his experience. Kolman's attendance was made possible by donations benefitting undergraduate educational curricular and extracurricular activities.

Undergraduate Energy Commons

MITEI will complete a new community space for energy students on campus in September 2016. Located directly under MIT's iconic dome in Room 10-063, the Energy Commons is a mixed configuration of educational and activity space for students to gather, hold events, and collaborate on projects. The development of this space was made possible by a grant from the S.D. Bechtel, Jr. Foundation.

Outreach

MITEI's outreach program promotes and disseminates energy research findings to the MIT community, as well as to policymakers, industry leaders, and other stakeholders. Through colloquia, symposia, and seminars, MITEI hosts thought leaders from across the energy value chain. MITEI staff, faculty affiliates, and graduate students also participate in events across the country and internationally, sharing their research and perspectives. Staff also participate in Institute-wide efforts focused on addressing climate change.

Outreach Program Highlights

MIT Plan for Action on Climate Change

MITEI participated in the development of the Institute's multifaceted five-year plan to enhance its climate action efforts, released in October 2015. Director Robert Armstrong has been named a member of the Climate Action Oversight Committee.

Guest Speakers

The Initiative brought highly regarded speakers to campus, including US Undersecretary for Science and Energy Lynn Orr, US Assistant Secretary of Energy David Danielson, Eisenhower Group President Susan Eisenhower, Environmental Defense Fund President Fred Krupp, Senior Adviser to the UN Secretary-General on Climate Change Janos Pasztor, and others.

Solve Conference at MIT

MITEI helped shape the first international Solve Conference, a program run by MIT aimed at solving the world's most challenging problems. Robert Armstrong and Angela Belcher organized and led the "Fuel" program track with a plenary panel and breakout discussions that focused on accelerating solutions to energy challenges, and other panels featuring MITEI staff and affiliated faculty.

Support for Campus Energy Events

MITEI sponsored and provided staff support for campus energy events including the Climate CoLab Crowds and Climates Conference and the student-led MIT Energy Conference. In addition to providing guidance on the agenda, logistics, and communications strategy, MITEI also facilitated US Secretary of Energy Ernest Moniz's participation in the Energy Conference. Secretary Moniz, the founding director of MITEI, gave a keynote address followed by a fireside chat with MITEI director Robert Armstrong, who was deputy director during Moniz's tenure.

2015 Annual Research Conference

The 2015 Annual Research Conference convened MITEI member companies, MIT faculty, staff, students, and guests to examine challenges and pathways forward for the global energy system.

2016 Associate Member Symposium

The 2016 Associate Member Symposium, "Designing Markets for a Decarbonizing Power System," brought together experts to discuss how to design well-functioning markets to meet the opportunities and challenges presented by the rise of low-carbon generation technologies like wind and solar photovoltaics.

Clean Energy Education and Empowerment Women in Clean Energy Symposia

MITEI hosted the fourth and fifth annual symposia and awards titled, "Leveraging Megatrends for a Clean Energy Future" (November 2015) and "The Role of Women Internationally in Decarbonizing Our Energy Futures" (May 2016) in collaboration with the US Department of Energy, under the auspices of the Clean Energy Ministerial (CEM). Each symposium featured awards to women who have made outstanding achievements advancing clean energy law, policy, and business, among other areas. Clean energy leaders gave keynote addresses and participated in panel sessions. Each symposium, with audiences of more than 200, also featured presentations from university students across the country. The Precourt Institute for Energy at Stanford University joined the Clean Energy Education and Empowerment (C3E) collaboration in 2016, and hosted the May symposium at Stanford in Palo Alto, CA. The 2016 C3E Symposium, held in conjunction with the US-led meeting of the CEM in San Francisco, featured a keynote address from Energy Secretary Moniz.

IHS CERAWeek

MITEI provided a strong MIT presence for the third year at one of the largest energy conferences in the US, CERAWeek, organized by the information and insights company IHS Markit. MIT's contribution included a faculty plenary panel, representation on numerous panels throughout the conference—including Maria Zuber, Vice President for Research—as well as media coverage of MIT initiatives and an alumni reception developed with the MIT Alumni Club of South Texas.

United Nations Climate Change Conference in Paris

The MITEI communications team covered MIT's participation in the UN Climate Change Conference by developing news articles, facilitating faculty commentary to media outlets, including two feature opinion pieces in *The Christian Science Monitor* by Robert Armstrong and Jessika Trancik, and by sharing updates on social media.

Enhanced External Communications

The communications team also significantly enhanced its initiatives, including launching a new weekly newsletter dedicated to MIT energy advancements and events, expanding social media presence across multiple platforms, and redesigning and redeveloping the MITEI website to provide a user-oriented experience for people interested in energy faculty, research, education, and outreach (launched in early July following extensive FY2016 development).

Organization

Leadership Team

Director Robert Armstrong's leadership team is broadening MITEI's membership base, seeking out potential members for the Low-Carbon Energy Centers, increasing opportunities for faculty research, strengthening operations, and playing a lead role in energy education at MIT.

Robert C. Armstrong, director

Robert Stoner, deputy director for science and technology

Martha Broad, executive director
Louis Carranza, associate director

Francis O'Sullivan, director, research and analysis

Antje Danielson, director, education (joined MITEI in FY2016)

Emily Dahl, director, communications (joined MITEI in FY2016)

Energy Council

The Energy Council helps shape MITEI's research, education, and outreach directions. Robert Stoner and Martha Broad are members of the council, which also includes Professors Angela Belcher, Vladimir Bulović, John Deutch (Department of Chemistry), Leon Glicksman (Departments of Architecture and Mechanical Engineering), and Christopher Knittel.

External Advisory Board

An External Advisory Board, composed of industry, academic, nonprofit, and public sector leaders—chaired by former US Secretary of State George Shultz—provides oversight to the Initiative. The views and guidance of the board greatly assist MITEI in maximizing its impact in helping to meet the world's energy needs, reduce the environmental impacts of energy production and consumption, and influence public discourse on energy and the environment. The board meets annually each fall.

Energy Education Task Force

The Energy Education Task Force, comprised of faculty members and students from all five of MIT's Schools, oversees the Initiative's education program. Task force members develop new directions and support activities in this realm of opportunity.

Members

MIT Energy Initiative Member Programs contribute to a critical link in the energy innovation chain—pairing MIT's world-class research teams with innovators in industry and government to respond to specific energy challenges and move solutions into the energy marketplace. Member engagement facilitates key focus, research opportunities, and critical funding for the next generation of energy technologists.

MITEI aggregates MIT's research capability, innovation, expertise, and experience in successful industry collaborations to help meet its research partners' key strategic objectives. A multi-tiered membership structure enables private-sector partners to sponsor multidisciplinary "flagship" research programs with MIT faculty; contribute to energy-focused labs, programs, and centers; fund critical energy fellowships; support innovative energy concepts from proposals solicited across the campus; and participate in MITEI's seminars, lectures, and colloquia.

MITEI offers a "commons" approach that multiplies benefits to its member participants. Each member individually benefits from opportunities to pool resources that increase the overall understanding of research and analysis for their organization.

Member Highlights

In the past year, new companies joined MITEI to participate in consortium research projects as associate members, and several existing members also joined these projects.

- The Utility of the Future Study added new members including Enzen and Lockheed Martin. Study member Duke Energy upgraded its participation in the project. In July 2016, the US Department of Energy also joined as a member.
- BP, Chevron, and Ferrovial joined the Mobility of the Future Study in addition to their existing MITEI memberships, and Toyota Mobility Foundation joined the study as a new member.
- Exelon, a new MITEI Associate Member, is also the first member of the Low-Carbon Energy Centers. Other companies are in the process of joining the Centers as well.

Affiliated Groups

MITEI is affiliated with faculty members in a number of MIT centers, departments, and laboratories pursuing interdisciplinary energy and environmental activities. MITEI supports the financial administration of certain projects and collaborates on research and education activities with these organizations.

Carbon Capture and Sequestration Technologies Program

The Carbon Capture and Sequestration Technologies Program at MIT conducted research into technologies to capture, utilize, and store CO_2 from large stationary sources from 2000–2016.

A core component of this effort was the Carbon Sequestration Initiative, an industrial consortium on carbon management led by MITEI senior research engineer Howard Herzog, which engaged more than two dozen member companies over the course of its existence.

Projects included research and analysis that advanced technologies, analyzed economics, informed regulatory policies, and shaped public perception of carbon management.

Center for Energy and Environmental Policy Research

Established in 1977, the Center for Energy and Environmental Policy Research (CEEPR) promotes research on energy and environmental policy to support improved decision making by government and industry. It is directed by Christopher Knittel and jointly sponsored by MITEI, the Department of Economics, and the Sloan School of Management.

Affiliated faculty and research staff as well as international research associates contribute to empirical research on policy issues related to coal, oil, gas, and electricity markets; nuclear power; transport; energy infrastructure; investment finance and risk management; and environmental and carbon constraints. CEEPR cooperates closely with associates in government and industry from around the globe to enhance the relevance of its research.

CEEPR produces working papers, policy briefs, and research input for larger, interdisciplinary studies. Additional activities include two annual research workshops in Cambridge, Massachusetts, and a European energy policy conference organized jointly with the Energy Policy Research Group at the University of Cambridge in the UK.

The E2e project is a collaborative project initiated by Professor Knittel, former MIT Professor Michael Greenstone (now University of Chicago), and Professor Catherine Wolfram of the University of California at Berkeley to leverage cutting-edge scientific and economic insights on the causes of the persistent energy efficiency gap. E2e focuses these talents on solving one of the most perplexing energy questions today and on communicating the findings to policymakers and the public. E2e's research generates rigorous and accurate evaluations of energy-efficiency technologies and programs using state-of-the-art empirical methodologies.

Joint Program on the Science and Policy of Global Change

Led by Professor Ronald Prinn and Senior Lecturer John Reilly, the Joint Program's integrated team of natural and social scientists studies the interactions between human and Earth systems to provide a sound foundation of scientific knowledge that will aid decision makers in confronting the coupled challenges of future food, energy, water, and climate and air pollution.

This mission is accomplished through:

- Quantitative analyses of global changes and their social and environmental implications, achieved by employing and constantly improving an Integrated Global System Modeling framework
- Independent assessments of potential responses to global risks through mitigation and adaptation measures
- Outreach efforts to analysis groups, policymaking communities, and the public
- Cultivation of a new generation of researchers with the skills to tackle complex global challenges in the future

Building on the twin pillars of science and policy, the Program was founded in 1991 as a joint effort of two distinct groups: the MIT Center for Global Change Science and the MIT Center for Energy and Environmental Policy Research.

The Joint Program hosts the Tsinghua-MIT China Energy and Climate Project (CECP), an initiative with the Institute for Energy, Environment and Economy at Tsinghua University in Beijing, China, directed by Valerie Karplus of the Sloan School of Management. At MIT, CECP is associated with and supported by MITEI. The goal of the project is to analyze the impact of existing and proposed energy and climate policies in China on technology, energy use, the environment, and economic welfare by applying—and where necessary developing—both quantitative and qualitative analysis tools.

Multi-Scale Materials Science for Energy and Environment Laboratory

MITEI continues to host the MultiScale Materials Science for Energy and Environment Laboratory, an international joint unit (UMI) between France's National Center for Scientific Research (CNRS) and MIT. The lab is at the center of a strategic association covering research, training, and education in partnership with industry. The UMI aims at "bottom up" simulation and experimental verification of properties of complex multiscale materials—from atomic-scale to microns, and from nanoseconds to years. Materials with important technological, economic, energy and environmental applications will be addressed, including cement, ceramics, nuclear fuels, steels, and geo-materials. The UMI hosts French researchers at MIT—each for multiple years—and is seen as a gateway to further collaboration between CNRS and MIT. The UMI, which is housed at MIT under the auspices of MITEI, has been designated by the CNRS as the lead unit of a Laboratoire d'Excellence, consisting of multiple institutions engaged in materials science.

Office of Sustainability

The Office of Sustainability leverages the collective intelligence of the MIT community and its peers to explore how best to position the campus as a testing ground and model for solutions that address the unprecedented challenges of a changing planet. The intent is both to advance the practice of sustainability within the MIT campus systems and to make these solutions accessible and scalable to institutions and communities across the world that face similar sustainability-related challenges. Examples of these challenges range from how to track and assess the impact of the materials used every day in MIT's operations to how to enhance the Institute's relationship to the river that runs along its urban campus.

MITEI staff and faculty affiliates collaborate with the Office of Sustainability through initiatives such as the Campus Sustainability Task Force and the MIT Climate Change Conversation Committee.

Robert C. Armstrong
Director
Chevron Professor of Chemical Engineering