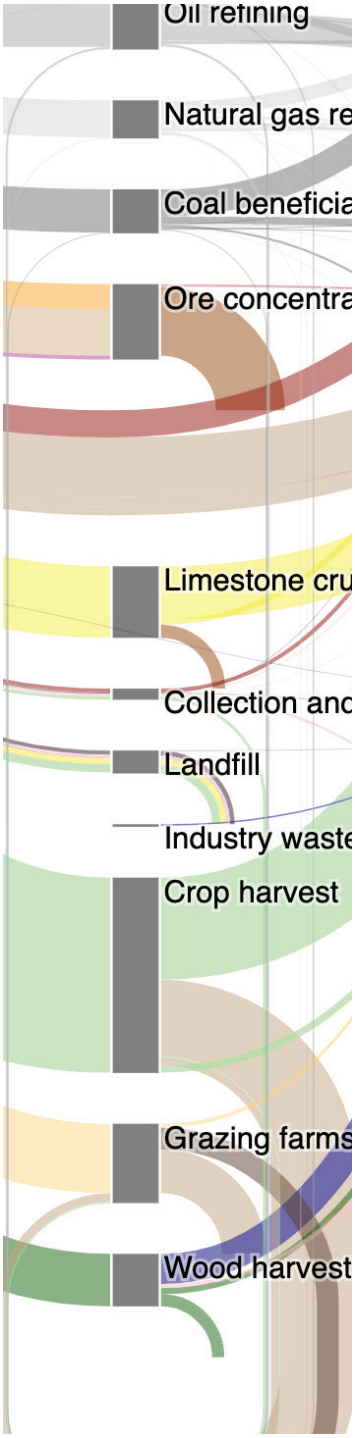
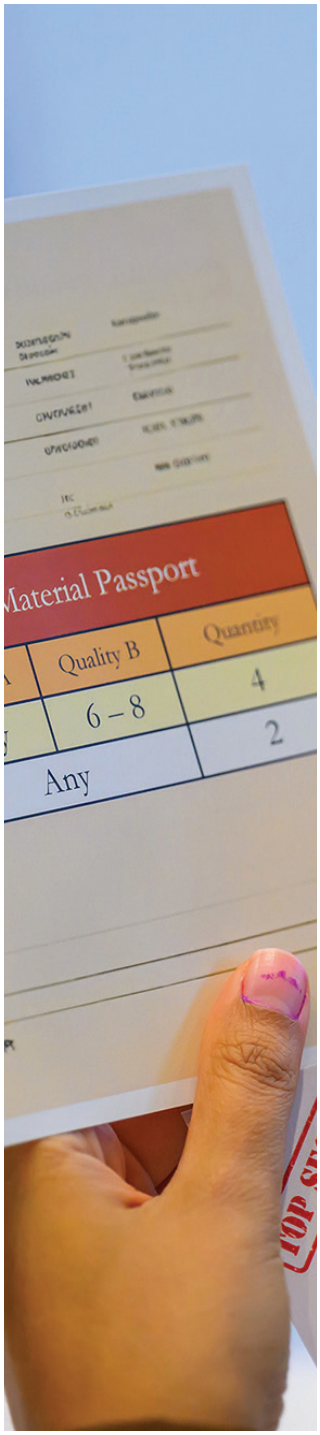
Impact Report 2024





MCSC | MIT Climate & Sustainability Consortium

Implementation & Impact

Few things are more rewarding in life than making real progress in mission-oriented work. We are delighted to share with you the key developments from our collective efforts in 2024 in this MCSC Impact Report. Empowered by the unique connections and resources of the MCSC, the postdoctoral impact fellows, staff, principal investigators, and researchers from across MIT, and key partners from each member company worked together to produce tangible outputs that advance progress toward measurable difference in the world. These include new tools, publications, and numerous, boundary-pushing engagements across the broader sustainability ecosystem. We are deeply thankful to and inspired by all who help make that possible.

THE CLIMATE PROJECT AT MIT

The year started off with incredible momentum as MIT President Sally Kornbluth announced the MIT Climate Project, an ambitious new model of accelerated, university-led innovation to respond to the multiple challenges of global climate change. Through this project, MIT seeks to become, within a decade, one of the world's most prolific and collaborative sources of technological, behavioral, and policy solutions — solutions that will change the expected trajectory of global climate outcomes for the better. As the MCSC embraces this Institute-wide effort on climate, we are thrilled to be finding new opportunities for our researchers, member companies, staff, and students to propel their work forward.

STRATEGIC PROGRAMMING

To accomplish our ambitious vision, throughout the year, the MCSC connected its member companies with the MIT research community through a series of mechanisms. Our Outcome Workshops include deep-dives on: the MCSC's Geospatial Trucking Industry Decarbonization Explorer (Geo-TIDE) tool, the logistics electrification planning process for accelerated carbon capture materials development, and the climate and sustainability implications of artificial intelligence. Our Study Group focused on corporate sustainability and climate disclosure, and our Annual Symposium in November covered a broad range of topics that are central to member companies' climate goals. Our series of Seed Award meetings highlighted the progress and findings that have emerged from funded research projects across campus and allowed MCSC member companies to inform next steps and real-world implementation of the discoveries.

MCSC Director Desirée Plata working with industry representatives at the annual symposium.

The Pixelframe team, including Inge Donovan and Jenna Schnitzler and led by MCSC Associate Director Caitlin Mueller, presenting their product.

FOCUS ON OUTCOMES

Perpetually focused on implementation, we produced an estimated 30 published works, including whitepapers, datasets, blog posts, tools, journal articles, working papers, topic briefs, and conference papers in 2024 alone! MCSC-sponsored research was featured in renowned scientific journals, such as *Nature Climate Change* and *Cell Reports Sustainability*, and the white papers hosted on DSpace (MIT's digital repository) were downloaded thousands of times from users across the world. Our Impact Fellows and leadership showcased MCSC work on more than 40 occasions through conferences, poster sessions, lightning talks, seminars, and lectures. And we show no signs of slowing down!

NEW SEED AWARDS PROJECTS

As we focus on the outcomes from the MCSC's 2022 Seed Awards program, we are eager to ramp up new projects awarded in 2024. The new projects represent emerging innovations with promise for rapid scalability in addressing climate and sustainability issues across a variety of sectors, from agriculture and architecture to employing AI in mechanical recycling systems. We are excited to see the direction of these nine projects, led by principal investigators across MIT's five schools and the Schwarzman College of Computing. We remind you that MCSC Member feedback is critically important to these projects as they evolve for maximum relevance in the world.

EDUCATING OUR FUTURE CLIMATE LEADERS

Education is central to MIT's mission, and the MCSC takes our role in training the next generation of climate leaders seriously. Through our Climate and Sustainability Scholars program, we engaged with 38 undergraduate students across MIT's schools within our 2023-2024 and 2024-2025 cohorts. These talented students researched diverse topics from innovating contaminated water testing in Nepal to the labor impacts of climate change. Our Undergraduate Research Opportunities Program (UROP) program facilitated direct collaboration between students and Impact Fellows, supporting 70 student-led projects. Overall, student participants report that the opportunity to learn about systems-level challenges — and the ground level action needed to move those systems — evolved their thinking in such a way that empowers them as they go forth beyond MIT. We hope they meet you there, and that you can all reflect proudly on what you have accomplished and the boundaries we will continue to push forward, collectively.

Thank you for engaging with us.

Anantha P. Chandrakasan | Chair
Desirée Plata | Director
Caitlin Mueller | Associate Director
Jeremy Gregory | Executive Director

MCSC Impact


13 Journal Articles
13 White Papers
3 Conference Papers
Outcomes
Pixelframe
Global Materials Flows
Geo-TIDE
6Cycle
Geospatial Value Chain Resilience
35 Papers, Tools & Innovations
635 Members Engaged in MCSC events
100,000+ LinkedIn Impressions
10,000+ Downloads on DSpace@MIT
500 Annual Symposium Attendees
Reach
39 Presented Works
18 Impact Fellows
285+ Student-led UROP Projects
Explorations
65 Principal Investigators across all of MIT's schools and the College
$8.5 Million Seed Awards
63 Supporting Researchers

Prologis | Susan Uthayakumar

Chief Energy and Sustainability Officer

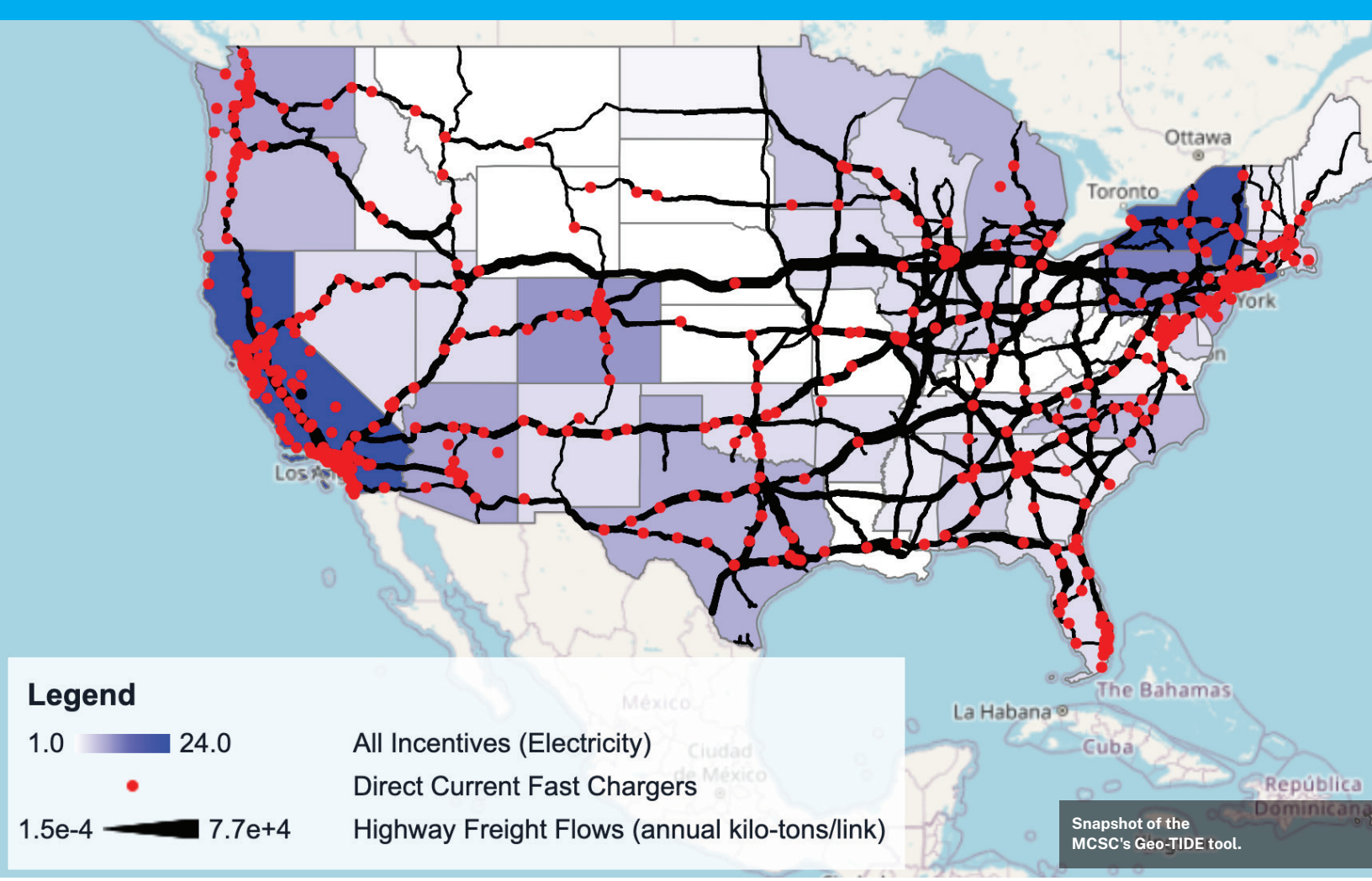
"The MCSC gives us a valuable outside perspective, bringing together bold thinking and practical solutions. Through research, workshops and strategy sessions, **the Consortium connects us to tested ideas we can put to work today.** As an example, insights on low-carbon construction are helping us reduce embodied carbon and test and scale lower-emission materials – making a real impact in industrial real estate."

Liberty Mutual Insurance | Francis Hyatt

Chief Sustainability Officer

"With climate technology advancing quickly and sustainability leadership evolving, we value the partnership and discussions that MCSC curates for its members, backed by the MIT's expertise as a leader in R&D. **It's a cross-sector community to learn, reflect and advance our collective goals** towards a more sustainable future."

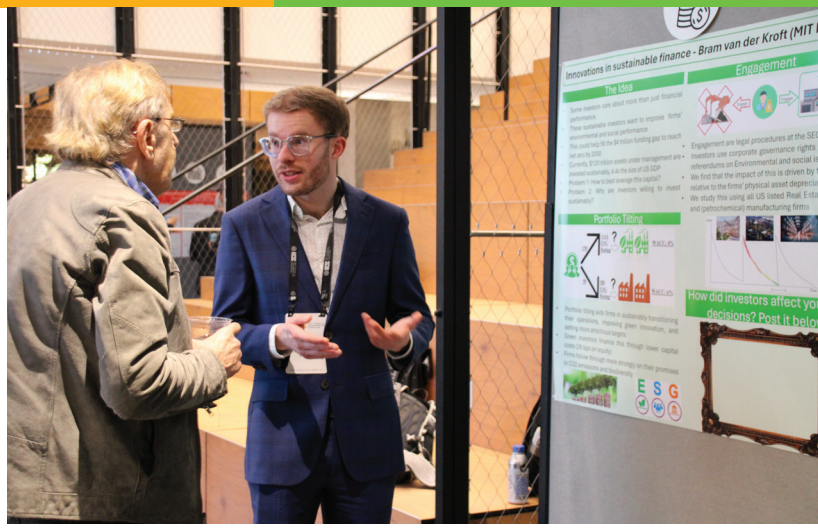
Contents



Snapshot of the MCSC's Geo-TIDE tool.

The limited printed version of this annual report is on recycled paper.

MCSC Impact Fellows regularly share their research with the MIT community and industry members.



Our Work & Mission

The MCSC is a unique academia-industry collaboration, working together to vastly accelerate the implementation of large-scale, real-world solutions, across sectors, to help meet global climate and sustainability challenges. We create new collaboration opportunities that amplify and extend MIT's current commitment to climate, while empowering industry to usher in, adapt to, and prosper in a decarbonized economy and world.

The three pillars that guide our work are:

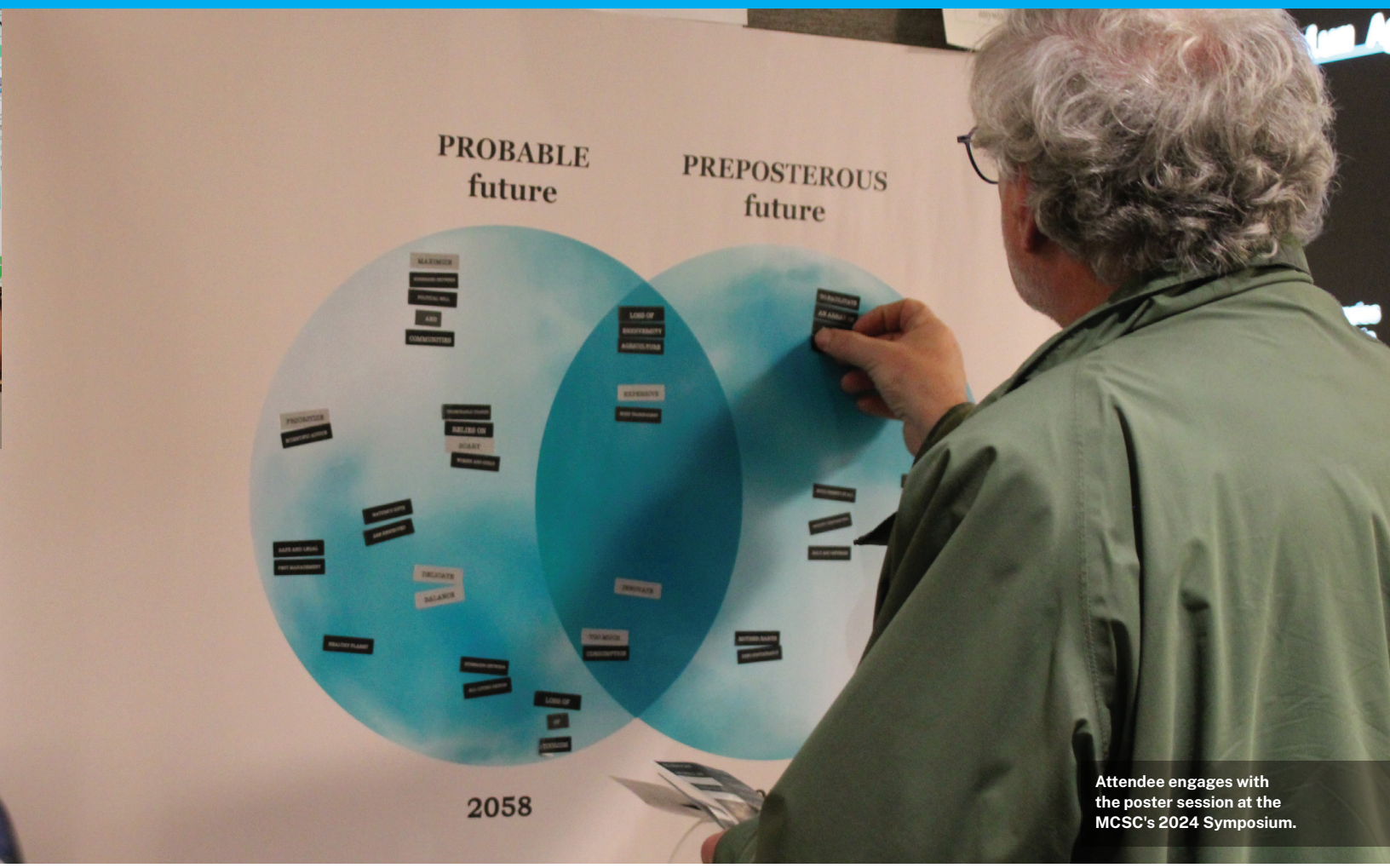
strategize:
link stated company goals to value chains, enhance synergy, and find unlocks

implement:
define, design, and pilot cross-industry technology, process, and organizational change

educate:
embed sustainability practice throughout workforce and university education

Through all three pillars, we are focused on ensuring our efforts have a positive impact – small and large, short-term and long-term, direct and indirect – on moving the needle on climate.

Our impact pathways are themes that help shape the work we do. They are based on member company input surrounding their organizational strategies and goals as well as the climate-focused expertise and work that is unfolding at MIT.



Attendee engages with the poster session at the MCSC's 2024 Symposium.

Focus Areas

MCSC | MIT Climate & Sustainability Consortium

- TOUGH TRANSPORTATION MODES
- CARBON CAPTURE & STORAGE
- VALUE CHAIN RESILIENCE
- DATA & COMPUTING
- CIRCULARITY
- SOCIAL DIMENSIONS
- NATURE-BASED SOLUTIONS
- CLIMATE FINANCE

Member Companies

MCSC member companies recognize industry's profound responsibility for action on climate change and its unique ability to rapidly deploy and optimize solutions. Representing the heart of global capital, they have committed not only to working with MIT but with each other, to confront climate challenge with the urgency required to realize their goals – and to be part of solving this existential threat for society.

These industry leaders can both help inspire transformative change within their own sectors and demonstrate the value of working together, across sectors, at scale.

2024 Industry Advisory Board Members

JIM ANDREW
Chief Sustainability Officer
PepsiCo, Inc.

JUAN BERNABE-MORENO
Director
IBM Research Europa/
Ireland and UK

SARAH CHANDLER
Vice President of Environment
and Supply Chain Innovation
Apple

LUIS COLOMA
Head of Care for Life and Nature
Inditex

GREG DOWNING
Senior Director, Climate
Cargill

NOLLAIG FORREST
Chief Sustainability Officer
Holcim

JAMES GOWEN
Senior Vice President,
Global Supply Chain
& Chief Sustainability Officer
Verizon

KARA HURST
Chief Sustainability Officer
Amazon

FRANCIS HYATT
Executive Vice President and Chief
Sustainability Officer
Liberty Mutual Insurance

ALISHA JOHNSON WILDER
Director, Environment,
Policy & Social Initiatives/
Racial Equity & Justice Initiative
Apple

JAVIER LOSADA
Chief Sustainability Officer
Inditex

CESAR LUCCHESE
Net Zero Transition Lead
for North America
Accenture

MARISSA MCINNIS
Senior Director,
Global Sustainability
Verizon

KATIE ROWEN
Senior Vice President,
Chief Administrative Officer
Vontier

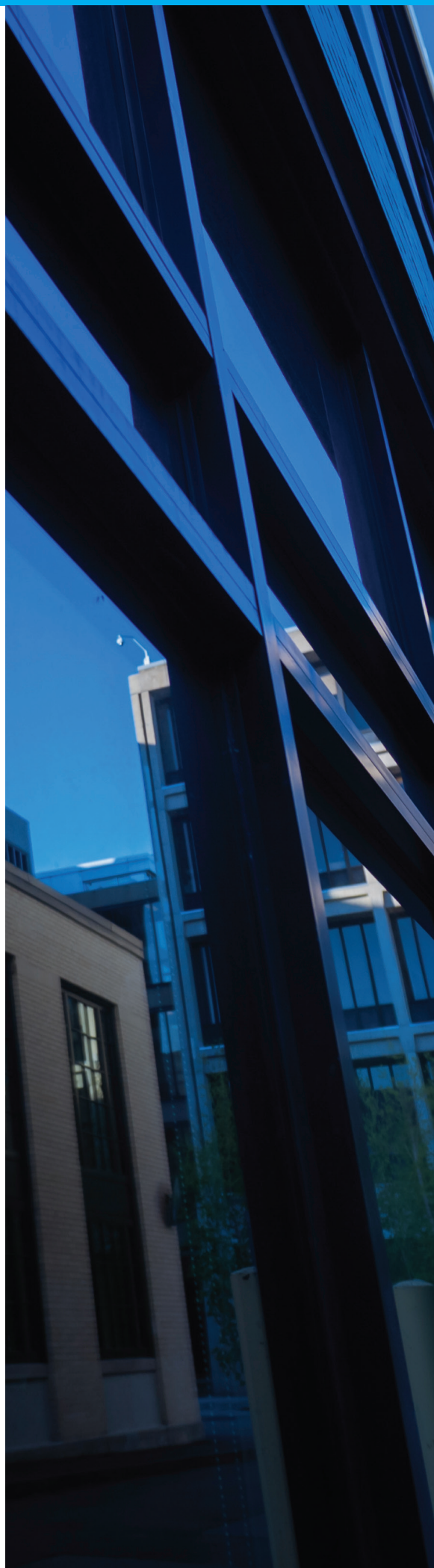
A.N. SREERAM
Senior Vice President and
Chief Technology Officer
Dow

NATE STREED
Senior Global Director of
Sustainability & ESG
Vontier

SUSAN UTHAYAKUMAR
Chief Sustainability and
Energy Officer
Prologis, Inc.

ANDREW VERONEAU
Vice President of Corporate
Development
RWCB, a Kraft Group Company

KOMMY WELDEMARIAM
Chief Scientist
Amazon



MCSC Community

Leadership

ANANTHA P. CHANDRAKASAN
Chair
Chief Innovation and Strategy Officer, MIT; Dean, MIT School of Engineering; Vannevar Bush Professor of Electrical Engineering and Computer Science

DESIRÉE PLATA
Director
Professor, Civil and Environmental Engineering

JEREMY GREGORY
Executive Director

ELSA OLIVETTI
Strategic Advisor
Jerry McAfee Professor in Engineering; Professor, Department of Materials Science and Engineering

In Fall 2024, Elsa Olivetti was named the mission director for the MIT Climate Project's Decarbonizing Energy and Industry mission, which supports advances in the electric power grid as well as the transition across all industry – including transportation, computing, heavy production and manufacturing – to low emissions pathways. In role as mission director, Olivetti is leading and coordinating the implementation of novel ideas that can move the needle forward on climate progress.

CAITLIN MUELLER
Associate Director
Associate Professor of Civil and Environmental Engineering; Associate Professor of Architecture

The MCSC welcomed Caitlin Mueller as Associate Director of the MCSC in September 2024. She has worked closely with the MCSC — embracing feedback from MCSC member companies to ensure her research is implementable and can have a positive, real-world impact on industrial decarbonization and material innovation.

JEFFREY GROSSMAN
Strategic Advisor
Morton and Claire Goulder and Family Professor in Environmental Systems

Adminstrative Staff

MELISSA ZGOLA
Program Manager for Member Engagement

MOLLY CHASE
Communications Manager

JAY LAMOUR
Administrative Coordinator

ELISE CHAMBERS
Program Manager for Student, Postdoctoral, and MIT Engagement

2024 Impact Fellows

Impact Fellows work with MIT researchers and consortium industry members — in collaboration with external organizations and communities — to implement solutions needed for global economic transformation to address the global climate change and sustainability crisis.

NOMAN BASHIR

AMANDA BISCHOFF

JUNGWOO CHUN

EVAN COLEMAN

LAURA FRYE-LEVINE

LAURENT LIOTÉ

MARY KATE MITCHELL LANE

DANIKA EAMER

AKACHUKWU (AC) OBI

ANEIL TRIPATHY

BRAM VAN DER KROFT

MICHELLE WESTERLAKEN

Climate & Sustainability Scholars

These undergraduate students are passionate about climate and sustainability and eager to explore and strengthen their interests and skills, while implementing research projects directly supported by faculty and principal investigators across MIT.

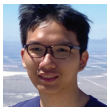
LAUREN AGUILAR
Major: Mathematics and Climate System Science and Engineering
Project Topic: Characterizing Distribution Grids and Quantifying The Load Impact of Electrification of Transportation and Home Heating

JOANNA CHEN
Major: Urban Science and Planning with Computer Science
Project Topic: Post-Climate Disaster Housing Recovery Toolkit

GRACE DEMARTINO
Major: Business Analytics
Project Topic: Leveraging ESG Shareholder Proposals to Drive Corporate Accountability in Climate Action

JANKA HÁMORI
Major: Artificial Intelligence and Decision Making
Project Topic: Imagining the Future of Sustainability in the Virtual World of VR

FRANKLIN NGUYEN
Major: Computer Science and Molecular Biology
Project Topic: Generalizing an AI Model for Flood Risk and Resilience Assessment in Thailand



QUAN NGUYEN
Major: Physics and Mathematics
Project Topic: Emulating Climate Models with Stochastic Dynamics

KANNAMMAI "KANNA" PICHAPPAN
Major: Brain and Cognitive Sciences with Anthropology
Project Topic: In Utero NDMA Exposure and Juvenile Neurological Health: Investigating Genetic Susceptibility and Ethanol's Influence in an In Vivo model

KALEIGH SPEARS
Major: Urban Science and Planning with Computer Science
Project Topic: Targeting Food Waste in Schools and Connecting Schools and Universities with Local, Sustainable Food Sources

WENDY ZHANG
Major: Artificial Intelligence and Decision Making
Project Topic: Rapid Assessment Surveys for Invasive Marine Species

JULIA CASEY
Major: Chemical Engineering
Project Topic: Development of Reaction-Transport Models for Biodegradation that Allow the Quantitative Extraction of Degradation Rates from Clear Zone Assays

AKORFA DAGADU
Major: Chemical-Biological Engineering
Project Topic: Investigating the Morphology of Bioinspired Random Heteropolymers for Protein Stabilization in Plastic Degradation

DEEPTA GUPTA
Major: Electrical Engineering and Computer Science
Project Topic: Ultradense and Efficient Power Converters for Variable DC-AC Applications

SARAH HERNANDEZ
Major: Chemical Engineering
Project Topic: Membrane Crossover Modeling for Electrochemical CO2 Separations

KRISTINE NGUYEN
Major: Biological Engineering
Project Topic: Developing Carbon-Negative Cementitious Materials via Bioengineering Bacillus subtilis Carbonate Precipitation

SAM PACKMAN
Major: Mathematics and Physics
Project Topic: Numerical Calculation of MPET Battery Model

DELPHINE PROTOPAPAS
Major: Civil and Environmental Engineering
Project Topic: Modeling and Mitigating Flood Risk on the MIT Campus

KANOKWAN "KANO" TUNGKITKANCHAROEN
Major: Mechanical Engineering
Project Topic: Trust-Building Hierarchical Automation: Validating the Transfer of Perovskite Properties Across Scales

ELDAR URKUMBAYEV
Major: Civil and Environmental Engineering
Project Topic: Exploring Salinity Tolerance of Etoposide-Treated Cajanus Cajan (Pigeon Pea)

TEACHING ASSISTANTS

MARIA ALDER
Major: Computer Science and Engineering with Environment and Sustainability

ANANDA SANTOS FIGUEIREDO
Major: Climate Systems Science and Engineering

ARI PERO
Major: Urban Science and Planning with Computer Science and Music

Impact Report design by Chandra Tallman Design

Franklin Nguyen at the MCSC Scholars poster session in spring 2025.

Moving the Needle on Climate Together

Holcim | Nollaig Forrest

Chief Sustainability Officer

“Smart design is key to sustainable construction. Collaborating with the MCSC and MIT’s Digital Structures research group, we contributed to the development of ‘Pixelframe’ to advance modular construction with building components designed for reuse, just like lego bricks. **By scaling up such systems that are circular by design, we can build better with less.”**

PepsiCo | Sami Ghazi

Senior Director

"Continuing to make progress in decarbonizing our network of fleet operations is a key component of our climate action strategy, and **our work with the MCSC has helped us identify barriers and address knowledge gaps** to do so. The transportation sector is complex and requires the input and perspectives of experts from diverse backgrounds – and we have found value in such collaborations with the MIT community through the MCSC.”

MIT | Amanda Bischoff

MCSC Impact Fellow

"It has been a valuable experience to work alongside Cargill and exchange ideas on reducing hard-to-abate emissions from agriculture, particularly nitrous oxide emissions. The insights Dana and her team bring to our work have helped us understand the current state of agricultural data collection and define benchmarks for new measurement technologies. Dana's input has also been crucial in **planning new research projects with large-scale implementation in mind from the beginning of technological development.**"

Cargill | Dana Boyer

Advisor, Climate

"Hard-to-abate agricultural emissions – like nitrous oxide – remain one of the biggest barriers to climate progress in our sector. That's why collaboration with researchers through the MCSC is so valuable: it helps bridge the gap between early-stage science and real-world application by involving industry from the outset. **We're already applying insights from the MCSC to inform program design on the ground.**"

MCSC 2024 Symposium
Bridging Academia and Industry to Scale Urgent Climate Solutions

Positioned as a bridge between academia and industry, the MCSC drives urgently needed solutions. Sessions were strategically crafted by the MCSC's Impact Fellows to be relevant to attendees' interests and needs, to spark conversation about best practices and shared challenges from various industries, and chart practical next steps.

Exploring Opportunities with MITEI to Decarbonize Thermal Processes and Heavy-duty Transportation

The event began with sessions held in conjunction with the MIT Energy Initiative Future Energy Systems Center, featuring expert speakers from MIT, industry, government, and national labs. The first session on decarbonizing heat generation – a process that has typically relied on fossil fuels because of the high temperatures required – explored a range of solutions being considered by industry. Discussion centered on integration and technical challenges in electrifying thermal processes due to hidden costs and complexities, as well as the need for more compact systems, phase change materials, ways to increase efficiency and lower cost, and actionable direction for industry members.

Anantha Chandrakasan, MCSC Chair

PHOTOS BY GRETCHEN ERTL

Dynamic Poster Session

The poster session was powerful- featuring the work of MCSC Impact Fellows, MCSC seed awardees, and others in the MIT community.

Outcomes from Industry-academia Partnerships

The second day of events began with a keynote speech by MCSC Associate Director Caitlin Mueller, Associate Professor of Civil and Environmental Engineering and Architecture at MIT, who presented a knock-your-socks off strategy for concrete reuse, Pixelframe, that aligns with the MCSC's focus area on circularity as well as the priorities of several member companies. This is the first start up to come from MCSC funding.

"Our research has confirmed that circularity can work technically and logistically at the scale of the built environment," said Mueller.

Understanding Scale & Connections in the Global Economy to Displace Fossil Fuels

Understanding the scale of the physical economy – the flow of materials and energy between sectors – and its connections is necessary to achieve true decarbonization without shifting burdens. A workshop centered on an interactive visualization to explore major flows in the global economy and how this framework can be used in decision-making to displace fossil fuels. Participants were pushed to think rigorously and design a fossil-fuel minimized future in small group discussions.

Social Dimensions of Climate and Sustainability

Participants engaged in two rounds of peer-to-peer dialogue, led by nine academic experts from social sciences, planning, and community implementation. Discussion highlights from the session include carbon colonialism and the Africa Carbon Markets Initiative, an MIT-initiated molten salt heat bank project in Mongolia, the relationship between biodiversity restoration action and corporate reporting, opposing strategies for publicizing corporate sustainability efforts, and the need to better understand foundational social concepts when transferring lab work into community action.

Advanced Modeling for Climate Risk

As the climate changes, system risk evaluations – of buildings, infrastructure, human health, and ecosystems – will require new modeling approaches that incorporate climate projections rather than relying on historical data.

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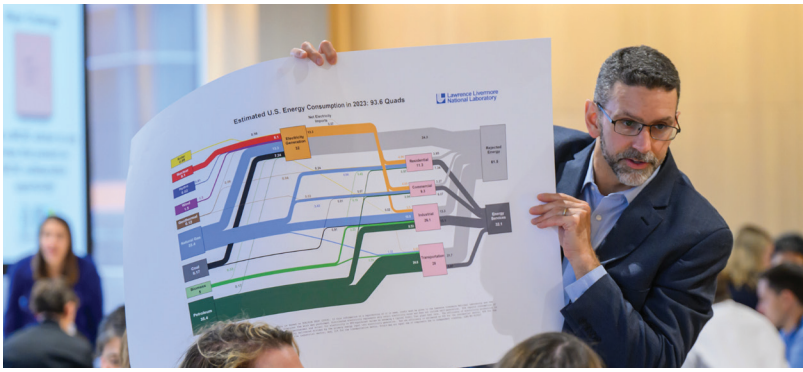
ATTENDEES WERE BROUGHT TOGETHER AT MCSC'S 2024 SYMPOSIUM.



Desirée Plata, MCSC Director

A session on the latest advances in advanced climate risk modeling explored the gap between current modeling capabilities and industry needs. Much discussion centered on the threshold for decision-grade data and how and who determines that delineation. Panelists also agreed that there is a need to better access and communicate uncertainty in models when presenting scenarios for decision making.

Building Biodiversity Strategies Through Environmental Data

Biodiversity is a non-fungible resource that forms the foundation of global value chains. Many efforts are underway to increase understanding of ecosystems through measurement and modeling, but data collection is not enough. “Efforts must go beyond measurement and reporting to identifying opportunities for nature-positive contributions,” said panelist Lydia Zemke, a Fellow at the Davies Lab, Harvard University, and Senior Advisor to EarthAcre Inc. in a session on developing strategies for biodiversity preservation and restoration through technological innovation.

Catalyzing Climate Action at MIT

The symposium closed with a conversation between leaders of the Climate Project, an Institute-wide MIT initiative that aims to accelerate interdisciplinary research and implementation. Panelists discussed the need for tools that policymakers can use to combat climate change, noting that an overview of policy efforts in the climate space across MIT will be beneficial to influence policy making. They also pointed to efforts in sustainable computing and computing for sustainability, such as using AI to analyze data towards improving the energy grid. The mission leaders ended by emphasizing that the impact of technical solutions on both policy and communities must be considered simultaneously and that the Climate Project is well-suited to hold that space.

“The MCSC represents what can happen through synergistic partnerships of incredibly dedicated individuals,” said Desirée Plata in her closing remarks, encapsulating the event’s unifying theme of harnessing the contributions of many individuals and industries to magnify impact and drive sustainability solutions. “Each of you in this room is proof of this reality.”

Discussion leaders, from across MIT, for the round table session.

The MIT Climate Project Missions

are MIT-wide problem solving communities that prioritize working with partners to scale solutions. The relationships, connections, and accomplishments of the MCSC underscore how important these collaborations are, and help to pave the way for how the Climate Project structures its work.

- Decarbonizing Energy and Industry
- Preserving the Atmosphere, Land and Oceans
- Empowering Frontline Community Action
- Designing Resilient and Prosperous Cities
- Enabling New Policy Approaches
- Wild Cards

2024 Seed Award Recipients
Span Cross-Industry Innovations $1 million to Fund 9 Projects Across MIT

The MCSC will provide more than $1 million to fund nine one-year projects, led by principal investigators across MIT and the Schwarzman College of Computing, through the 2024 Seed Awards program. Winning projects represent emerging solutions with promise for rapid scalability in addressing climate and sustainability issues across a variety of sectors, from agriculture and architecture to employing AI in mechanical recycling systems.

The nine winning projects align with the MCSC's Impact Pathways. Selection criteria include importance to members' goals, MIT researcher vision and expertise, and relevance to the consortium's mission of implementing real-world solutions to pressing climate and sustainability challenges by leveraging industry expertise with MIT's world-class resources.

MCSC 2024 SEED AWARD PROJECTS

"Optimization and collaboration toward a scalable charging infrastructure in logistics," co-led by Saurabh Amin, professor of civil and environmental engineering and principal investigator at the MIT Laboratory of Information and Decision Systems (LIDS); and Alexandre Jacquillat, associate professor of operations research and statistics at the MIT Sloan School of Management

ALIGNS WITH MIT CLIMATE PROJECT MISSION

Designing Resilient and Prosperous Cities and Decarbonizing Energy and Industry

"Global mapping of groundwater recharge and sustainable aquifer water withdrawals using satellite observations," led by Dara Entekhabi, Bacardi and Stockholm Water Foundations Chair; professor in the departments of Civil and Environmental Engineering and Earth, Atmospheric and Planetary Sciences

ALIGNS WITH MIT CLIMATE PROJECT MISSION

Preserving the Atmosphere, Land and Oceans

"Reducing embodied carbon @ work: Low-carbon cement-based product strategies for data centers, warehouses, and industry," led by Randolph Kirchain, director, MIT Concrete Sustainability Hub and principal research scientist at the MIT Materials Research Laboratory

ALIGNS WITH MIT CLIMATE PROJECT MISSION

Decarbonizing Energy and Industry

"Optimizing biological nitrification inhibitors for the suppression of N_2O emissions from agricultural soils," led by Darcy McRose, assistant professor in the department of Civil and Environmental Engineering

ALIGNS WITH MIT CLIMATE PROJECT MISSION

Decarbonizing Energy and Industry

"Employing AI to sort plastic waste by manufacturer," led by Bradley D. Olsen, Alexander and I. Michael Kasser (1960) Professor of chemical engineering

ALIGNS WITH MIT CLIMATE PROJECT MISSION

Decarbonizing Energy and Industry

"The impact of weather on the retail industry: long and short-term impacts," led by Georgia Perakis, interim dean and professor of operations research, statistics and operations management at MIT Sloan School of Management; and Talia Tamarin-Brodsky, assistant professor in the department of Earth, Atmospheric, and Planetary Sciences

ALIGNS WITH MIT CLIMATE PROJECT MISSION

Empowering Frontline Community Action

"Improving additionality assessment in voluntary carbon markets," led by Roberto Rigobon, professor of applied economics at MIT Sloan School of Management

ALIGNS WITH MIT CLIMATE PROJECT MISSION

Enabling New Policy Approaches

"Hyperspectral remote sensing of soil organic carbon using machine learning," led by Sherrie Wang, d'Arbeloff Career Development Assistant Professor in the department of Mechanical Engineering; Institute for Data, Systems, & Society (IDSS); and Laboratory for Information & Decision Systems (LIDS); and principal investigator of the Earth Intelligence Lab

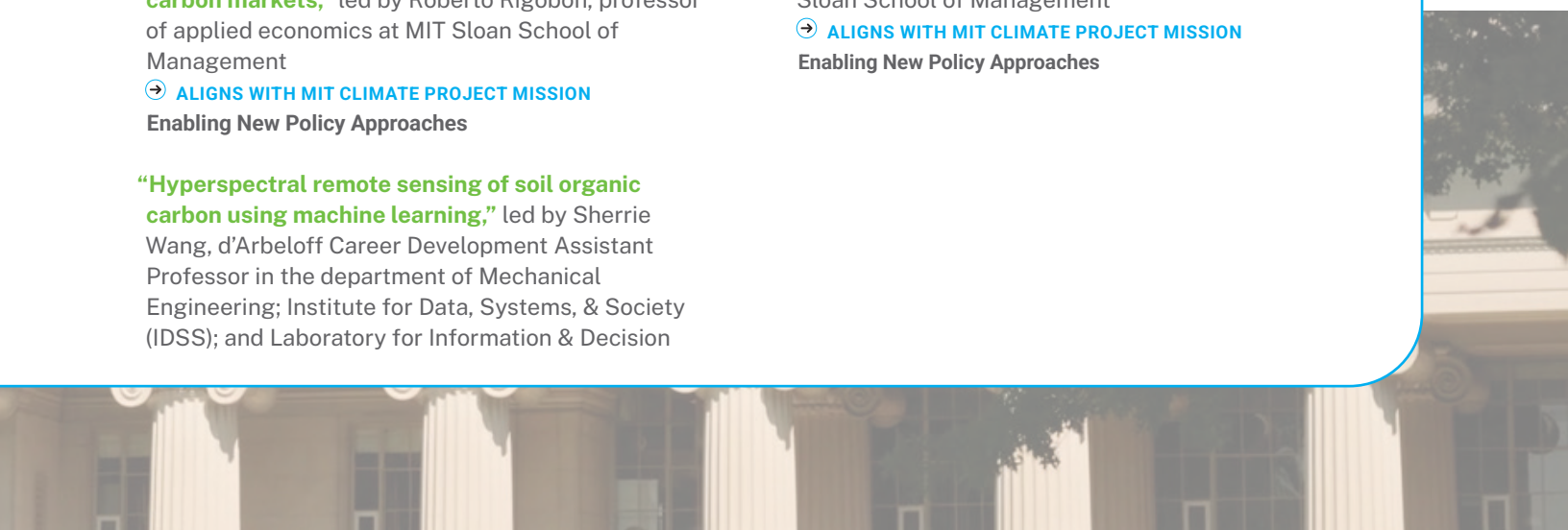
ALIGNS WITH MIT CLIMATE PROJECT MISSION

Preserving the Atmosphere, Land and Oceans

"Gaining green premiums from decarbonizing the built environment: A holistic evaluations approach for low-carbon investments," led by Siqi Zheng, faculty director of the MIT Center for Real Estate and the Sustainable Urbanization Lab; Roberto Rigobon, professor of applied economics at MIT Sloan School of Management

ALIGNS WITH MIT CLIMATE PROJECT MISSION

Enabling New Policy Approaches



MCSC-Funded Research Outcomes

These selected outcomes showcase the progress happening within MCSC-funded research projects. They highlight work led by MCSC Impact Fellows and staff, as well as principal investigators across all five of MIT's schools as part of both the MCSC Seed Awards program and MCSC directed projects.

TOUGH TRANSPORTATION MODES

JOURNAL ARTICLE

Climate and Air Quality Impact of Using Ammonia as an Alternative Shipping Fuel

As we transition to alternative fuels for tough to decarbonize transport segments, we must ensure we are not compromising other environmental or social impacts.

ANTHONY WONG
Graduate Student, Center for Sustainability Science and Strategy (CS3)

NOELLE SELIN
Professor, Institute of Data Systems and Society; Earth, Atmospheric & Planetary Sciences

SCAN OR CLICK TO READ MORE

SEED AWARD

Ammonia has been proposed as an important alternative fuel for maritime decarbonization. However, scientists have raised concern about the environmental impacts of increased ammonia utilization (e.g. nitrous oxide emission, air pollution, eutrophication). This is the motivation behind a team of researchers exploring the climate and air quality impacts of using ammonia as shipping fuel, relative to the current shipping system, which is based on fossil fuel. Their research, published in an article in *Environmental Research Letters*, suggests that while transitioning to ammonia fuel would reduce greenhouse gas emissions, ammonia emission regulations are required to mitigate potential negative effects on air quality.

WHITE PAPER

Global Bioenergy Availability

Given potential availability constraints for biomass feedstocks, industry and governments need line of sight to what is possible informs strategy and investment.

EVAN COLEMAN
Impact Fellow. MCSC

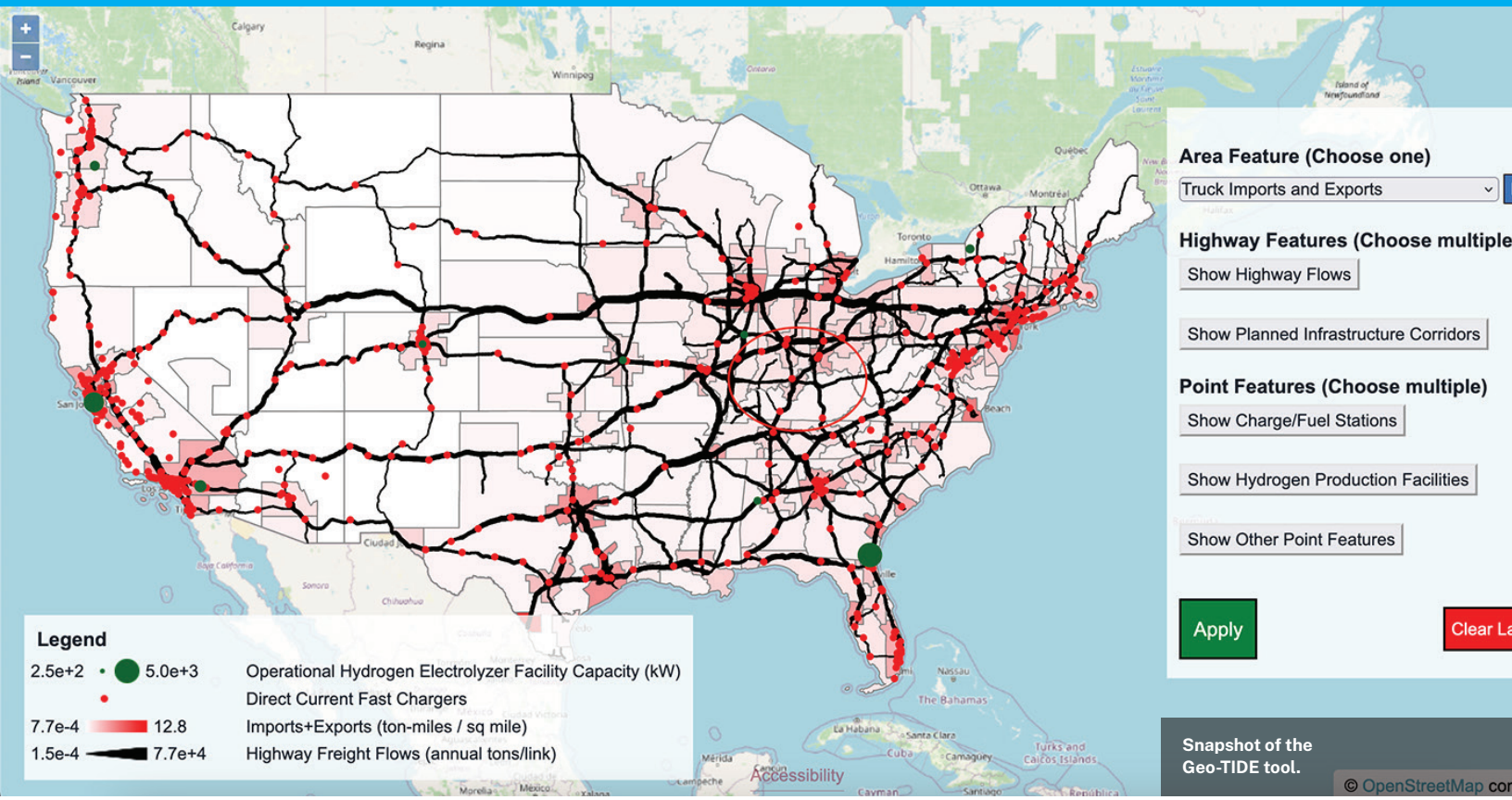
LAMA AOUDI
Graduate Student, Technology and Policy

KATIE DAEHN
Research Scientist, MCSC

SCAN OR CLICK TO READ MORE

FLORIAN ALLROGGEN
Research Scientist, MIT

A team of MIT researchers evaluate the total energy that may be supplied by crops and agricultural residues in the maritime shipping and air transportation sectors–reviewing the wide-ranging estimates in the literature and examining key sources of uncertainty. In exploring the potential of bioenergy to decarbonize maritime shipping and air transportation, this team of MCSC researchers found that while using crops and residues may not cover anticipated demand in tough-to-decarbonize transportation completely, and there are several obstacles, it is important to continue to identify the conditions in which bio-feedstocks make sense – and establish frameworks and incentives to support the best practices.



Snapshot of the Geo-TIDE tool.

TOUGH TRANSPORTATION MODES

TOOL

Geospatial Trucking Industry Decarbonization Explorer (Geo-TIDE)

Trucking industry stakeholders face significant uncertainty in navigating when, where, and how to decarbonize fleets and supporting infrastructure. This work integrates diverse datasets to inform these decisions from a policy, technical, and geographic perspective.

DANIKA EAMER
MCSC Impact Fellow

SCAN OR CLICK TO READ MORE

The Geo-TIDE tool helps trucking industry stakeholders decide where, when, and how to decarbonize their fleets by investing in low-carbon technologies. Its development is led by **Danika Eamer**, MCSC Impact Fellow, through a collaborative process with industry representatives and researchers across MIT. The tool hosts public freight-flow and emissions-related data for trucking, focusing on in-depth analysis and visualization of freight analysis framework (FAF5) data, complemented by supporting information from many other sources – such as the US Department of Transportation's Bureau of Transportation Statistics geographic datasets, the US Environmental Protection Agency's emissions and generation resource integrated database, and the US Energy Information Administration's electricity data. Together, the information represents a robust geospatial picture of regional freight flow densities, planned and available infrastructure, emission intensities, and relevant regulations and incentives.

CONFERENCE PROCEEDINGS PAPER

Techno-economic Outlooks for the Operation of Zero-Emission Heavy-Duty Trucks

Heavy-duty trucking is an essential part of our economy, but it is especially challenging to decarbonize because of the large amount of onboard energy storage required for range and performance. This research helps us better understand and overcome some of the uncertainty around alternative fuel options.

ZHIYI LANG
Graduate Student, Mechanical Engineering

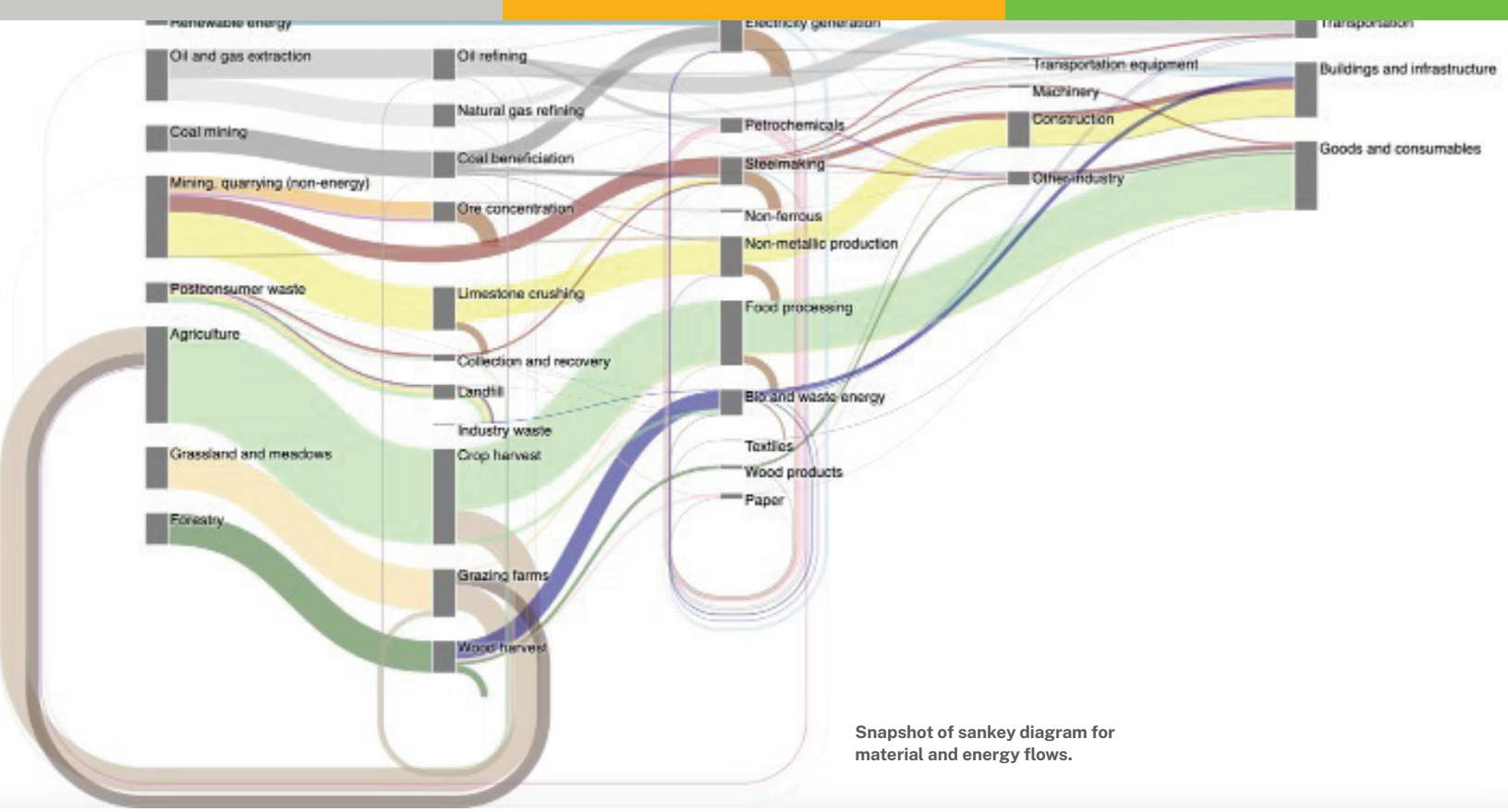
AMOS WINTER
Professor, Mechanical Engineering

SEED AWARD

BRYONY DUPONT
Visiting Scholar, MIT

SCAN OR CLICK TO READ MORE

Many socioeconomic and technoeconomic challenges exist when it comes to decarbonizing heavy-duty vehicles. They include range anxiety, the lack of refueling infrastructure and the high refueling costs of alternative fuels, and the economic uncertainty of adoption among stakeholders. To help address some of these challenges, MIT researchers are investigating different ways to decarbonize the heavy-duty transportation sector. The team analyzed the challenges that stakeholders currently face in decarbonizing diesel fleets, and quantified the technoeconomic tradeoffs between diesel, battery-electric, and hydrogen drivetrains from an operational perspective. They created a model that quantifies the technical limitations and the economic tradeoffs between traditional diesel drivetrains, battery-electric drivetrains, and 700-bar hydrogen fuel-cell drivetrains.



Snapshot of sankey diagram for material and energy flows.

TOUGH TRANSPORTATION MODES

TOOL

Sankey Diagram for Material and Energy Flows

Sectors can and must work together to reinforce and accelerate the transition to low-carbon resources. Sectors are physically coupled, and the feedback between them may lead to unexpected rates of change.

KATIE DAEHN
Research Scientist, MCSC

SCAN OR CLICK TO READ MORE

As the world transitions to a low-carbon economy, different sectors must work together at an unprecedented speed, developing shared assumptions and goals, while still delivering goods, energy, and services to a growing global population. The physical economy – the flow of energy and materials from raw resources to final services – must be transformed. Through an interactive Sankey diagram, the MCSC comprehensively maps the system we are all working together to decarbonize: the global economy. **Katie Daehn**, MCSC Research Scientist, led the development of the diagram – extracting and compiling data on the production and use of the major material and energy commodities. This data helps users explore scale and visualize connections between sectors. Most data are from international agencies, such as the International Energy Agency, the Food and Agricultural Organization, and worldsteel, and supplemented by literature.

VALUE CHAIN RESILIENCE

JOURNAL ARTICLE

Decarbonized Energy System Planning with High-resolution Spatial Representation of Renewables Lowers Cost

Since investments in renewables are costly, understanding the optimized locations prioritizes resources. The data to make these decisions must strike a balance between sufficient resolution to make a decision and computational efficiency to provide "on the ground teams" with timely insights.

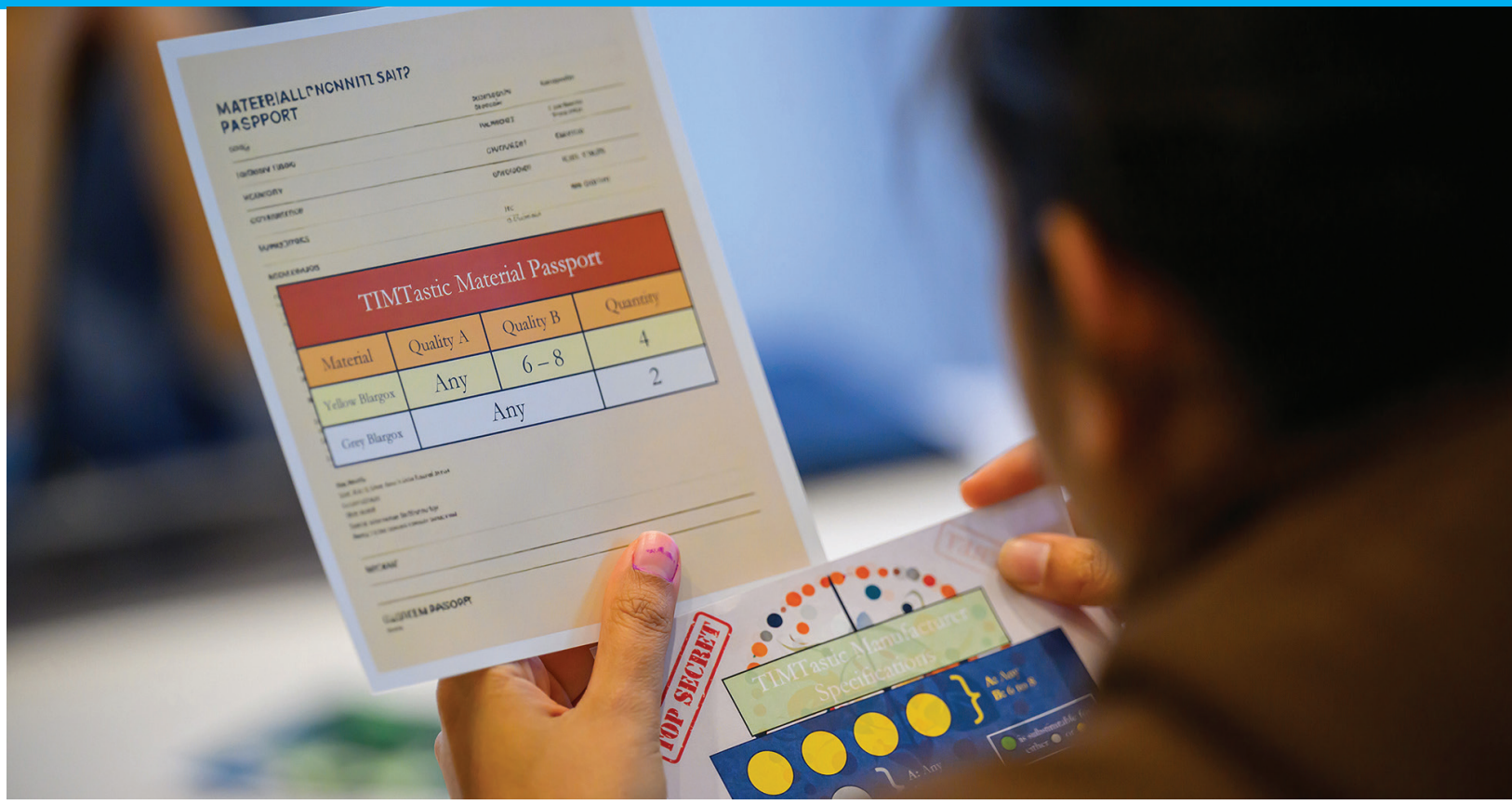
MICHAEL HOWLAND
Professor, Civil and Environmental Engineering

SCAN OR CLICK TO READ MORE

LIYING QIU
Postdoctoral Researcher, MIT

SEED AWARD

Optimizing variable renewable resources, such as wind and solar power, is an important step toward decarbonizing energy systems. Doing so requires effectively planning where wind and solar generation should be sited, but knowing where these sites should be to support power while minimizing costs remains challenging. To tackle this challenge, a team of MIT researchers found that high-resolution weather data combined with high-resolution energy system modeling significantly enhances cost-effective decision-making. In their study, the team used kilometer-scale resolution data in three diverse regions across the United States – California, Texas, and New England – and discovered ideal ranges for measuring wind and solar data.



CIRCULARITY

GAME

6Cycle

Transparency in how and where a product is made allows consumers to be more informed about what products they want to buy, and can motivate manufacturers to choose more sustainable approaches that appeal to these buyers.

EVAN COLEMAN
Impact Fellow. MCSC

POUSHALI MAJI
Impact Fellow. MCSC

SCAN OR CLICK TO READ MORE

Material passports, which list all the materials in a product or construction during its life cycle, are one valuable tool for decision-makers–documenting and conserving important data that can create value at both the recycler/downstream end and the manufacturer/upstream end of a supply chain.
A new game demonstrates the use of such material passports, simulating the challenges and opportunities in building and maintaining circular supply chains. 6cycle offers a practical way of understanding the complexities of sustainable resource management in a circular economy. It aims to bring to light the intricate balance between resource recovery and material usage in an interactive and hands-on manner.

JOURNAL ARTICLE

A Key Feedback Loop: Building Electricity Infrastructure and Electrifying Metals Production

Quantifying the tradeoff between electrification and needed energy infrastructure enables "no regrets" climate and sustainability investments. This work identified that the materials and resources required to electrify energy and industry are less than those required to continue fossil-fuel driven energy and industry systems.

KATIE DAEHN
Research Scientist, MCSC

ELSA OLIVETTI
Professor, Materials Science & Engineering
Strategic Advisor, MCSC

ANTOINE ALLANORE
Professor, Materials Science & Engineering

SCAN OR CLICK TO READ MORE

Metal production and the energy industry are interconnected; metals generate, store, and transmit energy, but the production of metal from ore is energy intensive. Achieving low-carbon or net-zero emissions without sacrificing each industry's demands poses a significant challenge. To tackle this issue, MIT researchers are exploring how the metals-energy industry can navigate the transition to a net-zero economy. In their latest research, they found that the metals industry can adapt to renewable electricity to aid the process, specifically in the case of extracting metal from ore using direct electrolysis. The team's research suggests that electrification provides a path forward for the metals-energy industry while reducing environmental impacts.

CIRCULARITY

JOURNAL ARTICLE

Stakeholders' Perceptions Of and Willingness to Pay for Circular Economy in the Construction Sector

Behavior change is an integral part of our ability to move the needle on climate and sustainability.

SIQI ZHENG
Professor, Urban and Real Estate Sustainability

JULIANA BERGLUND-BROWN
Graduate Student, Building Technology

RANDY KIRCHAIN
Principal Research Scientist, MIT Materials Research Laboratory

SCAN OR CLICK TO READ MORE

SEED AWARD

A team of MIT researchers has begun to assess what may be needed to spur widespread circular transition within the built environment in a new open-access study that aims to understand stakeholders' current perceptions of circularity and quantify their willingness to pay. The paper acts as a starting point into understanding what the industry is motivated by and how the integration of stakeholder motivations could lead to widespread adoption.

JOURNAL ARTICLE

Mechanism-Guided Discovery of Cleavable Comonomers for Backbone Deconstructable Poly(methyl methacrylate)

By making plastics easier to break down and recycle, this technology, which can integrate into existing production processes, supports a circular economy where materials are reused instead of discarded, lowering environmental waste and helping companies meet sustainability goals.

JEREMIAH JOHNSON
Professor, Chemistry

KWANGWOOK KO
Graduate Student, Chemistry

SCAN OR CLICK TO READ MORE

SEED AWARD

Every year, industries manufacture vast amounts of plastics, used for a wide range of applications – but when these plastics reach the end of their life, they are difficult to recycle, often ending up in landfills. This project tackles this major waste problem by designing a special building block – called a cleavable comonomer (CC) – that is integrated evenly throughout plastics during production to facilitate their degradation. When triggered by a mild chemical treatment at the end of the plastic's life, this built-in mechanism breaks the plastic into smaller, manageable pieces that can be easily recycled or upcycled without losing durability.

NATURE-BASED SOLUTIONS

WORKING PAPER

Structured Spectral Reconstruction for Scalable Soil Organic Carbon Inference

Quantifying the impact of agricultural and forestry land practices are most beneficial to carbon uptake requires the ability to measure carbon in the soil. This is prohibitively expensive using current methods so we must develop robust alternatives that leverage state of the art data-driven techniques.

EVAN COLEMAN
Impact Fellow, MCSC

SCAN OR CLICK TO READ MORE

ELSA OLIVETTI
Professor, Materials Science & Engineering
Strategic Advisor, MCSC

To promote soil health and agricultural decarbonization, accurate and cost-effective measurements of soil organic carbon, a key indicator of soil health, are necessary. While using hyperspectral imaging and other end-to-end approaches for measuring soil organic carbon are common practice, they sometimes struggle to generalize geographically. To tackle this challenge and make models more robust, a team of MIT researchers are working to train soil organic carbon regression models by taking a generative approach and reconstructing input spectra simultaneously with carbon measurement. For areas where collecting data on the ground is unachievable or costly, this approach can improve the chances of transferring soil organic carbon inference models to remote areas, and help identify where more expensive measurement campaigns need to be performed. In their working paper, the team finds evidence that more generalizable soil carbon measurement models can be built through the application of more advanced deep learning approaches.

MIT researchers address the end-of-life management challenges of synthetic polymers.

JOURNAL ARTICLE

Historical Impacts of Grazing on Carbon Stocks and Climate Mitigation Opportunities

This work highlights the potential of employing grazing as an effective climate mitigation strategy.

CÉSAR TERRER
Professor, Civil and Environmental Engineering

SCAN OR CLICK TO READ MORE

SEED AWARD

Research finds that excessive livestock grazing on a given amount of land can lead to carbon losses, but appropriate numbers can actually help sequester the carbon. The team's work translates higher-level findings from the literature to real-world, local-scale implementation.

WHITE PAPER

Nature-based Solutions Interventions: Quantifying the Potential for Positive Climate Impact

There are a multitude of different climate interventions, and companies must prioritize among them; knowing which interventions have most certainty around is critical to prioritize effective investments in nature-based solutions.

EVAN COLEMAN
Impact Fellow, MCSC

ELSA OLIVETTI
Professor, Materials Science & Engineering
Strategic Advisor, MCSC

CÉSAR TERRER
Professor, Civil and Environmental Engineering

SCAN OR CLICK TO READ MORE

EVAN FRICKE
Research Scientist, Civil and Environmental Engineering

SEED AWARD

Nature-based solutions (NBS) to climate change are becoming increasingly central to climate action plans because of their multifaceted benefits and potential for immediate scalability. A new MCSC white paper explores the classes of ecosystem intervention that present these opportunities to mitigate climate change — and explores different yet complementary sides of the multifaceted measurement and NBS conversations.

CARBON CAPTURE & STORAGE

WHITE PAPER

Charting the Chemical Space of Modular Heterocyclic Nucleophiles for CO_2 Capture

A broader set of chemicals that can effectively bind (or capture) CO2 is essential to abate tough to decarbonize industrial emissions with locked in capital such as cement production.

RAFAEL GÓMEZ-BOMBARELLI
Professor, Materials Science and Engineering

AKACHUKWU (AC) OBI
Impact Fellow, MCSC

AVNI SINGHAL
Graduate Student, Materials Science and Engineering

SCAN OR CLICK TO READ MORE

GLEN JUNOR
Past Impact Fellow, MCSC

SEED AWARD

MIT researchers offer insight into the design principles that allow for fine-tuning binding energetics. In their white paper, they outline that guanidine, olefin, and carbene-based systems offer a broad range of binding energies that are highly responsive to small structural changes. This research presents these heterocyclic nucleophiles as blueprints for tuning structure-function relationships for the design of efficient carbon capture materials. The essential and synergistic experimental work to complement this computational exploration is led by MIT Professors **Betar Gallant**, **Connor Coley**, and **William Green**, as well as the MCSC's **Akachukwu (AC) Obi**.

DATA & COMPUTING

WHITE PAPER

The Climate and Sustainability Implications of Generative AI

This framework supports Gen-AI to responsibly develop in ways that can support social and environmental sustainability goals alongside economic opportunity.

NOMAN BASHIR
Impact Fellow, MCSC

VIVIENNE SZE
Professor, Electrical Engineering and Computer Science

SYDNEY SROKA
Research Scientist, MCSC

PRIYA DONTI
Assistant Professor, Electrical Engineering and Computer Science and Laboratory for Information & Decision Systems

SCAN OR CLICK TO READ MORE

This open access paper by a team of MIT researchers explores some of the key drivers of generative AI (Gen-AI)'s rapid growth and why sustainability considerations for Gen-AI are lacking. They call for more responsible development of Gen-AI using a comparative benefit-cost evaluation framework. The paper highlights how the excitement around Gen-AI is leading to an incomplete consideration of value that ignores the potential costs. The resulting social and environmental impacts require detailed analysis, coordination, innovation, and adoption across diverse stakeholders to steer the direction toward responsible growth.

DATA & COMPUTING

CONFERENCE PAPER

The Sunk Carbon Fallacy: Rethinking Carbon Footprint Metrics for Effective Carbon-Aware Scheduling

We must have innovative metrics to enable effective decision making to reduce the impact of computing. Here we are informing how decision makers tradeoffs about machines with lower operating energy but higher upstream manufacturing burden, for example.

NOMAN BASHIR
Impact Fellow,
MCSC

CHRISTINA DELIMITROU
Assistant Professor,
Electrical Engineering and
Computer Science

SCAN OR CLICK TO READ MORE

The researchers evaluate carbon-aware job scheduling and placement on a given set of servers for several carbon accounting metrics. Their analysis reveals state-of-the-art carbon accounting metrics that include embodied carbon emissions when making operational decisions can increase the total carbon footprint of executing a set of jobs. They study the factors that affect the added carbon cost of such suboptimal decision-making. They then use a real-world case study from a datacenter to demonstrate how the sunk carbon fallacy manifests itself in practice. They also discuss the implications of their findings in better guiding effective carbon-aware scheduling in on-premise and cloud datacenters.

CONFERENCE PAPER

Scoping Sustainable Collaborative Mixed Reality

Informing effective carbon footprint of emerging and new technologies charts a path for improved design decisions.

NOMAN BASHIR
Impact Fellow, MCSC

ELSA OLIVETTI
Professor, Materials Science
& Engineering
Strategic Advisor, MCSC

SCAN OR CLICK TO READ MORE

While mixed reality (MR) end devices, such as headsets, have low energy intensity, the total number of devices and resource requirements of the entire MR ecosystem, which includes cloud and edge endpoints, is significant. The resulting operational and embodied carbon footprint of MR has led to concerns about its environmental implications. In this paper, the researchers identify key challenges, existing solutions, and promising research directions for improving MR sustainability. They explore adjacent fields of embedded and mobile computing systems for insights and outline MR-specific problems requiring new solutions. They identify the challenges that must be tackled to enable researchers, developers, and users to avail themselves of these opportunities in collaborative MR systems.

SOCIAL DIMENSIONS

WHITE PAPER

Standardizing Social Sustainability in ESG Reporting

Industry stakeholders can utilize this work to implement standardized approaches to addressing social sustainability.

LAURA FRYE-LEVINE
Impact Fellow,
MCSC

AVA MALYSA
Student, Mathematics and Computer Science

AMELIA DOGAN
Student, Urban Planning

SCAN OR CLICK TO READ MORE

The topic of social sustainability is often vague and unstandardized in corporate ESG reports. To tackle this, a team of MIT researchers created a rubric for understanding how corporations use social sustainability concepts in reports. In their white paper, the MIT research team analyzes the narrative sections from six corporate sustainability reports and propose an initial taxonomy of constitutive social sustainability concepts reflected in corporate speech. Through this analysis, the team developed a codebook to help document, streamline, and standardize how companies are talking about social sustainability.

CLIMATE FINANCE

WHITE PAPER

Timing Sustainable Shareholder Proposals in Real Asset Investments

If shareholders engage with companies on sustainable investments at the right time, they will be most effective.

ROBERTO RIGOBON
Professor, Management

JUAN PALACIOS
Visiting Assistant Professor, Center for Real Estate

SIQI ZHENG
Professor, Urban and Real Estate Sustainability

SCAN OR CLICK TO READ MORE

BRAM VAN DER KROFT
Impact Fellow,
MCSC

This working paper explores the effect of sustainable shareholder engagement on firm's sustainable investments – examining the real assets where investments are sporadic and occur following depreciation cycles. The authors find that sustainable engagement effectively steers firms to initiate tangible and long-lasting sustainable investments. However, engagement is ineffective or impairs such investments when it does not coincide with reinvestment periods, or investors vote down the proposal. The team uses unique micro-data tracking sustainable and conventional retrofit investments in all United States commercial real estate properties over the past two decades.

MIT'S CLIMATE PROJECT

Aligning MCSC Outcomes with MIT Initiatives

Similar to the **MCSC**, the MIT's **Climate Project** is all about *impact* — and how to prioritize efforts to spark the systems-level change necessary to move the needle on climate. The solutions and problem-solving that the MCSC develops with its member companies helps identify where those efforts should be focused. All of these MCSC outcomes, arising from these collaborations with member companies, are helping to lay the groundwork for the Climate Project's future efforts. We are eager to continue our work with industry and the Climate Project to bring even more solutions to the forefront.

MCSC PUBLICATIONS ACCUMULATED MORE THAN

2000

DOWNLOADS ON DSPACE@MIT FROM AROUND THE WORLD.

IN 2024

29 PUBLISHED OUTCOMES

8 JOURNAL ARTICLES

39 PRESENTED WORKS

Educate

Past Impact Fellows Share Current Work with MCSC Community

In the Summer of 2024, the MCSC welcomed past Impact Fellows back to our space to share their recent work with the MCSC community. Glen Junor and Paloma Gonzalez-Rojas, who both completed the Impact Fellow Program in 2023, spoke to MCSC researchers, staff, and students about their current roles, what skills they are using now, and how their time at the MCSC helped prepare them for what was next.

GLEN JUNOR is now the Head of Public Sector Programs at Sublime Systems Inc., a company that is developing a breakthrough process to make low-carbon cement. He leads Sublime's grant-writing efforts and coordinates public-sector deployment of Sublime's products – a role that uniquely blends his interests and passions in chemistry and science, climate and sustainability, equity, and collaboration.

During his time at the MCSC, Glen, who holds a PhD in Chemistry, learned about the importance of bringing in the voices and opinions of the community early when developing and implementing climate solutions. He has continued to prioritize this as he supports Sublime's community engagement efforts and bridges communication between scientists, engineers, and public audiences. His background and experience in the chemistry space have been invaluable, as he translates the company's technical achievements and plans to the community as well as various teams internally.

"My time spent with social scientists and humanities experts at the MCSC challenged my assumptions about how technology can impact our world and better the lives of those around us. I was humbled by my MCSC colleagues who hammered home the facts around the long history of failed technological deployment due to inadequate or insincere consideration of community impacts."

PALOMA GONZALEZ-ROJAS is an entrepreneur and material scientist with extensive experience in machine learning. She is now the CEO and co-founder of Hera Materials formerly Atacama Biomaterials, a startup developing plastic alternatives that can be made from diverse, local biomass while remaining cost-effective. The skills Paloma is using in this role are ones she developed through many years of research, collaborations, and conversations with faculty, industry, peers, and students.

The science behind Atacama's products began at MIT when Paloma was exploring emissions, life-cycle assessments, and advanced manufacturing as a doctoral researcher. She worked alongside MIT Professor Neil Gershenfeld, who is also director of MIT's Center for Bits and Atoms (CBA), where she built the knowledge and learned about the foundation for the product she is now using at Atacama. Before that, she collaborated with Professors Svafa Gronfeldt and Regina Barzilay, who guided her dissertation. She went on to work closely with MIT Professor Gregory Rutledge of Chemical Engineering as a postdoc alongside her work in the MCSC– where she helped with the prototype of the algorithm for scaling model/engine that is used as part of the science and technology at Atacama today.

During her time working with the MCSC, Paloma gained experience in working directly with industry. She learned how to effectively gather feedback from member companies to understand how they approach large-scale climate and sustainability challenges and use their perspectives to inform her work. Beyond working directly with member companies, one highlight of Paloma's time working with the MCSC was managing several students through MIT's Undergraduates Research Opportunities Program.

"Working with undergraduates through the MCSC sharpened my management experience and helped me learn about effectively building teams. I also loved learning from the other Impact Fellows, and remaining close friends."

10 IMPACT FELLOWS

HAVE COMPLETED THEIR TIME WITH THE MCSC AND HAVE GONE ON TO APPLY THEIR SKILLS IN BOTH ACADEMIC AND INDUSTRY SETTINGS.

Educate

MCSC Researchers through MIT's Undergraduate Research Opportunities Program (UROP)

The MCSC engages with MIT's talented student body.

WACUKA NGATA

"My ultimate goal is to contribute to a more sustainable future in which digital infrastructure grows responsibly, balancing technological progress with environmental stewardship."

With the rapid growth of generative artificial intelligence (Gen-AI), there are rising power demands on existing data centers and the need to build new ones. To investigate the ecological impact of these data centers, and identify specific concerns, student Wacuka Ngata is collaborating with MCSC Impact Fellows to conduct interviews (with local communities, environmental groups, and neighborhood coalitions. The information they collect will be highlighted in a comprehensive database to inform better decision-making for sustainable computing.

READ FULL PROFILE

SETH ROBLES

"I first became interested in getting involved with the project after working with another member of the lab. Alexis demonstrated this project's potential and I found it really interesting and was eager to be a part of it."

Seth built upon existing MIT cyclone modeling research on the separation of small-format plastics and glass. His goal was to upscale from an alpha prototype to a larger scale cyclone, enhancing the model's capabilities. Through the program, Seth improved his computer-aided design (CAD) skills concerning sustainable development.

ALEXANDRA CHUA

"Working with my mentors on each project has given me the chance to become involved in research that makes a difference, and explores topics that I am interested in. The MCSC is also a wonderful place to hear about influential initiatives that I had never been exposed to before. My work at the MCSC has also allowed me to present my research through lightning-talks, and convey complex information to others."

Alexandra, a student at Wellesley College, collaborated with MCSC Impact Fellows on research projects concerning soil elemental relationships and carbon capture & storage (CCS) logistics. Throughout her first project, she studied different elements in soil, their relationships, and how they influence each other and soil health. With the carbon capture project, she analyzed the sources and impact of different partnerships in CCS deployment. Alexandra drafted a research report for her work on soils and has further shared her research through lightning-talks.

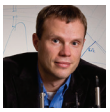
READ FULL PROFILE

COLLABORATED WITH:

NOMAN BASHIR
Impact Fellow, MCSC

MICHELLE WESTERLAKEN
Impact Fellow, MCSC

LAURENT LIOTÉ
Impact Fellow, MCSC



BRADLEY OLSEN
Professor, Chemical Engineering

ALEXIS HOCKEN
Graduate Student, Chemical Engineering

EVAN COLEMAN
Impact Fellow, MCSC

AKWACHUKWU (AC) OBI
Impact Fellow, MCSC

In 2024, the MCSC supported 70 STUDENT-LED PROJECTS through MIT's Undergraduate Research Opportunities Program (UROP).

MCSC Climate & Sustainability Scholars Program

The MCSC's Climate & Sustainability Scholars Program educates future climate leaders by offering MIT undergraduates a unique, yearlong, interdisciplinary experience developing and implementing climate and sustainability research projects.

2022-2023 Scholars Cohort

GRACE HARRINGTON

"The most valuable takeaway was realizing how people in every discipline are able to positively contribute to meeting our climate goals."

Grace's research focused on how to maximize wind farm power through physics-based computational models, allowing her to explore the scale of operation behind widespread renewable energy infrastructure. She investigated how changing the angles of the turbines relative to the incoming wind (called yawing) could deflect turbine wakes away from downstream turbines, increasing power production across a farm. Her research helps confirm that improving the efficiency of a wind turbine operation is possible through adjustment, and that "yawing" requires less infrastructure to meet energy demands.

READ FULL PROFILE

MICHAEL HOWLAND
Professor, Civil and Environmental Engineering

2023-2024 Scholars Cohort

SAM SALWAN

"I am particularly proud of improving my ability to communicate research effectively in order to reach a policy audience. Through the year, I developed this skill by conducting interviews with stakeholders in various levels of the government, allowing me to understand how they respond to research and enhancing my communication skills."

Sam researched the labor impacts of climate change, specifically the negative effects of heat exposure on the number of hours of heavy labor workers can complete globally each year. At the end of the program, Sam drafted a policy memorandum to the Occupational Safety and Health Administration outlining recommendations to foster resilience in the labor force against climate change, ensuring a more equitable and sustainable future.

READ FULL PROFILE

BENJAMIN OLKEN
Professor, Economics

JACOB MOSCONA
Professor, Economics

MITALI CHOWDHURY

"The MCSC Scholars Program helped me put my work into real-life contexts. We had conversations about environmental justice and anthropology, which exposed me to perspectives that helped my work feel more real and not just theoretical."

Mitali explored options for fast and affordable E. coli detection tests for water in underdeveloped areas, inspired by an ECC vial developed at MIT that can test for E. coli on-site without lab equipment and the popularization of at-home virus testing during the COVID-19 pandemic. Mitali's research aimed to further innovate the ECC vial to produce rapid results. She also collaborated with community partners on-site in Nepal, where she worked with two Nepali groups to ensure that the voices of those directly using the test are incorporated into the design and development process.

READ FULL PROFILE

BENEDETTO MARELLI
Professor, Civil and Environmental Engineering

SUSAN MURCOTT
Lecturer, D-Lab

Through our Climate and Sustainability Scholars program, we engaged with 38 UNDERGRADUATE STUDENTS across MIT's schools within our 2023-2024 and 2024-2025 cohorts.

Members of the MCSC's Industry Advisory Board gathered at the 2024 Symposium on MIT's campus.

MCSC researchers present their work at the poster session.

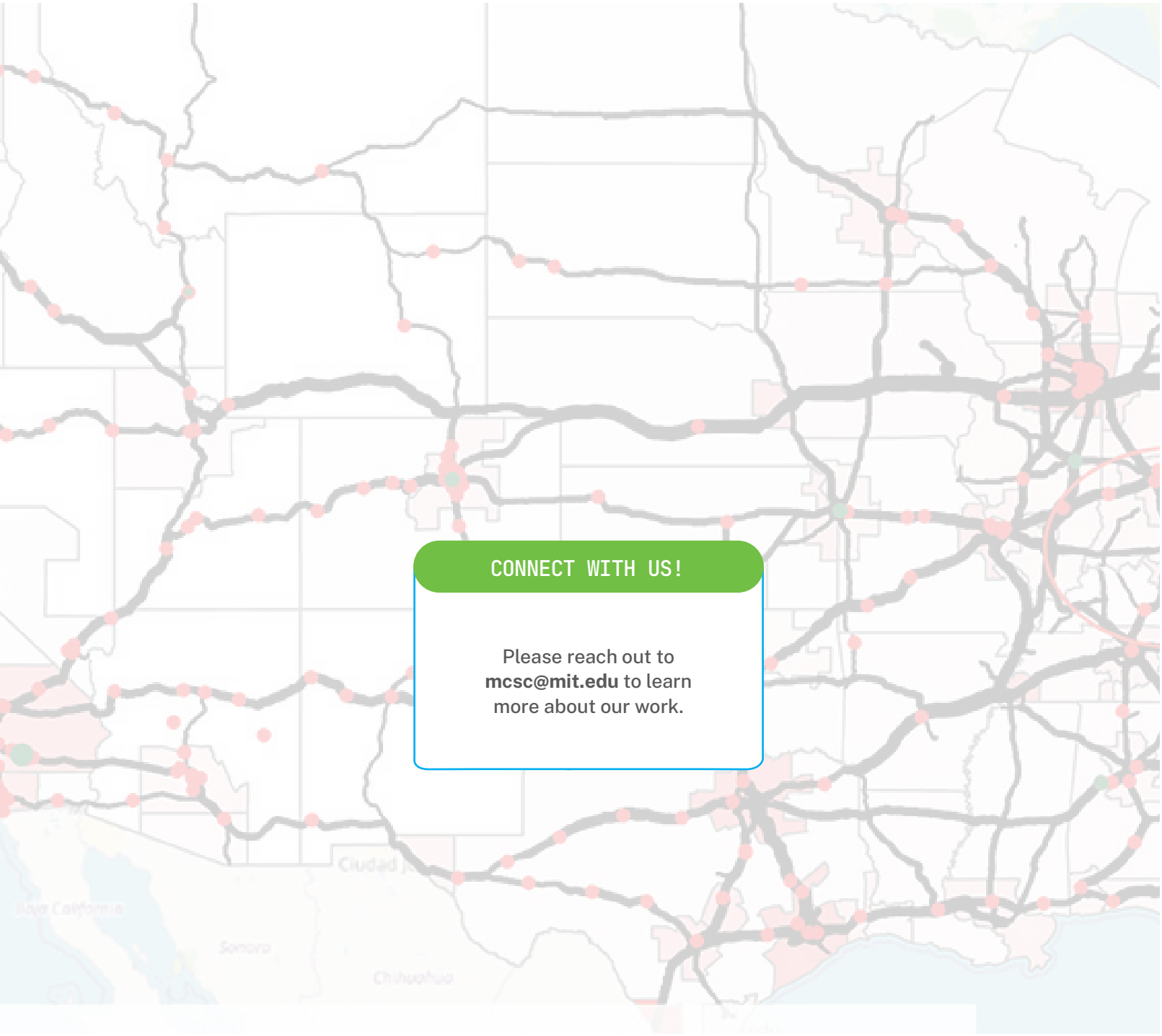
Member Benefits

Benefits and expectations of MCSC member companies include:

- Engage the robust climate and sustainability ecosystem at MIT
- Create key research and implementation work streams in partnership with MIT faculty and MCSC Member Companies
- Guide the evolution of the MCSC through strategic input to the Industry Advisory Board
- Access and participation in MCSC seminars and workshops
- Strengthen competencies through professional development
- Drive impact by fostering systems-level solutions

PHOTOS BY GRETCHEN ERTL

OVERVIEW OF BENEFITS



CONNECT WITH US!

Please reach out to **mcsc@mit.edu** to learn more about our work.

MCSC | MIT Climate & Sustainability Consortium