WEBINAR SERIES:

What is Water's Role in a Carbon Neutral Future?

Sandia National Laboratories

April 4 | Energy

AGENDA 10am-12pm MDT

10:00 – 10:15	Opening Remarks – **Robert Leland,** *Sandia National Laboratories*
10:15 – 10:35	Presentation 1 (Hydrogen) – **Ellen Stechel,** *Arizona State University*
10:35 – 10:55	Presentation 2 (Biomass) – **Ryan Davis,** *Sandia National Laboratories*
10:55 – 11:15	Presentation 3 (Balancing Renewables) – **Juliet Homer,** *Pacific Northwest National Laboratory*
11:15 – 11:20	BREAK
11:20 – 12:00	Moderated Session – **Alex Kizer,** *Energy Futures Initiative*

April 5 | Industrial Decarbonization

AGENDA 11:30am-1:30pm MDT

11:30 – 11:45	Opening Remarks – **Peter Fiske,** *National Alliance for Water Innovation*
11:45 – 12:05	Presentation 1 (Concrete) – **Sabbie Miller,** *University of California - Davis*
12:05 – 12:25	Presentation 2 (Mineral Extraction) – **Saleem Ali,** *University of Delaware*
12:25 – 12:45	Presentation 3 (Marine Transportation) – **Leah Dundon,** *Vanderbilt University*
12:45 – 12:50	BREAK
12:50 – 1:30	Moderated Session – **Jessica Rimsza,** *Sandia National Laboratories*

April 6 | Carbon Management

AGENDA 1:00pm-3:00pm MDT

1:00 – 1:15	Opening Remarks – **Emily Grubert,** *Department of Energy*
1:15 – 1:35	Presentation 1 (CO_2 Sequestration) – **Martina Leveni,** *Ohio State University*
1:35 – 1:55	Presentation 2 (Soil Sequestration) – **Umakant Mishra,** *Sandia National Laboratories*
1:55 – 2:15	Presentation 3 (Direct Air Capture)– **Jennifer Wilcox,** *Department of Energy*
2:15 – 2:20	BREAK
2:20 – 3:00	Moderated Session – **Amishi Claros,** *Department of Energy*

NNSA National Nuclear Security Administration | U.S. DEPARTMENT OF ENERGY

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Sandia National Laboratories

April 4 | Energy

AGENDA | 10am-12pm MDT

Opening Remarks

Robert Leland, Sandia National Labs
As Director of the Climate Change Security Center at Sandia National Laboratories, Robert Leland leads climate strategy development across the Labs; directs the Earth Sciences Research Foundation; and oversees laboratory and field work in New Mexico, Texas, and Alaska. The Center includes Sandia's Renewable Energy and Earth Sciences research groups. Rob also serves as Program Area Director for the Renewable and Fossil Energy Program within Sandia's Energy and Homeland Security Portfolio, and lead for Office of Science programs in climate and geosciences.

Rob previously served as Sandia's Vice President for Science and Technology and Chief Technology Officer. He led the Labs' research organization, overseeing research strategy, Laboratory Directed Research and Development, public and private research partnerships, tech transfer, and research compliance.

In 2017, Rob entered the National Renewable Energy Laboratory as Associate Lab Director for Scientific Computing and Energy Analysis and focused on accelerating the transformation of the nation's energy infrastructure through systems analysis and advanced computing. Rob returned to Sandia in 2021. Rob has a PhD in applied mathematics from Oxford University and a bachelor's degree in electrical engineering from Michigan State University.

Moderator

Alex Kizer, Energy Futures Initiative
Alex Kizer is the Senior Vice President of Research and Analysis at the Energy Futures Initiative (EFI). He develops and manages projects on cross-cutting issues related to technology, policy, and innovation in energy sectors at home and abroad. An expert in developing and managing major analytical initiatives, Kizer supports funders and sponsoring organizations with advice on navigating the interaction between technology disruptions and legacy markets and systems.

At EFI, Kizer oversees all qualitative and quantitative analysis for EFI reports, including "Optionality, Flexibility & Innovation: Pathways for Deep Decarbonization in California;" "Advancing the Landscape of Clean Energy innovation," for Bill Gates' Breakthrough Energy; "Investing in Natural Gas for Africans," a project sponsored by the Africa50 infrastructure fund; and white papers on blockchain technology applications for energy, an examination of the U.S. nuclear enterprise and the role it plays in national security, studies on large-scale carbon management, and a variety of budgetary analyses.

Kizer brings over fifteen years of experience advising clients at institutions such as Sandia National Laboratories, the National Infrastructure Simulation and Analysis Center, the U.S. Department of Energy, the U.S. Department of Defense, as well as energy companies that operate in the Middle East and Europe.

At EFI, he designs and manages projects that focus on investment strategies for accelerating clean energy innovation, oversees cost-benefit analyses of electric sector cyber security, develops methods for valuing U.S. energy security, and examines techniques for evaluating the emission savings from the at-scale deployment of all clean technologies. Kizer holds a B.A in Public Policy from Ohio University and an M.A. In International Security studies from American University.

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April 4 | Energy

AGENDA (continued) | 10am-12pm MDT

Presentation #1: Water's role in the production of Hydrogen: Will it be a major concern in the Southwest?

ABSTRACT

The bipartisan Infrastructure Investment and Jobs act commits significant resources for hydrogen, making it, moving it, storing it, and using it. This presentation will discuss hydrogen's role in a deeply decarbonized economy, its potential role in difficult to abate sectors. As the focus of this Webinar is water's role in a carbon neutral future, the presentation aims to put the water consumption for "Green", "Pink", and "Blue" hydrogen into context with other uses for water and energy production. It will focus primarily on Arizona as over the last fifteen years, the Southwest has experienced significant drought conditions, including Arizona. These conditions can lead to necessary changes in the state's water supply availability. However, the state has significant resources for producing hydrogen given the largest nuclear facility in the country and the only one not near a large body of water, blessed with a great solar resource and ample land. The state in a carbon neutral future will also have several use cases for that hydrogen. Furthermore, the state has good geology for storing the hydrogen. However, a question that is almost always asked is whether water would be a significant issue if the state produced hydrogen for usage in the state and for export. This presentation will address that question.

SPEAKER

Ellen Stechel, Arizona State University

Ellen B Stechel is Co-Director, ASU LightWorks; Director, Center for an Arizona Carbon Neutral Economy; Professor of Practice, School of Molecular Sciences; and Senior Global Futures Scientist, Julie Ann Wrigley Global Futures Lab at Arizona State University (ASU.) Ellen received her Ph.D in Chemical Physics from the University of Chicago. Her career has afforded her opportunities to build and/or coordinate research programs at a national laboratory, industry, a U.S. government agency, and now in higher education at ASU; in both basic and applied research; policy and commercialization of emerging technologies; and in multi-disciplinary R&D strategy and management. Her current research focuses on materials and systems design for solar technologies that produce sustainable liquid hydrocarbons from carbon dioxide, hydrogen from advanced water splitting, clean water, renewable ammonia, and thermochemical and chemical energy storage.

Sandia National Laboratories

April 4 | Energy

AGENDA (continued) | 10am-12pm MDT

Presentation #2: Algae cultivation for coupling water remediation with biomass production for low carbon intensity biobased commodities

ABSTRACT

Cultivation of algae biomass is being pursued as a means for renewable production of various commodities, including fuels, polymers, fertilizers, and feeds, using non-arable land and non-freshwater resources. The especially attractive feature of algae, and the basis of much of the R&D investments, is the especially high productivity of algae biomass, which exceeds terrestrial plants by at least a factor of 3, coupled to favorable biochemical composition. However, DOE's assessments of scale-up potential for all promising algae biofuel technologies to-date have resulted in Nth-plant model costs that exceed that of petroleum-derived products by factors of ~3-5. In light of this significant technoeconomic hurdle, new approaches for algae production are being pursued for incorporating ecosystem services to offset high costs for utilization of the biomass, including CO2 capture and remediation of compromised surface waters. In this presentation, we will discuss specific algae production technologies, including Open Raceway Ponds, attached 'Turf Algae' systems, and off-shore cultivation of macroalgae, and their respective connections to specific bioproducts, CO2 capture, and water resource management. Recent findings from researchers at Sandia suggest that cost effective, and in some cases, carbon negative solutions exist for algae industry scale-up, especially for generation of multiple products in a biorefinery context coupled to ecosystem services, such as water clean-up.

SPEAKER

Ryan Davis, Sandia National Labs
Ryan Davis, Ph.D., Principal Member of the Technical Staff at Sandia National Laboratories in Livermore, CA, is a biophysical chemist who focuses on fundamental and applied bioenergy research for biocatalytic production of fuels and commodities from biomass and waste-streams to enable decarbonization of transportation, agriculture, and manufacturing.

Presentation #3: Water for balancing renewables

ABSTRACT

This presentation will address potential opportunities for water and wastewater systems to help balance renewable energy variability to the grid. Demand and supply-side options will be described, and practical barriers and possible solutions will be presented.

SPEAKER

Juliet Homer, Pacific Northwest National Lab
Juliet Homer's work at PNNL centers on the energy-water nexus and electric grid planning with distributed energy resources. She is the team lead of the Energy Policy and Analysis Team within the Energy Policy and Economics Group at PNNL. She's a professional engineer with expertise in the changing electric power grid and associated changes to planning, policy, and regulation. She also has experience in municipal water and wastewater systems and was formerly a consulting water engineer with Greeley and Hansen LLC.

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April 5 | Industrial Decarb.

AGENDA | 11:30am-1:30pm MDT

Opening Remarks

Peter Fiske, NAWI (LBNL)
Dr. Peter S. Fiske is the Executive Director of NAWI – the National Alliance for Water Innovation headquartered at Lawrence Berkeley National Lab running the Department of Energy's Desalination Hub, a 5-year, $110M research program to radically cut the cost and energy consumption for water treatment in a variety of applications including ocean desalination, inland brackish water treatment, industrial water reuse and produced water treatment. Prior to joining LBNL, Fiske was the Chief Executive Officer of PAX Water Technologies, Inc. from 2008 until January, 2017 when it was acquired by UGSI Inc. in an all-cash transaction. PAX Water pioneered the use of biomimicry to develop innovative and energy efficient technologies for the water industry. PAX also led the industry in advanced manufacturing processes and approaches and successfully in-sourced manufacturing operations from abroad while lowering cost and improving quality and speeding innovation cycles. PAX Water won a number of national water industry awards and its iconic Lily impeller technology was featured in a major design exhibit at the New York Museum of Modern Art in 2008.

Moderator

Jessica Rimsza, Sandia National Labs
Jessica Rimsza, Ph.D., Senior Member of the Technical Staff in the Geochemistry Department at Sandia National Laboratories in Albuquerque, NM. Dr. Rimsza is a material scientist who focuses on molecular scale modeling of the surface chemistry and degradation mechanisms of oxide materials, including ceramics and minerals as well as diffusion and molecular scale transport in porous and cementitious materials.

Sandia National Laboratories

April 5 | Industrial Decarb.

AGENDA (continued) | 11:30am-1:30pm MDT

Presentation #1: Drivers in CO2 emissions and water demand to produce concrete

ABSTRACT

Construction is the largest driver of materials demand worldwide, and as a function of this high level of consumption, construction materials are a significant contributor to global environmental burdens. Concrete is the most consumed of these materials, with global production on the order of magnitude of 30 Gt annually. Concrete is composed of cement (a hydraulic binder), water, and aggregates. The broad availability of these resources, their low cost, and the desirable properties of concrete have driven its high demand. However, the chemical-derived and energy-derived CO2 emissions associated with producing cement, coupled with its high production levels to meet concrete demand is resulting in what is estimated as over 7% of the world's anthropogenic CO2 emissions.

Beyond the noteworthy CO2 emissions from producing cement and concrete, water consumption for the production of concrete is extremely high when considering water as a constituent, water used in energy generation, and water consumed in processes throughout concrete manufacture. Projections of population growth, infrastructure needs, and high industry-related water demands suggest much future demand will occur in regions with pronounced and increasing water scarcity. Notably, less than 15% of the water consumed is as a constituent in concrete; rather, the demand associated with energy and processes are the predominant drivers in water consumption.

While several solutions have been proposed to mitigate CO2 emissions from concrete production, the partial replacement of cement with alternative materials remains among the most readily implementable potential strategies. However, such CO2 emissions mitigation methods may not always lead to reductions in water demand. This presentation will cover the key drivers in water consumption in the production of the world's most popular building material as well as potential avenues for changes in production and policy measures that could aid in the reduction of water consumption to produce concrete with lower CO2 emissions.

SPEAKER

Sabbie Miller, University of California - Davis

Sabbie Miller is an Assistant Professor in the Department of Civil and Environmental Engineering at the University of California Davis. Professor Miller's research focuses on lowering the environmental impacts of the built environment, specifically on methods to quantify, assess, and mitigate the climate, health, and resource burdens from materials demand.

Sabbie is developing methods for improving materials design procedures to concurrently assess environmental impact and material performance by linking concepts from structural engineering, materials engineering, and life-cycle assessment. Professor Miller serves on several national and international committees pertaining to infrastructure material sustainability, she is a recipient of the National Science Foundation's CAREER award, and she is an editorial board member for the Institute of Physics Environmental Research and Infrastructure Sustainability journal.

She received her PhD from Stanford University in Civil and Environmental Engineering with a concentration in Structural Engineering and Geomechanics. Prior to joining the faculty at the University of California Davis, she was a postdoctoral scholar at the University of California Berkeley with a concentration in Industrial Ecology.

April 5 | Industrial Decarb.

AGENDA (continued) | 11:30am-1:30pm MDT

Presentation #2: The Hydro-economics of mining technology metals

ABSTRACT

Industrial mineral extraction requires water for a range of physical and chemical processes whereby metals can be produced from ore bodies. This presentation relates to ongoing research being carried out on applying life cycle analysis techniques to evaluate the environmental impact of a range of extraction processes in comparison with recycling and a transition to a circular economy. Accounting for water in the pricing of metals by source as well as mechanisms by which water can be conserved in the production process will also be analyzed. The presentation will finally lay out key environmental governance mechanisms which are being considered to improve the ways in which the mining and metal production sectors can improve water conservation as well as mitigating pollution to waterways.

SPEAKER

Saleem Ali, University of Delaware
Professor Saleem H. Ali holds the Blue and Gold Distinguished Professorship in Energy and the Environment at the University of Delaware where he is also the Chair of the Department of Geography and Spatial Sciences. He serves on the United Nations International Resource Panel and is an Honorary Professor at the Sustainable Minerals Institute at the University of Queensland, Australia. His books include Treasures of the Earth: Need, Greed and a Sustainable Future (Yale Univ. Press) and an upcoming book in May 2022 titled Earthly Order: How Natural Laws Define Human Life (Oxford University Press). Dr. Ali received his doctorate from MIT in Environmental Planning with earlier degrees in Chemistry and Environmental Studies from Yale and Tufts.

Twitter - @saleem_ali

Presentation #3: Getting to net-zero emissions in the North American marine shipping sector

ABSTRACT

Water-borne shipping is the leading transportation mode for U.S.-international trade by weight and value, and globally accounts for nearly 3% of all greenhouse gas emissions. However, decarbonizing the marine shipping sector has proved challenging for many reasons. Because it is already one of the most sustainable ways to ship freight, without more, emissions tied to marine shipping are only expected to increase as freight from more carbon-intense modes is routed to marine transport. Dr. Dundon will discuss the unique challenges of decarbonizing the North American shipping industry, the results of a recent study she led that focuses on decarbonizing the U.S. inland waterways, and the incentives, data, and, information still needed to support the transition to net-zero in the marine shipping industry.

SPEAKER

Leah Dundon, Vanderbilt University
Leah Dundon is Research Assistant Professor at the Vanderbilt University School of Engineering and serves as the Director of the Vanderbilt Climate Change Initiative. She completed her Ph.D. in 2017 after more than a decade as a practicing environmental attorney and still serves as Of Counsel to Beveridge & Diamond, P.C., one of the nation's top environmental law firms. At Vanderbilt, Dr. Dundon teaches an interdisciplinary course on climate change and her research focuses on infrastructure resilience and climate change adaptation.

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April 6 | Carbon Mgmt.

AGENDA | 1pm-3pm MDT

Opening Remarks

Emily Grubert, DOE
Dr. Emily Grubert is the Deputy Assistant Secretary for Carbon Management in the Office of Fossil Energy and Carbon Management (FECM). In this role, she oversees FECM's Carbon Management program, which focuses on minimizing the climate and environmental impacts of fossil energy through technology pathways, including carbon capture, carbon dioxide (CO2) removal, CO2 conversion into products, reliable CO2 storage; hydrogen production; and critical mineral production from industrial and mining waste.

Dr. Grubert is a civil engineer and environmental sociologist who studies and informs decision making regarding infrastructure systems, particularly related to justice-centering decarbonization of the U.S. energy system. Her expertise includes studying the life cycle and socioenvironmental impacts associated with future policy and infrastructure.

Dr. Grubert is an Assistant Professor of Civil and Environmental Engineering and, by courtesy, of Public Policy at the Georgia Institute of Technology. She holds a Ph.D. in Environment and Resources from Stanford, an M.S. in Environmental and Water Resources Engineering and an M.A. in Energy and Earth Resources from UT Austin and a B.S. in Mathematics and Atmosphere/Energy Engineering from Stanford.

Moderator

Amishi Claros, DOE
Amishi Claros is the Carbon Utilization R&D Program Manager in the Office of Clean Coal and Carbon Management at the U.S. Department of Energy-Fossil Energy and Carbon Management. The Carbon Utilization program works to develop commercially viable technologies to recycle waste CO2 emissions into value-added products. Carbon dioxide can be transformed into a wide range of products from building materials to fuels and chemicals using various conversion pathways such as catalytic systems or algae to make bio-products. Previously, Amishi was a Science and Technology Policy (STP) Fellow in the fossil energy office where she gained experience in the carbon capture, utilization, and storage industry as well as a broader understanding of technical, economic and policy-based changes occurring within the energy industry.

Prior to joining the DOE, Amishi was a Program Coordinator at the United States Energy Association (USEA). She earned a M.S. in Geological Sciences and a M.S. in Environmental Sciences at Indiana University; she received her B.A. in Earth and Environmental Sciences at Vanderbilt University.

In her free time, Amishi enjoys camping, eating, yoga, and organizing trash pick-ups in local parks. She has worked at the National Park Service through the AmeriCorps program at Mount Rainier National Park and San Juan National Historic Park.

Sandia National Laboratories

April 6 | Carbon Mgmt.

AGENDA (continued) | 1pm-3pm MDT

Presentation #1: Climate-benign direct air CO2 capture, utilization, and storage (DACCUS)

ABSTRACT

Transitioning towards a carbon managed energy infrastructure is essential to mitigate climate change. Negative emission technologies, such as direct air CO2 capture (DACC), together with renewable energies will likely to be necessary components in the effort to slow, stop, reverse the flow of carbon dioxide (CO2) to the atmosphere. We present an approach that combines DACC, long-term CO2 storage, and geothermal energy production: a climate-benign direct air capture, carbon utilization, and storage (DACCUS).

SPEAKER

Martina Leveni, **Ohio State University**

Martina Leveni is a Legacy Postdoctoral Scholar in the department of Civil, Environmental, and Geodetic Engineering at the Ohio State University (OSU). She holds a B.S. and a M.S. in engineering geology from the University of Milan-Bicocca (Italy). She obtained a PhD in Industrial Engineering from University of Rome Niccolò Cusano (Italy).

Before joining OSU, she worked as research engineer at the University of South Florida, Tampa, on innovative multi-generation systems. Her research interests include thermodynamics, energy analysis, applied geology, reservoir modeling, with focus on renewable energies, and negative emissions systems. Martina was born in Seregno, a small city near Milan, Italy, and she is a huge fan of teas and cookies.

Presentation #2: Predicting land use and climate change impacts on soil carbon

ABSTRACT

Land use and climatic factors may convert a land surface into a source or sink of atmospheric CO2. This presentation will provide several examples of using large number of field observations, environmental variables, and a variety of models to predict the fate of land surface under changing land use and climate. Our high-resolution predictions of soil organic carbon sequestration rates, bioenergy crop productivity, and loss of soil carbon from surface soils under future emission scenarios, is critical for policy implications.

SPEAKER

Umakant Mishra, **Sandia National Labs**

Umakant Mishra is a soil scientist in the Computational Biology and Biophysics Department of Sandia National Laboratories. He studies land use and climate change impacts on soil functions. Using field observations, remote sensing and environmental datasets, and geospatial and process-based modeling he quantifies anthropogenic and climatic impacts on the soil system. He has published studies on soil carbon vulnerability, bioenergy sustainability, spatial prediction of soil properties at regional and national scales, and benchmarking earth system model projections..

Sandia National Laboratories

April 6 | Carbon Mgmt.

AGENDA (continued) | 1pm-3pm MDT

Presentation #3: Resource requirements of direct air capture

ABSTRACT

President Biden has laid out a bold and ambitious goal of achieving net-zero carbon emissions in the U.S. by 2050. The pathway to that target includes cutting total greenhouse gas emissions in half by 2030 and eliminating them entirely from the Nation's electricity sector by 2035. Investment in technology research, design, development, and deployment (RDD&D) will be required to achieve the president's objectives, including investments in both carbon capture at point sources in addition to carbon dioxide removal approaches that target the accumulated pool of carbon in the atmosphere. Both will be required to achieve net-zero carbon emissions in time and they will require increased deployment in order to move down the cost curve. These efforts combined with effective policy will make these approaches economically viable.

These approaches are critical and they must be deployed in parallel. Deployment of these technologies at the scale required will necessitate the use of resources including land, water, and in some cases, low-carbon energy, while ensuring the secure and reliable storage of carbon dioxide (CO2) on a timescale that impacts climate. Therefore, CCS and CDR deployment must be implemented strategically in terms of regional goals and requirements.

The Office of Fossil Energy and Carbon Management will play an important role in the transition to net-zero carbon emissions by reducing the environmental impacts of fossil energy production and use – and helping decarbonize other hard-to abate sectors – through investments in technology solutions including CCS, direct air capture, and the deployment of carbon capture technologies to produce low-carbon products and fuel, including hydrogen.

SPEAKER

Jennifer Wilcox, DOE

Jennifer Wilcox, the Principal Deputy Assistant Secretary (Acting Assistant Secretary) in the Office of Fossil Energy and Carbon Management at DOE, was the Presidential Distinguished Professor of Chemical Engineering and Energy Policy at the University of Pennsylvania. As a senior fellow at the World Resources Institute, she led WRI's Carbon Removal Program.

Having grown up in rural Maine, Dr. Wilcox has a profound respect and appreciation of nature. That appreciation permeates her work; she focuses on minimizing climate and environmental impacts of our dependence on fossil fuels.

Dr. Wilcox holds a Ph.D. in Chemical Engineering and an M.A. in Chemistry from the University of Arizona and B.A. in Mathematics from Wellesley College. Dr. Wilcox's research takes aim at the nexus of energy and the environment, developing both mitigation and adaptation strategies to minimize negative climate impacts associated with society's dependence on fossil fuels. She has served on committees of the National Academy of Sciences and the American Physical Society to assess carbon capture methods and impacts on climate. She is the author of the first textbook on carbon capture, Carbon Capture, published in March 2012. She co-edited the CDR Primer on carbon dioxide removal in 2021.