Implications of Artificial Intelligence-Related Data Center Electricity Use and Emissions: A Workshop

November 12-13, 2024

National Academy of Sciences Building Auditorium

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Workshop Statement of Task

NATIONAL ACADEMIES *Sciences Engineering Medicine*

Implications of Artificial Intelligence-Related Data Center Electricity Use and Emissions: A Workshop
Statement of Task

The National Academies of Sciences, Engineering, and Medicine will organize a public workshop to explore trends, drivers, and implications of data center electricity use and greenhouse gas emissions related to artificial intelligence. The workshop will bring together a diverse group of expert stakeholders from the electricity industry, the computing industry including producers and users of AI, and the policy making and regulatory community to discuss areas such as:

- Trends, drivers, and tradeoffs related to AI that have the potential to impact energy demands;
- Application of AI tools to facilitate energy and water efficiency improvements in data centers;
- Standardizing benchmarks and accounting methods for energy efficiency and carbon emissions within the Information Technology sector;
- Trends in electricity markets, electrification, and options for all sectors to meet net-zero goals under increased demand for electricity;
- Regional considerations related to data center siting and clean generation resource availability.

The aim of the workshop is to understand how to map, measure, and mitigate the impacts of AI as they relate to data center electricity usage. Possible outcomes include describing the proportion of current data center electricity use and emissions related to AI; identifying a range of scenarios for potential increased electricity use and emissions; identifying options to mitigate potential increased electricity use and emissions; and catalyzing conversations among stakeholders on new approaches to understanding and meeting these challenges.

Workshop Planning Committee Biographies

NATIONAL ACADEMIES *Sciences Engineering Medicine*

Implications of Artificial Intelligence-Related Data Center Electricity Use and Emissions Workshop
Planning Committee Member Biographies

Benjamin Lee, *chair*

Benjamin C. Lee is a Professor of Electrical and Systems Engineering and of Computer and Information Science at the University of Pennsylvania. He is also a visiting researcher at Google in the Global Infrastructure Group. Dr. Lee's research focuses on computer architecture (microprocessors, memories, datacenters), energy efficiency, environmental sustainability, and security. He builds interdisciplinary links to machine learning and algorithmic game theory to better design and manage computer systems. His research on environmentally sustainable computing, in collaboration with Harvard, received an Expedition in Computing award from the National Science Foundation in 2024. Dr. Lee was an Assistant and then Associate Professor at Duke University. He received his post-doctorate in Electrical Engineering at Stanford University, Ph.D. in Computer Science from Harvard University, and B.S. in Electrical Engineering and Computer Science from the University of California at Berkeley. He has also held visiting positions at Meta AI, Microsoft Research, Intel Labs, and Lawrence Livermore National Lab. Dr. Lee received the NSF Computing Innovation Fellowship, NSF CAREER Award, and Google Faculty Research Award. He is an IEEE Fellow and ACM Distinguished Scientist.

Ayse Coskun

Prof. Ayse K. Coskun is a full professor at Boston University (BU) at the Electrical and Computer Engineering Department, where she leads the Performance and Energy Aware Computing Laboratory (PeacLab) to solve problems towards making computer systems more intelligent and energy efficient. Coskun is also the Director of the BU Center for Information and Systems Engineering (CISE) and recently served as the interim Associate Dean for Research at BU College of Engineering. Coskun's research interests intersect design automation, computer systems, and architecture. Her research outcomes are culminated in several technical awards, including the NSF CAREER Award, the IEEE CEDA Ernest Kuh Early Career Award, and an IBM Faculty Award. Coskun is a senior member of the IEEE and the ACM, and she currently serves as the Deputy Editor-in-Chief of the IEEE Transactions on Computer Aided Design. Coskun received her PhD degree in Computer Engineering from University of California San Diego.

Workshop Planning Committee Member Biographies

Benjamin Kroposki

Dr. Ben Kroposki is the Director of the Power Systems Engineering Center at the National Renewable Energy Laboratory (NREL) where he leads NREL's strategic research in the design, planning and operations of electrical power systems. He has over 30 years of experience in the design, testing, and integration of renewable and distributed power systems. As an IEEE Fellow, Dr. Kroposki was recognized for his leadership in renewable and distributed energy systems integration. Dr. Kroposki received his BSEE and MSEE from Virginia Tech and Ph.D. from the Colorado School of Mines. Dr. Kroposki is also an Adjunct Professor at the Colorado School of Mines and University of Colorado and teaches courses on integrating renewable energy into power systems. Dr. Kroposki serves as the organizational director for the Universal interoperability for Grid-forming Inverters (UNIFI) Consortium tackling the challenges with seamless integration of inverter-based resources and synchronous machines in all power systems.

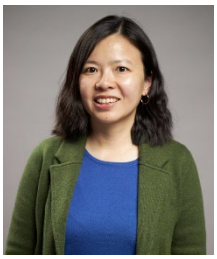
Eric Masanet

Eric Masanet is the Mellichamp Chair in Sustainability Science for Emerging Technologies at the University of California, Santa Barbara, where is also a Professor in the Bren School of Environmental Science and Management and (by courtesy) in the Department of Mechanical Engineering. He has (co-)authored more than 150 scientific publications on sustainability modeling of energy and materials demand systems, with particular focuses on data centers and IT systems. He has held numerous service roles to help advance energy and climate technology policy and their scientific evidence bases. These include service as: Head of the Energy Demand Technology Unit at the International Energy Agency in Paris (2015-2017), a Lead Author of the Intergovernmental Panel on Climate Change's (IPCC's) Sixth Assessment Report (WGIII, Chapter 5: Demand), an author of the Fifth U.S. National Climate Assessment (NCA5), a member of the Research Advisory Board of the American Council for an Energy Efficient Economy (2019-2024), and as a Consultant at the U.S. White House Office of Science and Technology Policy (2022-2024). He holds a PhD in mechanical engineering, with an emphasis on sustainable design and manufacturing, from the University of California, Berkeley.

Workshop Planning Committee Member Biographies

Prashant Shenoy

Prashant Shenoy is currently a Distinguished Professor and Associate Dean in the College of Information and Computer Sciences at the University of Massachusetts Amherst. His research interests lie in distributed systems and networking, with a recent emphasis on cloud and sustainable computing. He has been the recipient of several best paper awards at leading conferences, including a Sigmetrics Test of Time Award. He serves on editorial boards of the several journals and has served as the program chair of over a dozen ACM and IEEE conferences. He is a fellow of the ACM, the IEEE, the AAAS, and the AAIA. He received the B.Tech degree in Computer Science and Engineering from the Indian Institute of Technology, Bombay and the M.S and Ph. D degrees in Computer Science from the University of Texas, Austin.



Carole-Jean Wu

Carole-Jean Wu is a Director of AI Research at Meta, where she leads the Systems and Machine Learning Research team. She is a founding member and a Vice President of MLCommons – a non-profit organization that aims to accelerate machine learning innovations for the benefits of all. Prior to Meta/Facebook, Dr. Wu was a tenured professor at ASU. Dr. Wu's expertise sits at the intersection of computer systems and machine learning, with a focus on performance, energy efficiency and sustainability. Her work spans across datacenter infrastructures and edge systems. Dr. Wu's work has been recognized with several awards, including IEEE Micro Top Picks and ACM / IEEE Best Paper Awards. She is the recipient of NSF CAREER Award, CRA-WP Anita Borg Early Career Award Distinction of Honorable Mention, IEEE Young Engineer of the Year Award, Science Foundation Arizona Bisgrove Early Career Scholarship, and is in the Hall of Fame of ACM/IEEE ISCA, IEEE HPCA and IEEE IISWC. She earned her M.A. and Ph.D. from Princeton University and B.Sc. from Cornell University.

Workshop Agenda

Artificial Intelligence-Related Data Center Electricity Use and Emissions Workshop

In recent years, the global adoption of artificial intelligence (AI) has spurred significant construction and investment in new data centers and cloud computing. These data centers require large-scale continuous power, posing challenges for local electric grids and broader climate goals. This workshop will explore how to map, measure, and mitigate the impacts of AI data center electricity usage. Speakers from the computing industry, utilities, and government will discuss how recent AI developments can impact energy demands, identify options to mitigate increased electricity use and emissions, and consider regional implications related to data center siting and renewable resource availability.

TUESDAY, NOVEMBER 12, 2024

Purpose

- Zero in on AI trends that necessitate the growth of data centers
- Explore advances in data center infrastructure and grid integration
- Discuss the sustainability analyses of data centers from local and academic perspectives

8:00–8:30[1] BREAKFAST

8:30–9:00 Welcome and Opening Remarks
Kasia Kornecki, National Academies Board on Energy and Environmental Systems
Benjamin Lee, University of Pennsylvania, *Planning Committee Chair*

9:00–9:30 Keynote Presentation – Evolution of Data Center Energy Use
Lawrence Berkeley National Laboratory (LBNL) has studied and modeled the growth of data center energy use for over 25 years. Dr. Arman Shehabi (LBNL) will describe how data center energy use has evolved over the past two decades, sometimes rapidly increasing and at other times remaining relatively flat and discuss the drivers of that change. Dr. Shehabi will also present findings from the upcoming 2024 Data Center Energy Report to Congress and how the rise of highly specialized hardware and artificial intelligence are changing the data center landscape and creating new opportunities for efficiency and decarbonization. A Q&A session with the audience will follow.

[1] All times shown in ET

9:40–11:00 Moderated Panel Discussion – AI Technologies: Trends and Future Use Cases

This session will examine the trajectory of artificial intelligence, taking a holistic view of data processing, training, and inference. Opening remarks will elevate emerging models and applications driving future computational demands. The following moderated discussion will explore the implications of future use cases on electricity use and computing resource demands.

Moderator: Benjamin Lee, University of Pennsylvania, *Planning Committee Chair*
Speakers:

- Eric Xing, Carnegie Mellon University
- Prakhar Mehrotra, Blackstone

11:10–12:40 Moderated Panel Discussion – Data Center Infrastructure

This session will examine how data center design and operations adapt—and should continue to evolve—to meet the rising energy demands of AI workloads. Opening remarks will explore how data centers can achieve greater flexibility in their power consumption. A moderated panel discussion will focus on coupling flexible computing and infrastructure management, including cooling, with realistic performance and sustainability goals, ensuring scalability and responsiveness in the face of AI-driven demand.

Moderator: Ayse Coskun, Boston University, *Planning Committee Member*
Speakers:

- Adam Wierman, Caltech & Verrus
- Andrew Chien, University of Chicago
- Peter de Bock, U.S. Department of Energy, Advanced Research Projects Agency – Energy
- Ricardo Bianchini, Microsoft (Azure)

12:40–1:40 LUNCH

1:00-1:30 Fireside Chat – System Operator Perspectives on Connecting Grid-Friendly Data Centers

This session will highlight the on-the-ground experiences of utilities as more data centers are connected to the grid. Representatives from the Electric Reliability Council of Texas and Virginia's Dominion Energy will highlight the challenges and opportunities they are seeing in their states.

Moderator: K. John Holmes, National Academies Board on Energy and Environmental Systems
Speakers*:*

- Agee Springer, Electric Reliability Council of Texas
- Robert Wright, Dominion Energy

1:40–2:10 Keynote Presentation – Impact of Data Centers: Projected Power Use and Potential Implications for the Grid

Dr. Thomas Wilson (Electric Power Research Institute) will discuss projections of power use by U.S. data centers, requests for data center connections, and potential implications for the grid. The keynote presentation will also highlight the possibilities for more flexible data center operations to accelerate AI development while minimizing costs, lowering carbon emissions, and enhancing system reliability. A Q&A session with the audience will follow.

2:20–3:50 **Moderated Panel Discussion – Impact of Data Centers on the Grid**

This session will examine the increasing impact of large data centers on the electric power grid. A moderated discussion will elevate recommendations for how to handle load growth from data centers and maintain grid reliability.

Moderator: Thomas Wilson, Electric Power Research Institute
Speakers:

- Bruce Tsuchida, Brattle
- Costa Samaras, Carnegie Mellon University
- Line Roald, University of Wisconsin
- Ravi Jain, Tapestry (Google)

4:00–5:40 **Moderated Panel Discussion – Sustainability Analysis of Data Centers**

This session will discuss the sustainability impacts of data centers, including their environmental and human dimensions. Opening remarks will explore current data, methods, and standards, as well as gaps and hurdles, in analyzing energy, climate, water, waste, and community impacts of data centers from a life-cycle perspective. A moderated panel discussion will highlight potential solutions for addressing these gaps and identify areas that need further research.

Moderator: Eric Masanet, University of California - Santa Barbara, *Planning Committee Member*
Speakers:

- Cooper Elsworth, Google
- Davide D'Ambrosio, International Energy Agency
- Julie Bolthouse, Piedmont Environmental Council
- Laura Gonzalez Guerrero, Clean Virginia
- Sarah Boyd, Aligned Incentives

5:40–6:00 **Closing Remarks**

6:00 **ADJOURN DAY 1**

6:00–8:00 **RECEPTION**

WEDNESDAY, NOVEMBER 13, 2024

Purpose

- Explore emerging technologies and hardware architectures that could improve energy efficiency
- Propose technical and policy solutions for efficient and sustainable data centers

8:30–9:00 **BREAKFAST**

9:00–9:05 **Welcome and Opening Remarks**
Benjamin Lee, University of Pennsylvania, *Planning Committee Chair*

9:05–9:35 **Keynote Presentation - Efficiency through Technology Advancement: Hardware-Software Interactions**
Modern large language models (LLMs) have generated tremendous value and productivity improvements across almost all areas of human endeavor and, as a result, demand for both training and inference is growing at exponential rates which in turn drives a huge demand for energy. Over the last decade, numerous hardware improvements have improved the energy efficiency of LLM inference by 1000x. Similar gains have been made on the software (model) side. Dr. William Dally (NVIDIA) will describe the major contributors to this efficiency gain and the expected trend in hardware and model efficiency. A Q&A session with the audience will follow.

9:45–11:15 **Moderated Panel Discussion – Efficiency through Technology Advancement: Hardware-Software Interactions**
This session will examine opportunities to improve carbon efficiency and sustainability through the coordinated design of hardware and software. Opening remarks will define the landscape of hardware platforms and the role of specialized architectures for artificial intelligence. A moderated panel discussion will explore the software strategies required to achieve high performance and efficiency on these architectures.

Moderator: Carole-Jean Wu, Meta, *Planning Committee Member*
Speakers:

- Milos Popovic, Ayar Labs
- Tamar Eilam, International Business Machines Corporation
- Valerie Taylor, Argonne National Laboratory
- Vivienne Sze, Massachusetts Institute of Technology
- William Dally, NVIDIA

11:25–12:55 Moderated Panel Discussion – Societal Considerations of Data Center Expansion

This session will consider the impact of data center expansion on local economies and communities. A moderated panel discussion will highlight concerns related to local energy consumption, environmental impact, and workforce, weighing these aspects alongside the potential benefits of growth in AI.

Moderator: Prashant Shenoy, University of Massachusetts - Amherst, *Planning Committee Member*
Speakers:

- Kelly Sanders, University of Southern California
- Nate Benforado, Southern Environmental Law Center
- Tim Cywinski, Sierra Club
- Varun Rai, University of Texas, Austin

1:00–2:00 Closing Remarks

This concluding session will take a forward-looking perspective on AI and data centers. Each planning committee member will discuss their perspective on the challenges discussed through the workshop and the role of industry, academic research, and policymakers in contributing to the solution space.

Speakers:

- Benjamin Lee, University of Pennsylvania, *Planning Committee Chair*
- Ayse Coskun, Boston University
- Eric Masanet, University of California - Santa Barbara
- Prashant Shenoy, University of Massachusetts – Amherst
- Carole-Jean Wu, Meta

2:00 WORKSHOP ADJOURNS

Workshop Speaker Biographies

Implications of Artificial Intelligence-Related Data Center Electricity Use and Emissions Workshop Speaker Biographies

Adam Wierman, Caltech & Verrus

Adam Wierman is the Carl F Braun Professor in the Department of Computing and Mathematical Sciences at Caltech. He is also a founding advisor for Verrus, a startup building sustainable, grid-integrated data centers. He received his Ph.D., M.Sc., and B.Sc. in Computer Science from Carnegie Mellon University. Adam's research strives to make the networked systems that govern our world sustainable and resilient. He is best known for his work spearheading the design of algorithms for sustainable data centers, which has seen significant industry adoption, and his work on heavy tails, including co-authoring a book on "The Fundamentals of Heavy Tails." He is a recipient of a variety of awards, including the ACM Sigmetrics Rising Star award, the ACM Sigmetrics Test of Time award, the IEEE INFOCOM Test of Time award, the IEEE Communications Society William R. Bennett Prize, the Caltech IDEA Advocate award, multiple teaching awards, and is a co-author of papers that have received "best paper" awards at a wide range of conferences across computer science, power engineering, and operations research.

Agee Springer, Electric Reliability Council of Texas

Agee Springer is Sr. Manager of Grid Interconnections at ERCOT. His department is responsible for the reliable integration of all generation and large load interconnection requests into the ERCOT system. Prior to assuming this position, Agee served as Manager of Large Load Integration, which oversees the interim interconnection process for large loads, develops ERCOT Protocol and Planning Guide revisions to ensure their reliable operation on the ERCOT system, and provides support for ERCOT's Large Flexible Load Task Force. Agee's past experience at ERCOT includes developing situational awareness displays for the ERCOT control room, providing real-time engineering support and training for ERCOT system operators, performing analyses of ERCOT operational and market data, and leading ERCOT's Engineer Development Program. He has also served as Manager of Market Operations for RWE Renewables Americas. Agee holds a BS in Physics from Duke University and a MSEE from The University of Texas at Austin.

Andrew Chien, University of Chicago

Andrew A Chien is the William Eckhardt Distinguished Service Professor of Computer Science at the University of Chicago and Senior Scientist at Argonne National Laboratory. He has led the Zero-carbon Cloud project since 2015, and is well-known for his research on datacenters, renewable energy and sustainability, cloud resource management and software, large-scale system architecture, and graph computing architecture. He is leader of the IARPA funded "UpDown System Project", designing breakthrough scalable graph analytics systems. He is a leader in the NSF Expedition on Computational Decarbonization (CoDec). Chien has received numerous recognitions for his research. Dr. Chien currently serves on the NSF CISE Advisory Committee, NSF Advisory Committee on Advanced Cyberinfrastructure, and DARPA ISAT. He is a Fellow of the ACM, IEEE, and AAAS. He served as EiC of Communications of the ACM, 2017-2022, and Vice President of Research at Intel Corporation from 2005-2010. He has served on the Faculty of the University of Illinois and as SAIC Chair Professor of University of California, San Diego. He received BS, MS, and PhD degrees from the Massachusetts Institute of Technology.

Arman Shehabi, Lawrence Berkeley National Laboratory

Dr. Arman Shehabi is a Staff Scientist in the Energy Analysis and Environmental Impacts Division of the Energy Technologies Area at LBNL. He has over 15 years' experience measuring and modeling the potential energy, economic, and air pollutant impacts associated with the large-scale adoption of clean energy policy and technologies for buildings and manufacturing, with extensive research focused on the information and communication technology (ICT). Dr. Shehabi's research at LBNL applies life-cycle assessments (LCA) methods to explore systems-wide energy, emissions, and materials flows through buildings and industrial sectors. His current work is focused on emerging technologies and industries in the areas of data center energy/water use, electronic waste recycling, building material circularity, and industrial decarbonization. Dr. Shehabi has authored over 50 journal articles, research reports, and conference papers. His work has been published in Science Magazine and Nature journals, cited in U.S. congressional legislation, and featured in BBC, NPR, and NYT stories. Prior to joining LBNL, Dr. Shehabi held fellowship positions with the National Academy of Science in Washington, D.C. and with the Consortium on Green Design and Manufacturing at UC Berkeley. He received his M.S. and Ph.D. in Environmental Engineering from Stanford University and UC Berkeley, respectively, with an emphasis in building energy use and indoor air quality. Between graduate programs, he also worked as an engineering consultant and LEED Accredited Professional to develop and implement sustainable building metrics.

Bruce Tsuchida, Brattle

Mr. T. Bruce Tsuchida is a principal of The Brattle Group and has more than thirty years of experience in domestic and international power generation development, utility operations, and energy market analysis. He specializes in bridging technology, economics, and regulatory policy, particularly in assessing the impact of new technologies and regulatory changes. His expertise, largely in the electricity industry but also expands into the natural gas industry, includes integration studies for intermittent resources such as wind and solar power, storage technologies, operational logic studies, ancillary service studies, new load studies, and analyses required for regulatory proceedings. His work associated with regulatory proceedings includes cost benefit analyses, such as evaluating new technologies and the resource portfolio, as well as cost of service studies and rate design. He has analyzed and modeled market restructuring for the energy industry and power systems and evaluated utility business model options associated with the change in markets (structural changes through deregulation or varying cost allocation methods, and landscape changes such as increase in renewables, change in fuel requirements, or evolving load types). Mr. Tsuchida holds two M.S. degrees from the Massachusetts Institute of Technology, one in Electrical Engineering and Computer Science and the other in Technology and Policy. He holds a B.E. degree in Mechanical Engineering from Waseda University in Tokyo, Japan.

Cooper Elsworth, Google

Cooper Elsworth is a researcher and corporate sustainability practitioner developing actionable emissions data to drive corporate decarbonization. He is a Technical Program Manager at Google, where he manages data pipelines to monitor and reduce the emissions of Google's data center workloads, including those for AI products. This data powers detailed emissions allocation and reporting to customers across Google's enterprise products. Cooper previously advised Fortune 500 companies to advance their sustainability programs and developed sustainability software products at Watershed - a carbon accounting software start-up. He also built near-real-time deforestation and forest carbon monitoring tools to enable agricultural commodity teams to reduce deforestation happening in their supply chains at Descartes Labs - a satellite imagery analytics start-up. Prior to his work on corporate climate action, Cooper's academic research identified ice sheet tipping points to better constrain sea-level rise. Cooper holds a Ph.D. in Geophysics and M.S. in Computational Mathematics from Stanford University, and a M.S and B.S. in Engineering Science from the Pennsylvania State University.

Costa Samaras, Carnegie Mellon University

Dr. Costa Samaras is the Director of Carnegie Mellon University's Scott Institute for Energy Innovation, and the Trustee Professor of Civil and Environmental Engineering. He is an affiliated faculty member in the Department of Engineering and Public Policy and in the Heinz College of Information Systems and Public Policy. He analyzes how technologies and policies affect energy and emissions pathways, security, climate resilience, and economic and equity outcomes. From 2021-2024, he served in the White House Office of Science and Technology Policy (OSTP) as Principal Assistant Director for Energy, OSTP Chief Advisor for Energy Policy, and then OSTP Chief Advisor for the Clean Energy Transition. He assessed technologies and policies to achieve national climate commitments, co-led the White House report "U.S. Innovation to Meet 2050 Climate Goals", co-led the climate and clean energy efforts of the President's Executive Order on Artificial Intelligence, and led the White House report on the climate and energy implications of digital assets. He was previously a Senior Researcher at the RAND Corporation as well as a megaprojects engineer in New York City. He received a joint Ph.D. in Civil and Environmental Engineering and Engineering and Public Policy from Carnegie Mellon.

Davide D'Ambrosio, International Energy Agency

Davide D'Ambrosio is one of the lead authors of the World Energy Outlook series and WEO special reports. Davide's work includes extensive modelling and analysis to assess the long-term implications of current energy trends, government policies, and climate commitments. Davide is also the Head of the Sustainability, Technology, and Outlooks Data Working Group at the International Energy Agency (IEA). He leads the development of data analytics and visualization tools for the IEA's modelling teams, with a particular emphasis on policy and technology. Before joining the WEO team, he held various roles at the IEA, working on energy statistics and energy technology. He holds a master's degree in computer science engineering.

Eric Xing, Carnegie Mellon University

Professor Eric P. Xing is the President of the Mohamed bin Zayed University of Artificial Intelligence, and a Professor of Computer Science at Carnegie Mellon University. He completed his undergraduate at Tsinghua University and holds a PhD in Molecular Biology and Biochemistry from the Rutgers University, and a PhD in Computer Science from UC Berkeley. His main research interests are the development of machine learning and statistical methodology, and large-scale distributed computational system and architectures, for solving problems involving automated learning, reasoning, and decision-making in in artificial, biological, and social systems. In recent years, he has been focusing on building large language models, world models, agent models, and foundation models for biology. Prof. Xing has served on the editorial boards of leading scientific journals including the Journal of the American Statistical Association, Annals of Applied Statistics, PLOS Computational Biology, and Journal of Machine Learning Research. He was a member of the DARPA Information Science and Technology (ISAT) advisory group, and a recipient of the NSF Career Award, Sloan Fellowship, AFOSR Young Investigator Award, IBM Open Collaborative Research Faculty Award, Carnegie Science Award, and best paper awards in several leading AI/CS conferences such as ACL, NeurIPS, OSDI, and ISMB. He is a fellow of AAAI, ACM, ASA, IEEE, and IMS.

Julie Bolthouse, Piedmont Environmental Council

Julie Bolthouse is the Director of Land Use at Piedmont Environmental Council where she's worked for 14 years. She manages eight field staff that work on land use issues in Clarke, Loudoun, Fauquier, Rappahannock, Culpeper, Orange, Madison, Greene, and Albemarle counties. She holds a Bachelors in Fisheries Science with a minor in Watershed Management and two master's degrees in Urban Affairs and Planning and Natural Resources. Her advocacy work has allowed her to work on a wide variety of land use issues for the past decade but for the past three years she has been focused primarily on the pressing issue of the growing data center market in Virginia and massive expansions of the state's energy infrastructure to serve it.

Kelly Sanders, University of Southern California

Dr. Kelly Sanders is an Associate Professor in the University of Southern California's Sonny Astani Department of Civil and Environmental Engineering, currently on academic leave to serve as the Assistant Director of Energy Systems Innovation at the White House Office of Science and Technology Policy. Her research aims to accelerate the pace decarbonization and electrification, analyze tensions between climate change adaptation and mitigation strategies, and reduce the environmental impacts of providing energy and water. Sanders has authored more than 50 peer-reviewed publications and has been recognized in Forbes' 30 under 30 in energy, MIT Technology Review's 35 innovators under 35, and American Academy of Environmental Engineers and Scientists 40 under 40 for her contributions to the energy field. In 2019, she was granted an NSF Early CAREER award. Her research and commentary have been featured in national and international media outlets including The New York Times, The Los Angeles Times, The Washington Post, Foreign Affairs, WIRED magazine, Forbes, Bloomberg, The Wall Street Journal and Scientific American. Sanders received her B.S. in Bioengineering from the Pennsylvania State University, as well M.S.E and Ph.D. degrees in Mechanical Engineering and Environmental Engineering from the University of Texas at Austin, respectively.

Laura Gonzalez, Clean Virginia

Laura Gonzalez moved to Charlottesville in 2018 to pursue her master's degree in Public Policy at the University of Virginia. She was part of the U.S Department of Energy summer internship program, where she worked on fuel cells and hydrogen technologies implementation. For her graduation project, Laura worked with the Energy Office of South Carolina, studying options to increase access to clean energy for low to moderate-income communities. She has previously worked in Net-Neutrality policy and online privacy topics in Colombia.

Line Roald, University of Wisconsin

Line Roald is an Associate Professor in the Department of Electrical and Computer Engineering at University of Wisconsin—Madison, where she leads the Wisconsin Power Optimization (WISPO-POP) research group focused on optimization, sustainability and resiliency of electric power grids. She received her Ph.D. degree in Electrical Engineering (2016) from ETH Zurich, Switzerland, and was a postdoctoral research fellow at Los Alamos National Laboratory. She is the recipient of an NSF CAREER award, the Vilas Early Career Investigator Award and several best paper awards, and has co-authored more than 100 scientific papers. Her research interests center on the modeling and optimization of the electric grid - and infrastructures that depend on it - with a particular focus on managing uncertainty and risk from extreme weather and renewable energy variability.

Miloš Popović, Ayar Labs

Milos Popovic is Senior Technical Architect and Co-Founder at Ayar Labs, a technology startup developing optical I/O chiplets, based on silicon photonics, to enable the efficient scaling of AI and other compute hardware via optical interconnection. The technology stemmed from early research and demonstrations in his and his collaborators' university research groups, which included demonstration of the first microprocessor that communicates using light in 2015. Milos is also Associate Professor of Electrical and Computer Engineering at Boston University and in the BU Photonics Center where he leads the Silicon Photonics Research Group. He received his B.Sc. in Electrical Engineering from Queen's University, Canada, and his MS and PhD from MIT. Previously, he was on the faculty at the University of Colorado Boulder. His interests are in the theory and design of novel photonic integrated circuit technologies, and in the on-chip integration of photonics and CMOS electronics. He is an author or co-author of over 45 patents and 250 journal and conference papers. Milos is a Fellow of the Packard Foundation and of the National Academy of Inventors (NAI).

Nate Benforado, Southern Environmental Law Center

Nate Benforado is a Senior Attorney at the Southern Environmental Law Center. Based in Charlottesville, his work focuses on energy and utility issues in Virginia, from reducing carbon dioxide emissions from power plants to advancing energy efficiency programs that lower energy bills and cut emissions. Data centers have been a significant issue in Virginia for years, but recent growth projections have elevated the issue even more. Nate litigates cases at Virginia's State Corporation Commission, which regulates the state's utilities, and works on related legislation at the General Assembly.

Peter de Bock, DOE Advanced Research Project Agency-Energy
Dr. Peter de Bock currently serves as Program Director at the Advanced Research Projects Agency-Energy (ARPA-E) for the US Department of Energy. At ARPA-E Dr. de Bock leads and developed the ASCEND and PRE-TRAILS programs to realize a future of sustainable aviation. In addition, Dr. de Bock developed the COOLERCHIPS program focused on making a transformational leap in efficiency of cooling of Data Centers and manages projects in the areas of ultra-high power density battery systems, hydrogen storage and propulsion, additive manufacturing and power electronics. Prior to joining ARPA-E, Dr. de Bock worked at GE Research as Principal Engineer ThermoSciences and platform lead Power-Thermal Mechanical Systems. Dr. de Bock is the former chair of ASME K-16 committee on Heat Transfer in Electronics equipment, ASME Fellow, AIAA member and holds 50+ patents and publications. Dr. de Bock received his Ph.D. in Mechanical Engineering from the University of Cincinnati and holds MSc degrees from University of Twente in the Netherlands, and University of Warwick in the United Kingdom.

Prakhar Mehrotra, Blackstone
Prakhar Mehrotra is the Managing Director of Applied AI at Blackstone. He is responsible for helping Blackstone's portfolio companies apply AI and capitalize on this powerful technology. Prior to joining Blackstone, Prakhar served as Corporate Vice President and Head of Applied AI for Walmart US. He led Walmart's team to win the prestigious Franz Edelman Prize 2023 by Institute of Operations Research and Management Sciences (INFORMS) for its work on supply chain optimization. Prior to Walmart, he led the AI group at Uber. He started his career as data scientist at Twitter. Prakhar holds PhD in Aeronautics from California Institute of Technology, Pasadena and Master's from Ecole Polytechnique, Paris. He is a two-time recipient of the Edelman Medal (2020, 2023) and IEEE Senior Member. He serves on the peer review committee for major AI conferences (ICLR, AAMAS, CVPR, INFORMS). He was named in the AI 100 list as top people in Artificial Intelligence. During his graduate studies, he was awarded the Ernest E. Sechler Award in Aeronautics by Caltech and the Gaspard Monge Medal from Ecole Polytechnique.

Ravi Jain, Tapestry (Google)

Ravi Jain is Head of Products and Technology at Tapestry, the moonshot for applying AI to decarbonizing the electric grid at X (formerly Google X). Ravi has held several roles developing groundbreaking technological products, including leading AI for AR & Metaverse at Meta and Search AI & Alexa at Amazon. He also served as chief technology officer for Microsoft co-founder Paul Allen's Vulcan Inc., a director for mobile advertising at Google, and a senior scientist at Bellcore. PhD Computer Science, 70+ research papers, 3 books, 30+ patents. Ravi is an IEEE Fellow and an advisor to venture capital firms and startups.

Ricardo Bianchini, Microsoft (Azure)

Dr. Ricardo Bianchini is a Technical Fellow and Corporate Vice President at Microsoft Azure, where he leads the team responsible for managing Azure's Compute workload, server capacity, and datacenter infrastructure with a strong focus on efficiency and sustainability. Before joining Azure in 2022, Dr. Bianchini led the Systems Research Group and the Cloud Efficiency team at Microsoft Research (MSR). During his tenure at MSR, he created research projects in power efficiency and intelligent resource management that resulted in large-scale production systems across Microsoft. Prior to joining Microsoft in 2014, Dr. Bianchini was a Professor at Rutgers University, where he conducted research in datacenter power and energy management, energy-aware storage systems, energy-aware load distribution across datacenters, and leveraging renewable energy in datacenters. Dr. Bianchini received his Ph.D. in Computer Science from the University of Rochester. He is a Fellow of both the ACM and IEEE.

Robert Wright, Dominion Energy

Robert S. "Robbie" Wright, Jr. is vice president– Strategic Partnerships, Dominion Energy Virginia. He leads the company's Strategic Partnerships team, which focuses on meeting the needs of the largest commercial, industrial, governmental, and electric wholesale customers for Dominion Energy Virginia. He also heads the Data Center Practice, Rural Broadband and Energy Conservation organizations at Dominion Energy Virginia. Wright joined Dominion Energy in 1993 as an associate engineer and has held numerous technical, operational, and leadership roles related to the design, construction, and operation of the distribution system. In 2015, he was promoted to director–Electric Grid Planning and Asset Management, Dominion Energy Virginia, where he oversaw load planning and reliability performance for the electric distribution system, as well as vegetation management and asset data maintenance activities. Wright also has served as the lead witness for key areas of the company's Grid Transformation Plan filings since 2018. In 2022, he was named vice president–Grid and Technical Solutions for the company's Power Delivery Group. He assumed his current position in June 2024. He serves on the board of directors of the GridWise Alliance and is a member of the SEE Engineering and Operations Executive Committee. Wright received his bachelor's degree in electrical engineering from North Carolina State University. He is a Registered Professional Engineer in Virginia.

Sarah Boyd, Aligned Incentives

Sarah has spent her career using life cycle assessment (LCA) to drive decision-making in the corporate world. Sarah is Chief Strategy Officer of Aligned Incentives (now a part of Bureau Veritas) where she uses LCA at scale to identify granular carbon mitigation actions at the product and corporate level. Prior to joining Aligned Incentives, Sarah led product carbon footprinting for new product introductions at Apple. In her previous work in consulting, Sarah led over 100 product and corporate sustainability projects with clients across ICT, electrical utilities, aerospace, construction and consumer products sectors, and led data updates for the GaBi US LCA database for Sphera. Sarah holds a B.S. from Stanford University and M.S. and Ph.D. in mechanical engineering from the University of California, Berkeley. Her book "Life-cycle Assessment of Semiconductors", published by Springer, has found broad use with sustainability practitioners in ICT looking to drive LCA-based decisions themselves.

Tamar Eilam, International Business Machines Corporation
Dr. Tamar Eilam is an IBM Fellow and Chief Scientist for Sustainable Computing in the IBM T. J. Watson Research Center, New York. Tamar is leading research aiming at drastically reducing the carbon footprint associated with computing across infrastructure, systems, and software, data and AI. Tamar completed a Ph.D. degree in Computer Science in the Technion, Israel, in 2000. She joined the IBM T.J. Watson Research Center in New York as a Research Staff Member that same year. She was recognized as an IBM Fellow in 2014.

Thomas Wilson, Electric Power Research Institute
Dr. Tom Wilson is a Principal Technical Executive in the Integrated Grid and Energy Systems Division at EPRI. Dr. Wilson has conducted and managed research related to energy and environmental issues for over 40 years, the majority of which he has spent at EPRI. He has served as a convening lead author for the U.S. National Climate Assessment and as a contributing author to the Intergovernmental Panel on Climate Change's Fifth Assessment and has served in advisory roles to research groups, including MIT's Joint Program on the Science and Policy of Global Change, the University of Maryland's Global Energy Technology Strategy Program, Stanford's Energy Modeling Forum, and the National Renewable Energy Lab. From April 2022-June 2023, Dr. Wilson served as Assistant Director for Electricity at the Office of Science and Technology Policy in the White House. Dr. Wilson co-authored EPRI's recent white paper, Powering Intelligence: Analyzing Artificial Intelligence and Data Center Energy Consumption, and supported development of the Secretary of Energy Advisory Board recommendations to DOE on actions they could take to help power data centers.

Tim Cywinski, Sierra Club
Tim Cywinski is a political communications specialist who advocates for a livable, just future. His career in political, legislative and social advocacy spans more than 14 years and has centered on pushing for policy that advances justice in the context of poverty, student rights, education, college affordability, economic security, sustainability, and climate change. Tim currently leads public relations and communications strategy at the Sierra Club Virginia Chapter with a focus on promoting environmental justice policy at the local, state, and federal levels. Prior to the Sierra Club, Tim held a multitude of positions related to electoral campaigning, community organizing, and federal and state level lobbying. Outside of his professional position, Tim presents strategic communications, grassroots planning, and legislative advocacy training to civic and community groups. Tim earned a bachelor's in political science from Roanoke College in 2015 and a master's in political communications and public Relations and Media from Johns Hopkins University in 2023. He has considered Richmond, Virginia his home since 2015.

Valerie Taylor, Argonne National Laboratory

Valerie Taylor is the Director of the Mathematics and Computer Science Division and a Distinguished Fellow at Argonne National Laboratory. Her research is in high-performance computing, with a focus on performance analysis, modeling and tuning of parallel, scientific applications using AI. Her current work is on energy efficient methods. Prior to joining Argonne, she was the Senior Associate Dean of Academic Affairs in the College of Engineering and a Regents Professor and the Royce E. Wisenbaker Professor in the Department of Computer Science and Engineering at Texas A&M University. In 2003, she joined Texas A&M University as the Department Head of CSE, where she remained in that position until 2011. Prior to joining Texas A&M, Valerie Taylor was a member of the faculty in the EECS Department at Northwestern University for eleven years. She is also the CEO and President of the Center for Minorities and People with Disabilities in IT (CMD-IT), for which she is a co-founder. Valerie Taylor is an IEEE Fellow, ACM Fellow, and AAAS Fellow. Valerie E. Taylor earned her B.S. in ECE and M.S. in Computer Engineering from Purdue University in 1985 and 1986, respectively, and a Ph.D. in EECS from the University of California, Berkeley in 1991.

Varun Rai, University of Texas, Austin

Dr. Varun Rai is the Walt and Elspeth Rostow Professor in the LBJ School of Public Affairs at the University of Texas at Austin, with a joint appointment in Mechanical Engineering. Through his interdisciplinary research at the interface of complex systems, decision science, and public policy, he studies emergence in socio-technical systems, with applications toward the design of a sustainable and resilient global energy system. He was a Global Economic Fellow in 2009 and a Commissioner for the vertically-integrated electric utility Austin Energy from 2013-2015. At UT Austin, he has served as the Associate Dean for Research for the LBJ School (2017-2022) and as the director of the UT Austin Energy Institute (2019-2021). In 2016 the Association for Public Policy Analysis & Management (APPAM) awarded him the David N. Kershaw Award and Prize, which "was established to honor persons who, at under the age of 40, have made a distinguished contribution to the field of public policy analysis and management." He received his Ph.D. and MS in Mechanical Engineering from Stanford University and a bachelor's degree in mechanical engineering from the Indian Institute of Technology (IIT) Kharagpur.

Vivienne Sze, Massachusetts Institute of Technology
Vivienne Sze is a Professor in the Electrical Engineering and Computer Science Department at Massachusetts Institute of Technology. She works on computing systems that enable energy-efficient machine learning, computer vision, and video compression/processing for a wide range of applications, including autonomous navigation, digital health, and the internet of things.

William Dally, NVIDIA
Bill Dally joined NVIDIA in January 2009 as chief scientist, after spending 12 years at Stanford University, where he was chairman of the computer science department. Dally and his Stanford team developed the system architecture, network architecture, signaling, routing and synchronization technology that is found in most large parallel computers today. Dally was previously at the Massachusetts Institute of Technology from 1986 to 1997, where he and his team built the J-Machine and the M-Machine, experimental parallel computer systems that pioneered the separation of mechanism from programming models and demonstrated very low overhead synchronization and communication mechanisms. From 1983 to 1986, he was at California Institute of Technology (CalTech), where he designed the MOSSIM Simulation Engine and the Torus Routing chip, which pioneered "wormhole" routing and virtual-channel flow control. He is a member of the National Academy of Engineering, a Fellow of the American Academy of Arts & Sciences, a Fellow of the IEEE and the ACM, and has received the ACM Eckert-Mauchly Award, the IEEE Seymour Cray Award, and the ACM Maurice Wilkes award. He has published over 250 papers, holds over 120 issued patents, and is an author of four textbooks. Dally received a bachelor's degree in electrical engineering from Virginia Tech, a master's in electrical engineering from Stanford University and a Ph.D. in Computer Science from CalTech. He was a cofounder of Velio Communications and Stream Processors.