**MIT Industrial Liaison Program Faculty Knowledgebase Report**

2024 MIT Sustainability Conference

## October 22, 2024 8:00 am - 5:00 pm

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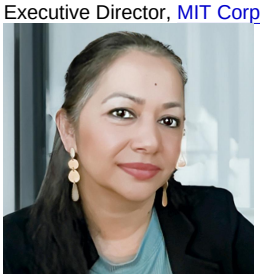
| 8:00 AM | Registration and Light Breakfast |

9:00 AM

Welcome and Introduction
Gayathri Srinivasan
Executive Director, MIT Corporate Relations

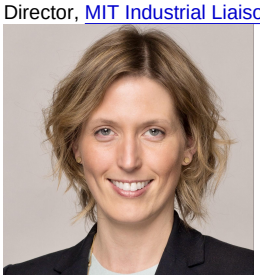


Gayathri Srinivasan
Executive Director
MIT Corporate Relations

Dr. Srinivasan is a distinguished scientist who received her PhD in Microbiology from The Ohio State University in 2004, where she contributed to the discovery of the 22nd amino acid, Pyrrolysine (2002). She first came to MIT as an NIH Postdoctoral Fellow in Prof. Tom Rajbhandary's lab, where her research focused on understanding protein synthesis mechanisms in Archaea.

Dr. Srinivasan subsequently moved into the business development and technology licensing space, serving in MIT's Technology Licensing Office, where she helped commercialize technologies in medical devices and alternative energies. She then moved to UMass Medical School's Office of Technology Management in 2009 and to Emory University in Atlanta in 2014 as the Director of Public and Private Partnerships for the Woodruff Health Sciences Center. In 2019, Dr. Srinivasan joined Emory's Office of Corporate Relations as Executive Director, and in 2021, she led the Office of Corporate and Foundation Relations.

Rebekah Miller
Director, MIT Industrial Liaison Program



Rebekah Miller
Director
MIT Industrial Liaison Program

Rebekah Miller joined the Office of Corporate Relations team as a Program Director in March 2022. Rebekah brings to the OCR expertise in the life sciences and chemical industries as well as in applications including sensors, consumer electronics, semiconductors and renewable energy.

Prior to joining the OCR, Rebekah worked for over a decade at Merck KGaA, most recently as a Global Key Account Manager in the Semiconductor division. Rebekah also served as Head of Business and Technology Development for the Semiconductor Specialty Accounts, during which time she led strategic planning and technology roadmapping.

While at Merck KGaA, Miller established a strong track record in industry-university partnerships, corporate entrepreneurship, and innovation management, with experience in roles spanning Technology Scouting, Alliance Management, and New Business Development. Early in her career, she led early phase R&D projects as a member of the Boston Concept Lab, which focused on technology transfer from academia.

Miller earned her B.A. in Chemistry and Biology from Swarthmore College and her Ph.D. in Chemistry, with a Designated Emphasis in Nanoscale Science and Engineering, from the University of California, Berkeley. She first joined MIT as a postdoctoral associate in the Bioengineering and Material Science Departments.

Yuri Ramos

Program Director, MIT Industrial Liaison Program

Yuri Ramos

9:10 AM Keynote: CleanTech Investment to Advance Industrial Strategy and Address Climate Change

Brian Deese

9:40 AM

MIT Climate Project: Mission Directors
Richard Lester

Interim Vice President for Climate, MIT
Japan Steel Industry Professor, and Professor of Nuclear Science and Engineering (NSE)

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**Richard Lester** is vice president for climate *pro tem*, Japan Steel Industry Professor, and professor of nuclear science and engineering at the Massachusetts Institute of Technology.

From 2015 through August 2024 Lester served as MIT's inaugural vice provost (formerly associate provost) for international activities, responsible for providing intellectual leadership, guidance, and oversight of the Institute's international policies and engagements. In that role, he led the development of the Institute's first global strategy; championed new MIT research and educational activities, especially in Africa and Asia; worked to enhance the international educational experiences available to MIT students; and served as President of MIT International.

Lester also served as the architect of MIT's global geopolitical risk management processes and chaired the Institute's Senior Risk Group, helping to introduce critical assessments and guidance for faculty, research staff, and administrators to identify and manage risk and ensure successful collaborations with international parties.

As convenor and co-chair of the MIT China Strategy Group, Richard crafted an influential 2022 report to develop principles and recommendations for how MIT should approach its academic interactions and collaborations with China. The report outlines approaches that uphold MIT's core values and advance knowledge for the benefit of the nation and the world, without endangering human rights or damaging US interests in security or the economy.

Lester has also been active in advancing MIT's efforts on climate research and innovation. Most recently, he served as the architect of the Climate Project at MIT and he previously spearheaded MIT's Climate Grand Challenges.

From 2009 to 2015, Lester headed MIT's Department of Nuclear Science and Engineering, leading the department successfully through a period of rapid rebuilding and strategic renewal. He is also the founder and faculty chair of the MIT Industrial Performance Center.

Lester's research focuses on innovation, productivity, and industrial strategy, and under his leadership the MIT Industrial Performance Center conducted multiple major studies of local, regional and national innovation and industry performance.

Lester is also well known for his teaching and research on energy and climate policy and nuclear technology innovation, management, and control. He has been a longtime advocate of advanced nuclear reactor and fuel cycle technologies to improve the safety and economic performance of nuclear power, and his studies in the field of nuclear waste management helped provide the foundation for new institutional and technological strategies to deal with this long-standing problem.

Lester's most recent book, *Unlocking Energy Innovation: How America Can Build a Low-Cost, Low-Carbon Energy System*, written with David Hart, outlined a strategy for mobilizing America's innovation resources in support of a decades-long transition to an affordable and reliable low-carbon global energy system. Lester is also the author or co-author of seven other books, including *The Productive Edge: A New Strategy for Economic Growth*; *Innovation —The Missing Dimension* (with Michael Piore); *Making Technology Work: Applications in Energy and the Environment* (with John Deutch); *Made in America: Regaining the Productive Edge* (with Michael Dertouzos and Robert Solow), and *Radioactive Waste: Management and Regulation* (with Mason Willrich).

Lester obtained his undergraduate degree in chemical engineering from Imperial College and earned his PhD in nuclear engineering from MIT. He has been a member of the MIT faculty since 1979. He served as chair of the National Academies' Board on Science, Technology, and Economic Policy, and more recently served as founding chair of the OECD Nuclear Energy Agency's Global Nuclear Forum. He has been an advisor to governments, corporations, foundations, and nonprofit groups.

The Climate Project at MIT is a major new effort to change the trajectory of global climate outcomes for the better over the next decade. It will focus MIT's strengths on six broad climate-related areas where progress is urgently needed. The mission directors in these fields, representing diverse areas of expertise, will collaborate with faculty and researchers

10:25 AM

Leveraging the Campus as a Test Bed for Sustainability: Catalyzing Innovation, Imagination, and Impact

Julie Newman

10:35 AM

Networking Break

11:00 AM

Data Center and AI Energy Reduction

Vijay N. Gadepally

The energy requirements of data centers in the United States is on the order of millions of tons of carbon dioxide annually, and the demand is forecasted to increase significantly over the coming years. In this presentation, Dr. Vijay Gadepally of MIT's Lincoln Laboratory will share strategies for reducing energy use of high-performance computing applications, improving energy transparency, and incentivizing data center users to reduce their carbon footprint.

11:30 AM

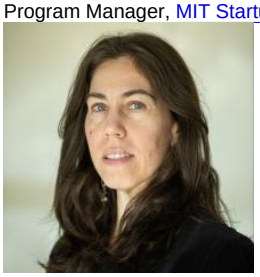
Tackling Climate Change with Machine Learning

Priya L. Donti

Climate change is one of the greatest challenges that society faces today, requiring rapid action from across society. In this talk, I will describe how machine learning can be a potentially powerful tool for addressing climate change when applied in coordination with policy, engineering, and other areas of action. From energy to agriculture to disaster response, I will describe high-impact problems where machine learning can help through avenues such as distilling decision-relevant information, optimizing complex systems, and accelerating scientific experimentation. I will also describe key considerations for the responsible development and deployment of such work. While this talk will primarily discuss opportunities for machine learning to help address climate change, it is worth noting that machine learning is a general-purpose technology that can be used for applications that both help and hinder climate action. In addition, machine learning has its own computational and hardware footprint. I will therefore briefly present a framework for understanding and contextualizing machine learning's overall climate impacts, and describe associated considerations for machine learning research and practice as a whole.

12:00 PM

MIT Startup Exchange Lightning Talks
Ariadna Rodenstein
Program Manager, MIT Startup Exchange



Ariadna Rodenstein
Program Manager
MIT Startup Exchange

Ariadna Rodenstein is a Program Manager at MIT Startup Exchange. She joined MIT Corporate Relations as an Events Leader in September 2019 and is responsible for designing and executing startup events, including content development, coaching and hosting, and logistics. Ms. Rodenstein works closely with the Industrial Liaison Program (ILP) in promoting collaboration and partnerships between MIT-connected startups and industry, as well as with other areas around the MIT innovation ecosystem and beyond.

Prior to working for MIT Corporate Relations, she worked for over a decade at Credit Suisse Group in New York and London, in a few different roles in event management and as Director of Client Strategy. Ms. Rodenstein has combined her experience in the private sector with work at non-profits as a Consultant and Development Director at New York Immigration Coalition, Immigrant Defense Project, and Americas Society/Council of the Americas. She also served as an Officer on the Board of Directors of the Riverside Clay Tennis Association in New York for several years. Additionally, she earned her B.A. in Political Science and Communications from New York University, with coursework at the Instituto Tecnológico y de Estudios Superiores de Monterrey in Mexico City, and her M.A. in Sociology from the City University of New York.

Daniel Stack

Kai Narita

Evan Haas

Kent S. Sorenson, Jr.

Josh Santos

Emre Gençer

Jacopo Buongiorno

Emmanuel Kasseris
Co-Founder and CEO
Emvolon

12:50 PM

Lunch with Startup Exhibit

1:40 PM

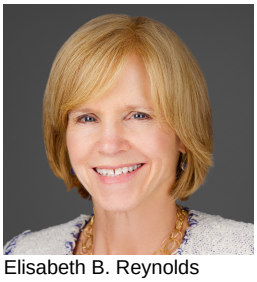
Triple Innovation for a Sustainable Future: Technology, Policy, and Business Models

Don Lessard

This session will explore the critical need for innovation across various sectors to enhance sustainability in industrial processes. Participants will examine the interplay between advanced technologies, progressive public policies, and innovative business models that can drive significant improvements in environmental performance. Through case studies and expert insights, attendees will gain a comprehensive understanding of how integrating these elements can lead to transformative changes, ultimately fostering a more sustainable future for industries worldwide. Join us to uncover practical strategies and collaborative approaches that can facilitate this essential transition.

Elisabeth B. Reynolds

Professor of the Practice, MIT Department of Urban Studies and Planning
Former Executive Director, MIT Task Force on the Work of the Future and IPC
Former Special Assistant to the President for Manufacturing and Economic Development



Elisabeth B. Reynolds

Professor of the Practice, MIT Department of Urban Studies and Planning
Former Executive Director, MIT Task Force on the Work of the Future and IPC
Former Special Assistant to the President for Manufacturing and Economic Development

Elisabeth B. Reynolds, Ph.D., is Professor of the Practice at the MIT Department of Urban Studies and Planning. She was Special Assistant to President Biden for Manufacturing and Economic Development at the National Economic Council (NEC, 2021-2022) where she helped lead the Administration's work on national manufacturing strategy, supply chain resilience, and industrial strategy. Before working at the NEC, Reynolds was a Principal Research Scientist and executive director of the MIT Industrial Performance Center (2010-2021), an interdisciplinary research center focused on systems of innovation and industrial transformation. She also co-led the MIT Task Force on the Work of the Future (2018-2021) which examined the relationship between emerging technologies and work. Reynolds' work and research focus on systems of innovation and manufacturing including growing innovative firms to scale and digital technology adoption.

Reynolds has worked on rebuilding manufacturing capabilities in the U.S. in a number of capacities including advising three Massachusetts governors. She is on the board of the non-profits, Advanced Functional Fabrics of America (AFFOA) and the Advanced Regenerative Manufacturing Institute (ARMI) as well as an advisor to the Special Competitive Studies Project, a Washington think tank focused on national security and critical technologies.

Yet-Ming Chiang

Joe Hicken

2:10 PM MIT Climate & Sustainability Consortium Project Highlights

Jeremy Gregory

Noman Bashir

The rapid expansion of generative artificial intelligence (Gen-AI) neglects consideration of negative effects alongside expected benefits. This incomplete cost calculation promotes unchecked growth and a risk of unjustified techno-optimism with potential environmental consequences, including expanding demand for computing power, larger carbon footprints, and an accelerated depletion of natural resources. The current siloed focus on efficiency improvements results instead in increased adoption without fundamentally considering the vast sustainability implications of Gen-AI.

In this talk, I will propose that responsible development of Gen-AI requires a focus on sustainability beyond only efficiency improvements and necessitates benefit-cost evaluation frameworks that encourage (or require) Gen-AI to develop in ways that support social and environmental sustainability goals alongside economic opportunity. However, a comprehensive value consideration is complex and requires detailed analysis, coordination, innovation, and adoption across diverse stakeholders. Engaging stakeholders, including technical and sociotechnical experts, corporate entities, policymakers, and civil society, in a benefit-cost analysis would foster development in the most urgent and impactful directions while reducing unsustainable practices. More details are in our white paper, which is accessible at MIT Gen-AI Sustainability White Paper.

Björn Lütjens

Climate models are computationally very expensive for exploring the impacts of climate policies. For example, simulating the impacts of a single policy emission scenario can take multiple weeks and cost hundreds of thousands of USD in computing. Compellingly, deep learning models can now forecast the weather in seconds rather than hours in comparison to conventional weather models and are being proposed to achieve similar reductions by approximating climate models. Climate approximations or emulators, however, have already been developed since the 1990s and I will present how we implemented a linear regression-based emulator that outperforms a novel 100M-parameter transformer-based deep learning emulator on the most common climate emulation benchmark. I will use our results to discuss more nuanced insights highlighting how chaotic dynamics influence emulator performance and use cases where deep-learning emulators can improve existing linear emulators.

Danika MacDonell

This presentation shares the journey of creating an interactive geospatial decision support tool in close collaboration with industry and academic partners of the MIT Climate & Sustainability Consortium. The tool leverages comprehensive public data on freight flows, costs, emissions, infrastructure, and regulatory incentives. Integrating key insights and methodologies from our partners, it aims to assist trucking industry stakeholders in identifying and assessing strategies to transition fleets to low-carbon energy carriers.

2:40 PM Decarbonizing Chemical Manufacturing

Yogesh Surendranath

The chemical industry is the major source of carbon emissions, requiring new technologies for disruptive decarbonization. The direct and selectivity electrochemical synthesis of commodity chemicals from CO2 could play a key role in decarbonizing chemical manufacturing. However, many key chemicals are accessible over a narrow range in electrochemical potential, requiring general design principles for controlling kinetic branching in these reactions. We have uncovered the central role of the reaction environment in facilitating selective $CO_2$ reduction at electrode surfaces and have employed electrolyte design to alter the mechanistic profile of chemical synthesis. Our latest findings in this area will be discussed.

3:10 PM Networking Break

3:35 PM

Formate Economy and AI-Assisted Catalyst Search

Ju Li

Battelle Energy Alliance Professor, MIT Department of Nuclear Science & Engineering
Professor, MIT Department of Materials Science and Engineering

Ju Li

Battelle Energy Alliance Professor, MIT Department of Nuclear Science & Engineering
Professor, MIT Department of Materials Science and Engineering

Ju Li is the Tokyo Electric Power Company Professor in Nuclear Engineering and a Professor at the MIT Department of Materials Science and Engineering. Prof. Li's group investigates the mechanical, electrochemical, and transport behaviors of materials, as well as novel means of energy storage and conversion. His research has led to advances in materials with applications in nuclear energy, batteries, and electrolyzers—and near- and long-term implications for decarbonizing the planet. His group also works on various aspects of computing, from the development of the first universal neural network interatomic potential to energy-efficient neuromorphic computing hardware.

Li is a recipient of the 2005 Presidential Early Career Award for Scientists and Engineers, the 2006 Materials Research Society Outstanding Young Investigator Award, and the TR35 award from Technological Review. He was elected Fellow of the American Physical Society in 2014 and a Fellow of the Materials Research Society in 2017. Li is the chief organizer of the yearly MIT A+B Applied Energy Symposia that aims to develop practical solutions to global climate change with "A-Action before 2040" and "B-Beyond 2040" technologies.

View full bio

Carbon efficiency is one of the most pressing problems of carbon dioxide electroreduction today. While there have been studies on anion exchange membrane electrolyzers with carbon dioxide (gas) and bipolar membrane electrolyzers with bicarbonate (aqueous) feedstocks, both suffer from low carbon efficiency. In anion exchange membrane electrolyzers, this is due to carbonate anion crossover, whereas in bipolar membrane electrolyzers, the exsolution of carbon dioxide (gas) from the bicarbonate solution is the culprit. Here, we first elucidate the root cause of the low carbon efficiency of liquid bicarbonate electrolyzers with thermodynamic calculations and then achieve carbon-efficient carbon dioxide electro- reduction by adopting a near-neutral-pH cation exchange membrane, a glass fiber intermediate layer, and carbon dioxide (gas) partial pressure management. We convert highly concentrated bicarbonate solution to solid formate fuel with a yield (carbon efficiency) of greater than 96%. A device test is demonstrated at 100 mA cmÀ2 with a full-cell voltage of 3.1 V for over 200 h. ["A carbon-efficient bicarbonate electrolyzer," Cell Reports Physical Science 4 (2023) 101662]

3:55 PM

Fireside Chat: The Business of Sustainability
Jason Jay

Senior Lecturer, MIT Sloan School of Management
Director, Sustainability Initiative at MIT Sloan

Jason Jay

Senior Lecturer, MIT Sloan School of Management
Director, Sustainability Initiative at MIT Sloan

Jason Jay is a Senior Lecturer and Director of the MIT Sloan Sustainability Initiative. He teaches executive and masters-level courses on strategy, innovation, and leadership for sustainable business. He has helped secure MIT Sloan's position as a leader in the field of sustainability through teaching, research, and industry engagement. Dr. Jay's publications have appeared in the Academy of Management Journal, California Management Review, MIT Sloan Management Review, Stanford Social Innovation Review, Greenbiz, and World Economic Forum. With Gabriel Grant, he is the author of the international bestseller Breaking Through Gridlock: The Power of Conversation in a Polarized World. Dr. Jay also works as a facilitator for companies, organizations, and business families, supporting high quality conversation and shared commitment to ambitious sustainability goals. His clients have included EFG Asset Management, Novartis, Bose, Environmental Defense Fund, BP and the World Bank.

Mahesh Jayakumar

Dimitris Bountolos

4:25 PM Decarbonizing Industry Lightning Talks

Florian Allroggen

To meet ambitious environmental goals while continuing to connect the world, the air transportation sector needs to increase the level of ambition in mitigating its environmental impacts. In this talk, Dr. Allroggen outlines what an air transportation system with near-zero impact on global warming and air pollution could look like. For this purpose, he first provides a strategic perspective on the key impacts which need to be mitigated to meet near-zero goals. He then connects such mitigation measures to new technologies and operational measures which will target the most significant impacts. The analysis concludes by providing insights into the technical feasibility and economic viability of the resulting air transportation system which can achieve near-zero environmental impacts.

Cem Tasan

Solid state consolidation has tremendous potential for steel making from steel scrap, without remelting. In this talk, the scientific fundamentals and engineering solutions associated with a particular process invented at MIT will be introduced, focusing on the successful examples of several different ferrous and non-ferrous alloys.

Caitlin Mueller

New computational design and digital fabrication methods for innovative, high-performance buildings and structures will enable a more sustainable and equitable future. By focusing on the creative interface of architecture, structural engineering, and computation, Prof. Mueller's research group has developed strategies for unconventional material use in building structures.

This presentation will focus on algorithmic design approaches, such as those incorporating underutilized wood sources and reassembleable concrete parts. The PixelFrame system, for example, targets circularity strategies for reducing the material footprint of concrete. Connections are dry-jointed, avoiding the use of grout or mortar. The conventionally fused assembly of steel and concrete is separated, allowing each material to respond independently to tensile and compressive forces without impeding the longevity or function of the other. Through structural element reuse, PixelFrame can achieve more than 50% embodied carbon savings up-front.

Sayandeep Biswas

Hydrogen is a promising fuel to drive the decarbonization of long-haul trucking. However, the high cost of distribution as a compressed gas or cryogenic liquid has stunted its wide-scale adoption. Liquid Organic Hydrogen Carriers (LOHCs) can be a cost-competitive option but have inefficiencies from endothermic dehydrogenation and compression needs. We are building a novel powertrain system to mitigate these drawbacks and establish LOHC as a cost-competitive diesel alternative.

5:30 PM - 7:00 PM Networking Reception