

FRONTIERS IN MATERIALS MANUFACTURING

DECARBONIZING INDUSTRY THROUGH ELECTROCHEMICAL PROCESSING PROFILES

October 21, 2021

PAUL K. KEARNS

Laboratory Director, Argonne National Laboratory



Paul K. Kearns has served as Director of the U.S. Department of Energy (DOE) Argonne National Laboratory since 2017.

Argonne is a growing multidisciplinary science and engineering research center with a \$1.2 billion diversified research portfolio and more than 3,300 employees, 8,000 facility users, and 800 visiting researchers. Kearns has set the laboratory's strategic vision to deliver pivotal discoveries, pioneering leadership, and powerful scientific tools and facilities. He has strengthened sponsor relationships and fostered a welcoming and inclusive culture valuing diversity, innovation and collaboration, and laboratory impact.

A biologist and accomplished steward of diverse scientific resources, Kearns has managed complex research and development enterprises for over 30 years, enabling them to achieve ambitious goals in energy, environment, and national security. As Argonne laboratory director, Kearns oversees multiple projects critical to Argonne's mission of accelerating science and technology to drive U.S. prosperity and security. Upgrading the Advanced Photon Source and launching the first exascale computer in the U.S. at the Argonne Leadership Computing Facility are critical to maintain U.S. leadership in science and technology. Argonne's leadership of the Joint Center for Energy Storage Research reflects the laboratory's long history of battery science expertise and collaboration.

As Argonne chief operations officer from 2010 to 2017, Kearns directed over 900 staff providing mission support services in financial management, human resources, safety performance, business systems, technology commercialization, and facilities management. Kearns also guided the establishment of an independent energy storage start-up and directed construction of cutting-edge research laboratories.

Kearns was an executive with Battelle Global Laboratory Operations for five years prior to joining Argonne. Kearns helped establish a

groundbreaking program to deploy micro-grids and support cyber security technologies for the U.S. military. He worked with the University of Manchester, the United Kingdom's National Nuclear Laboratory, and the United Kingdom Technical Strategy Board to define a research and development investment strategy in nuclear energy. As President and Managing Director of Battelle-Italia, Kearns implemented an integrated business plan for Battelle Memorial Institute subsidiary working with the government of Italy and industry to address energy, security and environmental challenges.

Kearns' stewardship of DOE resources includes accomplished tenures with the Idaho National Engineering and Environmental Laboratory (INEEL) and Pacific Northwest National Laboratory (PNNL) between 1995 and 2005. He helped develop technical and contracting strategies for high-level radioactive waste processing by the Hanford Tank Waste Remediation System and managed an award-winning PNNL staff conducting R&D activities for public and private sector clients in chemical, thermal, electrochemical, and radiochemical processing. At INEEL, Kearns oversaw the laboratory's program in energy, environment, and national security, including the Advanced Test Reactor and Specific Manufacturing Capability Tank Armor Production Facility.

Kearns is a fellow of the American Association for the Advancement of Science. He serves on the Executive Committee of the DOE National Laboratory Directors' Council and the U.S. Council on Competitiveness' National Commission on Innovation and Competitiveness Frontiers. He was also recently named Director of the Year by the Federal Laboratory Consortium and was appointed chair of the National Lab Directors' Council.

Kearns has a doctorate and a master's degree in bionucleonics and bachelor's degree in natural resources and environmental sciences, all from Purdue University.



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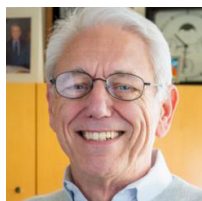
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GEORGE W. CRABTREE

*Director of the Joint Center for Energy Storage Research
and a DOE Energy Innovation Hub*



George Crabtree, an Argonne National Laboratory Senior Scientist and Distinguished Fellow, is the Director of the Joint Center for Energy Storage Research (JCESR). As JCESR Director,

Dr. Crabtree directs the overall strategy and goals of the research program and operational plan, acts as liaison to executives of JCESR partner organizations, and represents JCESR with external constituencies and advisory committees.

He has won numerous awards for his research, including the Kammerlingh Onnes Prize for his work on the physics of vortices in high-temperature superconductors. This prestigious prize is awarded once every three years; Dr. Crabtree is its second recipient. He has won the U.S. Department of Energy (DOE) Award for Outstanding Scientific Accomplishment in Solid State Physics four times, a notable accomplishment. He won an R&D 100 Award for his pioneering development of magnetic flux imaging systems.

Dr. Crabtree is a Fellow of the American Physical Society, a Charter Member of ISI's Highly Cited Researchers in Physics, a Member of the U.S. National Academy of Sciences and a Fellow of the American Academy of Arts and Sciences.

Dr. Crabtree has published more than 440 papers in leading scientific journals, collected more than 18,000 career citations, and has given more than 150 invited talks at national and international scientific conferences. His research interests include energy storage, materials science, nanoscale superconductors and magnets, superconductivity, and highly correlated electrons in metals.



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JOE CRESKO

Chief Engineer, Advanced Manufacturing Office, U.S. Department of Energy



Joe Cresko is the Chief Engineer and Strategic Analysis Lead in DOE's Advanced Manufacturing Office (AMO), where he leads AMO's efforts to assess the life cycle and cross-sector impacts of advanced manufacturing technologies.

Cresko has also served at DOE as an Engineering Sciences Fellow for the Industrial Technologies Program, and a Science & Technology Policy Fellow in the Office of Energy Efficiency & Renewable Energy.

Prior to joining DOE, Cresko was the Director of the Emerging Technology Applications Center in Bethlehem, PA, where he helped manufacturers to improve their energy efficiency and environmental footprint through industrial energy efficiency assessments and applied R&D. He is an expert in the application of electrotechnologies for materials processing and manufacturing innovations, including the use of microwave, radio-frequency, induction, UV and electron beam technologies. Cresko has performed research, analysis and technology transfer for the aerospace, ceramics, polymer, composites, foundry and food manufacturing industries.



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ANTOINE ALLANORE

Associate Professor of Metallurgy, Department of Materials Science & Engineering, Massachusetts Institute of Technology



Antoine Allanoire is Associate Professor of Metallurgy at the Massachusetts Institute of Technology (USA). After several years of service with ArcelorMittal working on GHG-reduction in the steel industry, he teaches metallurgy in the Department of Materials Science & Engineering, and conducts research on sustainable metals and minerals processing. Prof. Allanoire earned his engineering degree from the Ecole Nationale Supérieure des Industries Chimiques (ENSIC, Nancy, France), and MSc. and PhD from University of Lorraine (France). He was awarded the TMS DeNora Prize in 2012, recognizing outstanding contributions to the reduction of environmental impacts, especially focused on extractive processing, and TMS Early Career Faculty Award in 2015.



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WEI CAI

Energy Transformation Technology Leader, GE Research



Wei Cai is the Inclusion & Diversity Leader at GE Research, responsible for leading efforts in this area while working closely with the broader network of leaders across GE to drive sustainable change with real impact.

Most recently, Cai was the Technology Director for the Functional Materials Discipline at GE Research in Niskayuna, NY since 2017. In this role, Cai led a team of material scientists, chemists, physicists and chemical engineers to develop innovative material and engineering solutions that drives technology differentiation, system performance and product cost-out for our customers. Cai's team worked on cutting edge technologies such as, Ceramic Matrix Composites (CMC's) that improves fuel efficiency for jet engines, advanced Energy Storage technologies — one of the critical elements of the world's renewable energy ecosystem, Wearable Sensors that monitors vital signs of human bodies to enhance physical performance and healthcare, Insulation Materials that enables high power machines and motors, Optical Materials, Electronic Materials and Multiphysics Modeling.

Prior to this role, Cai was the Business Program Manager (BPM) at GRC where she oversaw global technology development programs for GE Power and Water businesses, and was responsible for the technology strategy, program execution and innovation adoption. Prior to her BPM role, Cai was the General Manager of GE Research in Shanghai, where she led a multidisciplinary research team of over 200 technologists to innovate and develop new technologies, products and services for GE. Wei started her career at GE Research in Shanghai, China as a research scientist in 2003. Throughout her career at GE, she has led technology development at different phases, ranging from ideas discovery to feasibility validation, prototype building, and all the way to new product introduction.

Cai has a PhD in Materials Science from the University of Wisconsin-Madison. Wei has more than 40 U.S. patents filed and has authored over 10 journal articles.



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MEGAN CLIFFORD

Associate Laboratory Director for Science and Technology Partnerships and Outreach, Argonne National Laboratory



Megan Clifford is responsible for maximizing outcomes of Argonne's existing collaborations and partnerships; supporting the creation of new collaborations and partnerships; and support of Lab-wide strategy and program development — all with the goal of increasing the impact of the Laboratory's work.

Prior to serving in her current role, Clifford served as Argonne's Chief of Staff. Working with leaders across the Laboratory, Clifford stewarded Argonne's change initiative to deliver lasting impact through science and technology leadership, research and operations excellence, and people development. She promotes a culture of diversity and inclusion within the Laboratory through values-based leadership.

Clifford joined Argonne in November 2013. Prior to becoming Chief of Staff, she served as Director of Strategy and Innovation for the Global Security Sciences division. In this role, she developed strategies and programs with multidisciplinary teams to address a range of energy and global security challenges.

Clifford's career of more than 20 years has focused on national security and resilience policy and analysis, strategic planning, and program design. Her involvement in the national security mission dates back to the establishment of the U.S. Department of Homeland Security, where she helped to create the foremost national preparedness doctrine.

Clifford previously held a senior executive position at Booz Allen Hamilton Inc. in Washington, D.C., where she served on the leadership team responsible for performance of the firm's Justice and Homeland Security business.



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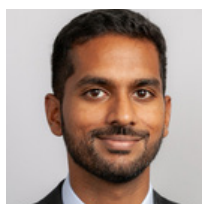
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RUNEEL DALIAH

Senior Analyst, Lux Research



Runeel Daliah is a Senior Analyst at Lux Research and part of Lux Research's Energy Transition team. He currently leads the group's coverage on the decarbonization of the energy system, focusing on Carbon Capture & Utilization (CCU) and the Hydrogen Economy. In this role, he advises global energy, materials & chemicals, and government organizations on the technical and regulatory drivers enabling the adoption of low-carbon technologies, drawing from extensive primary research with policymakers, professors, technology developers, and corporate stakeholders.

Daliah holds a Master of Engineering (MEng) in chemical engineering from The University of Manchester in the United Kingdom.



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LAUREL HARMON*Vice President of Government Relations, LanzaTech*

Dr. Harmon provides policy direction and leadership on international legislative and regulatory matters and develops collaborative research and demonstration projects for LanzaTech.

LanzaTech is the global leader in gas fermentation technology, offering novel and economic routes to a variety of products, including aviation fuel, from waste carbon streams, including industrial emissions. By recycling carbon, LanzaTech's solutions mitigate carbon emissions from industry without adversely impacting food or land security. LanzaTech's unique process, certified by the Roundtable on Sustainable Biomaterials and currently protected by over 600 granted patents, produces sustainable fuels and platform chemicals that serve as building blocks for everyday products such as rubber and plastics.

Dr. Harmon received her Ph.D. in Physical Chemistry from the University of Michigan and has over 30 years of experience in policy matters and technology development.



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JOHN HRYN

*Group Leader for Emergent Materials and Processes,
Argonne National Laboratory*

Moderator



John Hryn is an expert in aluminum and magnesium processing and recycling, and electrolysis processing. He has spent most of his career at Argonne, focusing his research on energy-efficient and environmentally sound aluminum and magnesium processing and recycling technology development.

Dr. Hryn is developing energy-efficient manufacturing and nanomanufacturing initiatives. He is a senior advisor for program development to the Physical Sciences and Engineering Directorate at Argonne. Dr. Hryn is a Fellow in the Northwestern – Argonne Institute of Science and Engineering (NAISE).

He has over 50 publications, holds seven U.S. patents, and has received numerous awards related to his research.



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DI-JIA LIU*Senior Chemist, Argonne National Laboratory***Di-Jia (DJ) Liu is a senior chemist in the Chemical Sciences and Engineering Division.**

He joined Argonne National Laboratory in 2002 after 12 years of R&D at Honeywell International where he last served as senior principal scientist. His current interests at Argonne cover mainly in nanomaterials for fuel cells, electrocatalysis for water splitting, CO₂-to-chemical/fuel conversion, hydrogen/methane storage, lithium-air battery, catalytic reforming for H₂ production, advanced x-ray characterization techniques, energy-water research, etc. At Honeywell, he led various projects in fuel cells, automotive emission control catalysis, aviation environmental control system, advanced material characterization and industrial Six-Sigma process improvement. Dr. Liu is a Senior Scientist at Pritzker School of Molecular Engineering of University of Chicago and a Graduate Faculty Scholar at Northern Illinois University. He also serves as the operating agent on behalf of USDOE in coordinating Annex 31 (fuel cell materials) activities in Technology Collaboration Program on Advanced Fuel Cells (AFC TCP) under the International Energy Agency. He is a member of American Chemical Society, Electrochemical Society and American Association for the Advancement of Science.

Dr. Liu has over 100 scientific publications including five in Science and Nature family, 29 granted US patents and numerous patent applications and international patents ranging from PEM and solid oxide fuel cells, electrocatalysis for CO₂ conversion and water splitting, environmental catalysis, hydrogen production/storage, to sensors.



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KATE PERETTI

*Technology Manager in the Advanced Manufacturing Office,
U.S. Department of Energy*



Kate Peretti is the Technology Manager in the Advanced Manufacturing Office at the Department of Energy. She is responsible for managing funding in modular chemical process intensification work through the RAPID Institute and work aimed at reducing plastic waste through technology development.



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BRIAN STOREY

*Director of Accelerated Materials Design and Discovery Program,
Toyota Research Institute*



Brian Storey is Director of the Accelerated Materials Design and Discovery (AMDD) program. The goal of the AMDD program is to develop tools for accelerating the development of new energy materials for emissions free mobility. The AMDD program consists of our internal AMDD research team as well as an extensive collection of funded collaborative research at leading universities. The goal of AMDD is to translate new ideas, tools and technology for accelerating materials discovery to practice within TMC and the broader research community.

In addition to his role at Toyota, Dr. Storey is a professor of mechanical engineering at Olin College. He has been on the faculty at Olin since 2000 and was one of the founding faculty members for this undergraduate, engineering focused college. Dr. Storey received his Ph.D. from the University of California at Berkeley, M.S. from University of Illinois, and BS from the University of Texas at Austin — all in mechanical engineering.



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JEFFREY S. SPANGENBERGER

*Group Leader for Materials Recycling and Director of the ReCell Center,
Argonne National Laboratory*

Moderator



Jeff Spangenberg is the Materials Recycling Group Leader in the Applied Materials Division.

His group works to solve material separation, recovery, and recycling challenges resulting in cost effective and environmentally sustainable processes resulting in commercialized plants.

Spangenberg and his team have demonstrated the recovery of plastics, metals and materials from numerous waste streams such as auto shredder residue, electronic waste, and furniture at scales ranging from bench to commercial. He has received four patents related to this effort.

In recent years, his research has expanded into lithium-ion battery recycling and is leading Argonne's advanced battery recycling program to evaluate and advance the cost effective and sustainable recycling of end-of-life batteries.

Spangenberg also leads the ReCell Center, a national collaboration — located at Argonne — of industry, academia and national laboratories working together to advance recycling technologies along the entire battery life-cycle for current and future battery chemistries.



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PINGPING SUN

Principal Energy Systems Analyst, Argonne National Laboratory



Dr. Pingping Sun, is a principal energy systems analyst at Argonne National Laboratory.

She works on energy systems analysis and technology evaluation by technoeconomic analysis (TEA) and life cycle analysis (LCA). Her work includes analysis in industry decarbonization, refinery operation, fossil and renewable hydrogen production analysis from various technologies and processes, plastic waste conversions, electro fuels production, biofuel production, etc.

Prior to joining Argonne, Sun worked in oil and refining companies of ConocoPhillips and Phillips 66 for refinery technology development via catalytic conversions and future transportation fuels analysis. She holds a PhD in chemical engineering from University of California at Davis and had postdoc training at University of California at Berkeley. She had academic training in catalysis, microporous/mesoporous materials, and chemical engineering thermodynamics.

