

Carbon Utilization Infrastructure, Markets, Research and Development

Committee

Emily A. Carter

Chair

Emily A. Carter (NAS/NAE) is Senior Strategic Advisor and Associate Laboratory Director for Applied Materials and Sustainability Sciences at the Princeton Plasma Physics Laboratory (PPPL). She is also the Gerhard R. Andlinger Professor in Energy and the Environment and Professor of Mechanical and Aerospace Engineering, the Andlinger Center for Energy and the Environment, and Applied and Computational Mathematics at Princeton University. Since arriving at PPPL in 2022, she began working to diversify this Department of Energy national laboratory's research portfolio into the science of electromanufacturing and solar radiation management; her portfolio expanded to include microelectronics and quantum information science in 2023. A physical chemist by training, Dr. Carter began her independent academic career at UCLA in 1988, rising through the chemistry and biochemistry faculty ranks before moving to Princeton University in 2004, where she spent the next 15 years as a jointly appointed faculty member in mechanical and aerospace engineering, and applied and computational mathematics. She was the Founding Director of Princeton's Andlinger Center for Energy and the Environment from 2010 to 2016 and then became Princeton's Dean of the School of Engineering and Applied Science (2016-19) before being recruited back to UCLA in 2019 as its Executive Vice Chancellor and Provost, and as Distinguished Professor of Chemical and Biomolecular Engineering. Dr. Carter maintains an active research presence, developing and applying quantum mechanical simulation techniques to enable discovery and design of molecules and materials for sustainable production of energy, fuels, chemicals, and materials. Her research is supported by grants from the U.S. Department of Defense and the Department of Energy, as well as Princeton University. The author of over 450 publications and patents, Dr. Carter has delivered nearly 600 invited and plenary lectures worldwide and serves on advisory boards spanning a wide range of disciplines. She is the recipient of numerous honors, including election to the U.S. National Academy of Sciences, the American Academy of Arts and Sciences, U.S. National Academy of Inventors, the U.S. National Academy of Engineering, and the European Academy of Sciences. Dr. Carter earned a B.S. in Chemistry from UC Berkeley in 1982 and a Ph.D. in Physical Chemistry from Caltech in 1987, followed by a brief postdoc at the University of Colorado, Boulder.

Shota Atsumi

Member

Shota Atsumi is a Professor in the Department of Chemistry at the University of California, Davis. He was a postdoctoral researcher with Dr. John W. Little at the University of Arizona and with Dr. James C. Liao at the University of California, Los Angeles. His current research focuses on the use of synthetic biology and metabolic engineering approaches to engineer microorganisms to convert CO₂ to valuable chemicals. The primary research goals of his group are to develop a platform for valuable chemical production from carbon dioxide using photosynthetic microorganisms and to develop novel biosynthetic pathways to produce chemical compounds which microbes naturally produce in trace amounts or not at all. He received the Hellman Fellowship in 2021, the NSF CAREER award in 2014, and the Chancellor's Fellowship in 2018. Dr. Atsumi received his Ph.D. in Biological Chemistry from Kyoto University in 2002, his Master of Science in Biological Chemistry from Kyoto University in 1998, and his Bachelor of Science from Kyoto University in 1996.

Makini Byron

Member

Makini Byron is the Director External Technologies at Linde, a leading industrial gas and engineering company. In her current role, Makini identifies technologies at startups, universities, and research institutes that can benefit her company, and gains access through partnerships, collaborations, or investments. She has over 12 years of experience within the energy and chemicals sectors, with a focus on emerging technologies for decarbonization. Makini has managed or participated in several DOE-funded projects for the commercial engineering design and demonstration of post-combustion and oxy-combustion carbon capture technologies. Her technology development experience includes several CO₂ utilization technologies, from biological conversion of CO₂ to valuable end products, mineralization of CO₂ to cementitious material, and the application of supercritical CO₂ for lubrication and cooling. She has an M.S. in Chemical Engineering and a certificate in Science, Technology, and Energy Policy from Princeton University. Makini is a registered Project Management Professional and a member of the Project Management Institute and the American Institute of Chemical Engineers.

Jingguang Chen

Member

Jingguang Chen is the Thayer Lindsley Professor of Chemical Engineering at Columbia University, with a joint appointment at Brookhaven National Laboratory. His research interests include the thermocatalytic and electrocatalytic conversion of carbon dioxide, utilizing both experimental and theoretical approaches. He is currently the President of the North American Catalysis Society and the director of the Synchrotron Catalysis Consortium. He received the George Olah Award from the American Chemical Society and the R.H. Wilhelm Award from the American Institute of Chemical Engineers. He received his PhD degree from the University of Pittsburgh and carried out his Alexander von Humboldt postdoctoral research in KFA-Julich in Germany.

Stephen Comello

Member

Stephen Comello is Senior Vice President, Strategic Initiatives at the EFI Foundation and Deputy Director of the Energy Futures Finance Forum. In his EFI Foundation role, Steve helps steer its overall direction including program development, long-term planning and strategic collaborations. Within the Energy Futures Finance Forum, he leads strategic development of all research products, drives the analytical agenda and co-leads engagement with external stakeholders, including policymakers, business executives, advisory board members, and the academic and nongovernment organization communities. Steve brings over 20 years of experience in systems engineering, finance, and strategic management. Steve has been a lead author on various academic and industry publications exploring such topics as carbon capture and utilization in the industrial sector, at-scale deployment of carbon capture, use and storage in the U.S., policy for carbon capture in California, the market and policy prospects for clean hydrogen industrial hubs in the U.S., and the ambition of corporate decarbonization strategies. Previously, he spent close to a decade as the research director of the Energy Business Innovations focus area and as a lecturer in management at the Stanford Graduate School of Business. He was also a research affiliate within the Grid Integration, Systems and Mobility (GISMo) group at the SLAC National Accelerator Laboratory and a technoeconomic lead on a variety of research initiatives at the Precourt Institute for Energy at Stanford University. He holds a Ph.D. in Civil and Environmental Engineering from Stanford, and M.S. and B.S. degrees in Mechanical and Industrial Engineering from the University of Toronto.

Maohong Fan

Member

Dr. Maohong Fan is a School of Energy Resources Professor in Chemical and Petroleum Engineering at the University of Wyoming and an Adjunct Professor in Environmental Engineering at Georgia Tech. He has led and worked on many projects in chemical production, clean energy generation, and environmental protection. The projects have been supported by various domestic and international funding agencies such as NSF, DOE, EPA, USGS and USDA in the US, New Energy and Industrial Technology Development Organization (NEDO) in Japan, the United Nations Development Programme (UNDP), and industrial companies such as Siemens and Caterpillar. He has helped various chemical, environmental, and energy companies overcome their technical challenges. He has published many refereed papers in different chemical and environmental engineering, energy, and chemistry journals. He is one of the highly cited researchers according to Web of Science. His recent NSF and DOE projects cover the areas of carbon capture, utilization, and storage (CCUS), catalyzed solar-energy-driven biomass conversion, rare earth oxide extraction, and reduction of rare-earth oxides to rare-earth metals, carbon fuel cells, production of chemicals, materials, and fuels from fossil resources.

Benny D. Freeman

Member

Benny Freeman is the William J. (Bill) Murray, Jr. Endowed Chair of Engineering in the McKetta Department of Chemical Engineering at The University of Texas at Austin. Dr. Freeman's research is in polymer science and engineering and, more specifically, in mass transport of small molecules in solid polymers. His research group focuses on structure/property correlation development for desalination and gas separation membrane materials, new materials for hydrogen separation, natural gas purification, carbon capture, and new materials for improving fouling resistance in liquid separation membranes. He leads the Center for Materials for Water and Energy Systems (M-WET), a DOE Energy Frontier Research Center and serves as Challenge Area Leader for Membranes in the National Alliance for Water Innovation (NAWI), a five-year, DOE sponsored Energy-Water Desalination Hub to address critical technical barriers needed to radically reduce the cost and energy of water purification. He is a Fellow of the AAAS, AIChE, ACS, and the PMSE and IECR Divisions of ACS. He has served as Chair of the PMSE Division of ACS, Chair of the Gordon Research Conference on Membranes: Materials and Processes, President of the North American Membrane Society, Chair of the Membranes Area of the Separations Division of the AIChE, and Chair of the Separations Division of AIChE. His research has served as the basis for several startup companies, including Energy-X and NALA Systems. He completed graduate training in Chemical Engineering at the University of California, Berkeley, earning a Ph.D. in 1988. In 1988 and 1989, he was a postdoctoral fellow at the Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (ESPCI), Laboratoire Physico-Chimie Structurale et Macromoléculaire in Paris, France. Dr. Freeman was a member of the chemical engineering faculty at NC State University from 1989 -2002, and he has been a professor of chemical engineering at The University of Texas at Austin since 2002.

Matthew Fry

Member

Matthew Fry joined the Great Plains Institute in August 2021 as the State and Regional Policy Manager, supporting the Carbon Management program. Matt has over 20 years of experience in natural resource management, regulation, and policy in both the public and private sectors. Matt served as a Senior Policy Advisor to Wyoming Governor, Matt Mead, where he focused on natural resource, energy, and carbon capture, utilization and storage (CCUS) policy. Additionally, he developed and managed the Wyoming Pipeline Corridor Initiative (WPCI), which is a project that authorized a statewide network of pipeline corridors in Wyoming that aimed to establish corridors on public lands dedicated for future use of pipelines associated with CCUS, enhanced oil recovery (EOR), and delivery of associated petroleum products. He currently serves on the Council for Environmental Quality CCUS Federal Lands and Outer Continental Shelf Permitting Task Force and leads the Safety, Societal Considerations, and Impacts Task Group for the National Petroleum Council's study on Deployment of Low Carbon Intensity Hydrogen Energy at Scale. Matt earned a Bachelor of Science in biology and chemistry from Davis & Elkins College, and a Master's in Natural Resource Law from the University of Denver – Sturm College of Law.

Sarah M. Jordaán

Member

Dr. Sarah Jordaán is an Associate Professor of Industrial Ecology and Life Cycle Assessment at the Department of Civil Engineering and the Trottier Institute for Sustainability in Engineering and Design, McGill University. Her research focuses on improving life cycle assessment, techno economic analysis, and technology innovation in support of a sustainable, low carbon energy future. Her articles examine carbon capture, utilization, and storage technologies in early R&D stages but also large-scale deployment in Paris-compliant scenarios. She won the 2022 Educational Leadership Award from the American Center for Life Cycle Assessment, where she has been a member since 2008. She is co-chairing a sub-group for the National Petroleum Council on a task that aims to assess greenhouse gas emissions reduction plans and potential across the U.S. natural gas value chain. Prior to McGill, she held positions at Johns Hopkins University, Harvard University, the Electric Power Research Institute, Shell, the University of Calgary, and the Laboratory on International Law and Regulation at the UC, San Diego. She holds a doctorate in Environmental Design from the University of Calgary and a Bachelor of Science in Physics with a Computer Science from Memorial University.

Haroun Mahgerefteh

Member

Haroun Mahgerefteh is Professor of Chemical Engineering at University College London and a Fellow of the Institution of Chemical Engineers. His research spans all aspects of CCUS, particularly CO₂ pipeline safety and operational issues. He coordinates several national- and multi-national collaborative projects, including the European Commission FP7 and H2020 projects, CO₂PipeHaz, CO₂QUEST, and C4U (total funding \$32 m). Project highlights include the development of best practice guidelines for injection of CO₂ into highly depleted gas fields and the construction of the world's longest fully instrumented CO₂ pipeline rupture test facility. Haroun is one lead author of the Zero Emission Platform report titled 'A Trans-European CO₂ Transportation Infrastructure for CCUS: Opportunities & Challenges'. The report is aimed at facilitating the development of a pipeline and ship infrastructure for transporting several Mt/yr of CO₂ captured from major regional industrial emitters for permanent offshore geological storage; considered as key enabler for meeting Net Zero emission target by 2030. Author of over 190 publications, Haroun's professional engagements includes membership of the UK Carbon Capture and Storage Research Council. He is the recipient of several prizes, including Institutions of Chemical Engineers Global Process Safety for his CO₂QUEST H2020 Project.

Ah-Hyung A. Park

Member

Ah-Hyung (Alissa) Park is the Lenfest Earth Institute Professor of Climate Change in the Departments of Earth and Environmental Engineering & Chemical Engineering at Columbia University. She is also the Director of the Lenfest Center for Sustainable Energy. Her research focuses on sustainable energy and materials conversion pathways with emphasis on integrated Carbon Capture, Utilization, and Storage (CCUS) technologies addressing climate change. Park group is also working on Direct Air Capture of CO₂ and Negative Emission Technologies including BioEnergy with Carbon Capture and Storage (BECCS) and sustainable construction materials with low carbon intensity. Park received a number of professional awards and honors including the U.S. C3E Research Award (2018), PSRI Lectureship Award at AIChE (2018), ACS Energy and Fuels Division - Emerging Researcher Award (2018), ACS WCC Rising Star Award (2017), and the National Science Foundation CAREER Award (2009). Park also led a number of global and national discussions on CCUS including the Mission Innovation Workshop on CCUS in 2017 and the National Petroleum Council CCUS Report in 2019. She is an elected Fellow of the American Association for the Advancement of Science (AAAS), American Institute of Chemical Engineers (AIChE), American Chemical Society (ACS), and Royal Society of Chemistry (RSC).

Joseph B. Powell

Member

Joseph Powell (NAE) is a Fellow and former Director of the American Institute of Chemical Engineers and served as Shell's first Chief Scientist – Chemical Engineering from 2006 until retiring at the end of 2020, culminating a 36-year industry career where he led R&D programs in new chemical processes, biofuels, enhanced oil recovery, and advised on R&D for the energy transition to a net-zero carbon economy. Dr. Powell is a co-inventor on more than 125 patent applications (60 granted), has received AIChE / ACS / R&D Magazine awards for Innovation, Service, and Practice, and is co-author of Sustainable Development in the Process Industries: Cases and Impact (2010). He chaired the U.S. Department of Energy Hydrogen and Fuel Cell Technical Advisory Committee (HTAC) and was elected to the U. S. National Academy of Engineering (2021) after serving two terms on its Board on Chemical Sciences and Technology. Other roles include guest editor for Catalysis Today Natural Gas Utilization, editorial board for Annual Review of Chemical and Biological Engineering, Crosscutting Technologies area lead, and author for Mission Innovation Carbon Capture Utilization and Storage (2017). He currently advises in energy and chemicals and process development (ChemePD LLC). Education: Ph.D. U. Wisconsin-Madison (1984); BS U. Virginia (1978), both in chemical engineering.

Dr. Powell is currently serving in an advisory role for Blue Planet Systems.

Claudia A. Ramírez Ramírez

Member

Dr. Andrea Ramírez Ramírez is a professor of Low Carbon Systems and Technologies at Delft University of Technology, the Netherlands. Her research focuses on the evaluation of novel low-carbon technologies and the design of methodologies and tools to assess their potential contribution to sustainable industrial systems. She currently coordinates the research line on System Integration and Fair Governance of the Dutch project RELEASE, aiming to develop reversible large-scale energy storage based on electrochemical conversion of CO₂ into molecules. In 2018, she was awarded one of the largest scientific grants for individuals in the Netherlands to investigate the system impacts of using alternative raw materials such as CO₂, biomass, and waste in petrochemical industrial clusters. In the last ten years, Professor Ramírez co-coordinated the European project 'Environmental due diligence of novel CO₂ capture and utilization technologies (EDDICCUT)', led the research line Technoeconomic and Environmental Analysis of the Dutch R&D program 'Catalysis for Sustainable Chemicals from Biomass (CATCHBIO)', and coordinated the program line Transport and Chain Integration of the Dutch R&D program for CO₂ capture, Transport, and Storage (CATO). Professor Ramírez holds a bachelor's in chemical engineering, a master's in Human Ecology, and a Ph.D. in industrial energy efficiency. She has (co-)authored over 115 publications and is Editor-in-Chief of the International Journal of Greenhouse Gas Control.

Volker Sick

Member

Volker Sick is the DTE Energy Professor of Advanced Energy Research and an Arthur F. Thurnau Professor at the University of Michigan, Ann Arbor. He leads the Global CO₂ Initiative at the University of Michigan that aims to reduce atmospheric CO₂ levels by transforming CO₂ into commercially successful products using technology assessment, technology development, and commercialization. His research focuses on accelerating deployments of CO₂-utilization technologies that will innovate existing infrastructure and manufacturing processes, thereby finding sustainable decarbonization solutions and continued access to required carbon-based products to help address the climate crisis. The author of numerous publications in both peer-reviewed and popular periodicals, his most recent awards and honors include the Royal Society of Chemistry Spiers Memorial Lecture Award (2021), DTE Energy Professor of Advanced Energy Research (2019), President's Award for Distinguished Service in International Education (2018). He is a Fellow of SAE International (2007) and a Fellow of The Combustion Institute (2018). He received his Doctorate in Chemistry and Habilitation in Physical Chemistry from the University of Heidelberg, Germany. He joined the University of Michigan as a Professor of Mechanical Engineering in 1997.

Simone H. Stewart

Member

Dr. Simone H. Stewart currently works as the industrial policy specialist on the Climate and Energy Policy program team at the National Wildlife Federation, with a portfolio focused on carbon capture, utilization, and storage, carbon dioxide removal technologies, as well as other strategies to aid in a just green transition for difficult to decarbonize sectors such as energy and industry. Her work covers the intersections of emerging technologies and environmental justice across areas such as policy, industry, NGO, and public education, and collaboration with government agencies. Simone joined the National Wildlife Federation in 2021 after receiving her Ph.D. in Mechanical Engineering from the University of California Santa Barbara, where she was a National Science Foundation Graduate Research Fellow. At UCSB her research focused on investigating the fluid mechanics of fluxes over rough surfaces, with applications in large-scale direct air carbon capture and clean energy architecture. During that time, Simone also worked as the graduate assistant for the UCSB Blum Center on Poverty, Inequality, and Democracy, where she led a variety of programming, created detailed info campaigns centered around justice and community enfranchisement, and helped develop a comprehensive People's Guide to the Green New Deal rooted in the tenants of environmental and economic justice. Prior to graduate school, she received dual bachelor's degrees in Physics and Spanish Language, Literature, and History from William Jewell College.

Jason Patrick Trembly

Member

Dr. Jason Trembly is Russ Professor of Mechanical Engineering, and a graduate faculty member in the Department of Chemical and Biomolecular Engineering. He is also Director of Ohio University's Institute for Sustainable Energy and the Environment. Prior to joining Ohio in 2011 as an assistant professor, Trembly was a leading young researcher at internationally recognized energy research centers. From 2007 to 2011, he was a research chemical engineer and team leader for syngas and CO₂ conversion at RTI International's Energy Technology Division. There, he was responsible for ideation and development of processes and catalysts for conversion of syngas and CO₂ into chemicals and fuels. He is also a former ORISE Fellow at the U.S. DOE's National Energy Technology Laboratory, where he completed his graduate research focused on solid oxide fuel cell development. Trembly's research group utilizes process simulation with materials R&D to develop intensified process designs to address energy and environmental issues. His main research interests include solid oxide fuel cells and electrolyzers, electrochemical capture of nutrients from waste streams, produced water remediation, and sustainable building materials. He received his PhD in Chemical Engineering from Ohio University in 2007.

Jenny Y. Yang

Member

Dr. Jenny Yang is currently a Chancellor's fellow and Professor of Chemistry at the University of California, Irvine (UCI). Previously, she worked as a senior scientist at the Pacific Northwest National Laboratory and at the Joint Center for Artificial Photosynthesis at Caltech. She has been working in the area of CO₂ capture and/or utilization for over 10 years, with a focus on electrochemical methods. Dr. Yang is on the Executive Advisory Board of the Solutions that Scale Institute at UCI and is the director of the DOE-funded Energy Frontier Research Center (EFRC) Closing the Carbon Cycle (4C). She has received the Presidential Early Career Award for Scientists and Engineers, Sloan Foundation Fellow, and Camille Dreyfus Teacher-Scholar Award. Dr. Yang received her PhD in Chemistry from the Massachusetts Institute of Technology and her BS from the University of California, Berkeley.

Joshua S. Yuan

Member

Joshua Yuan joined the faculty at Washington University in St. Louis in 2022 and serves as chair of the Department of Energy, Environmental, and Chemical Engineering. Previously, he was a faculty member at Texas A&M University since 2008 and was appointed as the Chair for Synthetic Biology and Renewable Products in 2018. He was a Sungrant Fellow at the University of Tennessee, Knoxville, and National Renewable Energy Lab before joining Texas A&M. He has served on various leadership and management positions at Texas A&M University, University of Tennessee, and University of California, San Francisco from 2001. Dr. Yuan also worked in BASF from 2000 to 2001. He has been awarded three U.S. patents and has two pending. He has written more than 100 peer-reviewed journal articles, published in Nature Communications, Green Chemistry, Chem, Advanced Sciences, ChemSusChem, and Proceedings of National Academy of Sciences USA, among others. He has won numerous awards and honors, including the Regional Solid Waste Planning Award and the Environmental Educator Award in 2018; the Excellence in Innovation Award from Texas A&M University System in 2017; and Gamma Sigma Delta Outstanding Graduate Student Award in 2007, among others. He earned his PhD from the University of Tennessee in 2007.