# The Food-Energy-Water Nexus

16th National Conference and Global Forum on Science, Policy and the Environment

## WELCOME

This year is our biggest and most ambitious conference to date, with three full days containing:

- 60+ sessions;
- 400+ speakers;
- 70+ posters;
- 2 receptions;
- An exhibition;
- Book signings and more…

Environmental science has been developing a systems-based approach for many years. Advances in sensors, data management, computing, and modeling are now allowing the integration of food, energy, and water systems in a manner not possible previously. An emerging 'community of practice' is developing and connecting new scientific insights and engineering solutions with decision-making and public policy.

They will develop holistic solutions to complex challenges that stem from the question: how do we provide food, energy, and water for 9, 10, or 11 billion people in a manner that is environmentally sustainable at different scales of space and time?

Conferences are about people. The strength of this conference lies in the diversity of participants and perspectives present. Embrace the diversity and be challenged by it. Leave with new ideas, new collaborators, new inspiration and motivation, and maybe even new funding leads. Use the next three days to help you be the leader and change agent that you seek to be.

Peter Saundry
Chief Scientist
National Council for Science and the Environment

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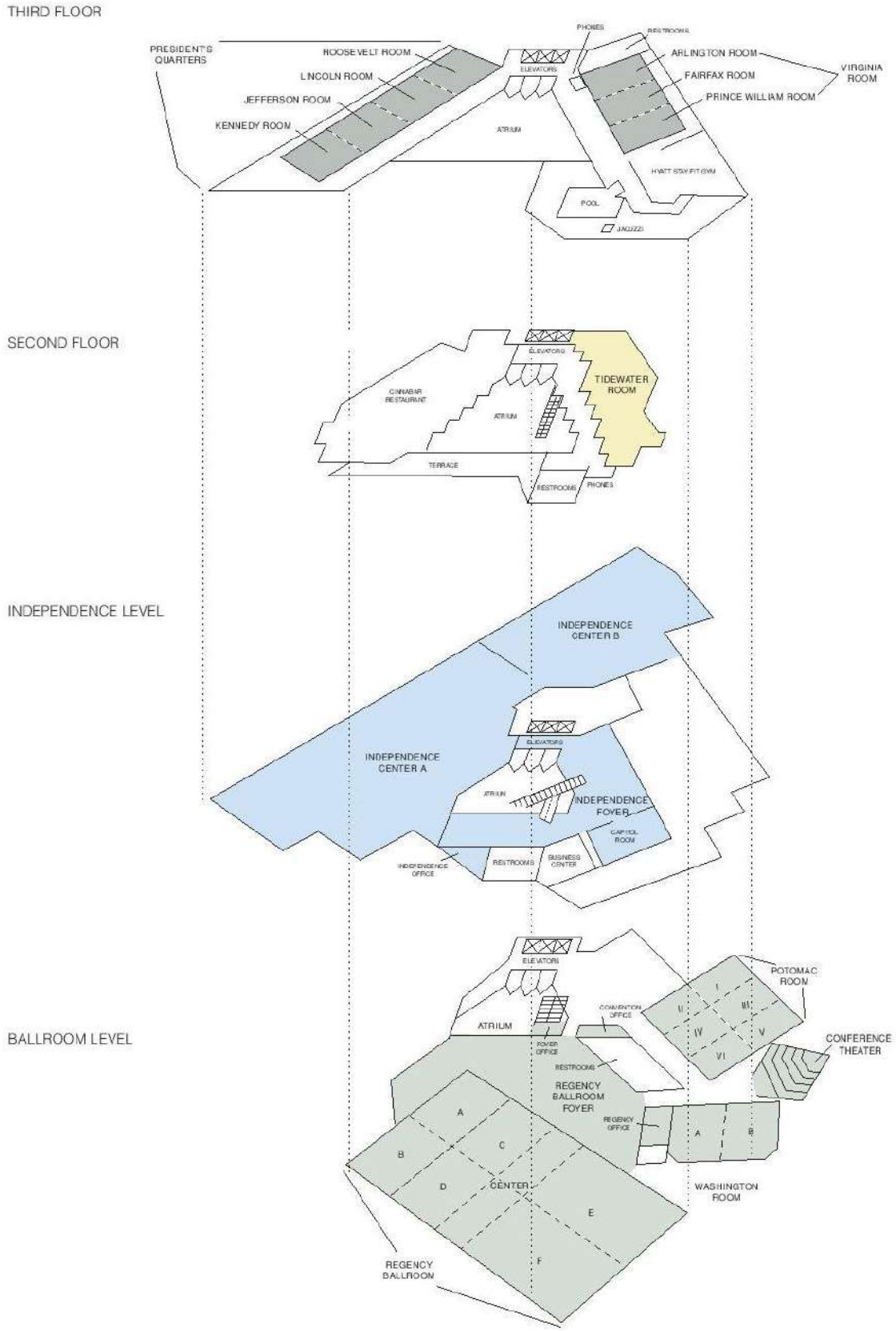
# HYATT REGENCY CRYSTAL CITY

## VENUE MAP



# AGENDA
# TUESDAY, JANUARY 19, 2016

**7:30 a.m.** Continental Breakfast, Exhibition, and Scientific Poster Presentations open – *Regency Ballroom Foyer adjacent to the Plenary Hall and the Regency Ballroom, where Plenary sessions occur.*

**7:30 a.m. – 9:00 a.m.** Discussion: Arizona, the Living Laboratory: How Food, Energy, and Water Converge in the Southwest
Results/discussion from the University of Arizona's NSF sponsored workshop – *Washington Room A*

**9:00 a.m.** Welcome: Peter Saundry, Conference Chair, National Council for Science and the Environment (NCSE)
Introduction to New NCSE Leadership: James L. Buizer, Chair and Michelle Wyman, Executive Director

**9:40 a.m.** Plenary 1: "Megatrends" and the Food-Energy-Water Nexus
Moderator: Kathleen Merrigan, Executive Director of Sustainability, George Washington University
Speakers:

- Robert Engelman, Senior Fellow, Worldwatch Institute
- Clive Mutunga, Population, Environment and Development Technical Advisor, U.S. Agency for International Development
- Nebojsa Nakicenovic, Deputy Director General, International Institute for Applied Systems Analysis
- Rebecca Shaw, Associate Vice President and Senior Lead Scientist, Environmental Defense Fund

**10:40 a.m.** Plenary 2: Opportunities for New Science and Innovation
Moderator: John Nielsen, Science Correspondent
Speakers:

- Daniel Kammen, Director, Renewable and Appropriate Energy Laboratory, University of California, Berkeley
- Edwin Piñero, Senior Vice President for Sustainability, Veolia
- Richard Spinrad, Chief Scientist, National Oceanic and Atmospheric Administration
- Catherine Woteki, Under Secretary for Research, Education & Economics, U.S. Department of Agriculture

**11:45 a.m.** Introduction: Betsy Fink and Jesse Fink, Co-founders, Betsy and Jesse Fink Foundation

**11:50 a.m.** Keynote: Daniel Barber, Executive Chef, Blue Hill Farm
Interviewed by Kathleen Merrigan, Executive Director of Sustainability, George Washington University

**12:20 p.m.** Lunch on your own: *Assorted items can be purchased in the Regency Ballroom Foyer*
Book signing by Daniel Barber

**1:45 p.m.** Symposia A

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| **5:30 p.m.** | John H. Chafee Memorial Lecture: Simran Sethi, Author, *Bread, Wine, Chocolate: The Slow Loss of Foods We Love*<br>Introduction by Michelle Wyman, Executive Director, National Council for Science and the Environment | | |
| **6:15 p.m.** | Reception – Networking – Explore the Exhibition and Posters – *Regency Foyer*<br>Book signing by Simran Sethi | | |

# WEDNESDAY, JANUARY 20, 2016

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| **9:00 a.m.** | Keynote: Anthony Michaels, CEO, Midwestern BioAg | | |
| **9:30 a.m.** | Plenary 3: Solutions from the Private Sector<br>Moderator: Terry Yosie, President, World Environment Center<br>• Greg Koch, Senior Director, Global Water Stewardship, The Coca-Cola Company<br>• Sanjeev Krishnan, Managing Director, S2G Ventures<br>• Peter Williams, Chief Technology Officer, Big Green Innovations, IBM Corporation<br>• Brandon Owens, Director of Ecomagination Strategy, General Electric | | |
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| **6:10 p.m.** | Keynote: France Córdova, Director, National Science Foundation | | |
| **6:30 p.m.** | Reception | | |

# Thursday, January 21, 2016

**7:30 a.m.** Continental Breakfast, Exhibition, and Scientific Poster Presentations open – *Regency Ballroom Foyer adjacent to the Plenary Hall and the Regency Ballroom, where Plenary sessions occur*

**8:50 a.m.** Opening: Carlos Rodriguez-Franco, Acting Deputy Chief, USDA Forest Service

**9:00 a.m.** Keynote: Juergen Voegele, Senior Director, Agriculture Global Practice, The World Bank

**9:45 am - 11:15**

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**11:30 a.m.** Plenary 4: Implementing Innovations
Moderator: Richard Harris, Science Correspondent

- Chizuru Aoki, Lead Environmental Specialist, Global Environment Facility
- Rabi Mohtar, TEES Endowed Professor, Texas A&M University
- Alexander Müller, Study Leader, The Economics of Ecosystems and Biodiversity Agriculture and Food
- Franklin Orr, Under Secretary for Science and Energy, U.S. Department of Energy

**12:30p.m.** Keynote: Paul Lussier, Director, Science Communications With Impact Network at Yale; Founder, President and Executive Producer, Me2U Media, Inc.

**1:00 p.m.** Lunch on your own: *Assorted items can be purchased in the Regency Ballroom Foyer*

**Symposia and World Cafés 2:30 p.m. - 4:00 p.m.**

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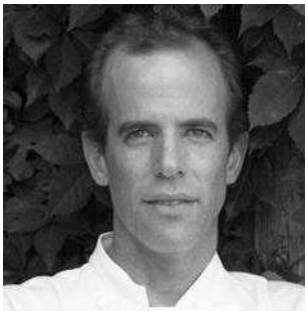
**5:30 p.m.** Adjourn

# Keynote Speakers

**France A. Córdova** is the Director of the National Science Foundation (NSF). In 2016, NSF is launching the Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS) initiative through which it hopes to provide $75 million in grants per year for five years. INFEWS is a unique opportunity for NSF to work, within both a national and an international context, toward building a platform for more accurate, process-based models that incorporate relevant social, political, economic, and cultural factors as well as improved precipitation forecasts, which have the capacity to presage tipping points in water availability and physical measurements that give real-time feedback on the effect of land, energy, and water management. Córdova is the former President of Purdue University (2007-2012) Chancellor of the University of California, Riverside (2002-2007), Vice Chancellor for Research and Professor of Physics at the University of California, Santa Barbara (1996-2002), and Chief Scientist of NASA (1993-1996). Prior to joining NASA, she headed the Department of Astronomy and Astrophysics at Pennsylvania Satate University from 1989 to 1993. Córdova has received numerous awards for her research and scientific leadership.

**Kathleen Merrigan** is the Executive Director of Sustainability at George Washington University, where she leads the GW Sustainability Collaborative and the GW Food Institute and serves as Professor of Public Policy. From 2009-2013, Merrigan was U.S. Deputy Secretary and Chief Operating Officer of the U.S. Department of Agriculture, a $150-billion, 110,000-employee institution. As Deputy Secretary, Merrigan created and led the Know Your Farmer, Know Your Food Initiative to support local food systems; was a key architect of First Lady Michelle Obama's "Let's Move!" campaign; and made history as the first woman to chair the Ministerial Conference of the Food and Agriculture Organization (FAO) of the United Nations. Before joining the USDA, Merrigan held a variety of agriculture policy positions. Merrigan holds a Ph.D. in Environmental Planning and Policy from the Massachusetts Institute of Technology.



**Daniel Barber** is the co-owner and executive chef of Blue Hill and Blue Hill at Stone Barns, and the author of The *Third Plate: Field Notes on the Future of Food.* His opinions on food and agricultural policy have appeared in the *New York Times*, along with many other publications. Appointed by President Barack Obama to serve on the President's Council on Physical Fitness, Sports, and Nutrition, Dan continues the work that he began as a member of Stone Barns Center for Food and Agriculture's board of directors, with the mission to blur the line between the dining experience and the educational, bringing the principles of good farming directly to the table. Barber has received multiple James Beard awards including Best Chef: New York City (2006) and the country's Outstanding Chef (2009). In 2009 he was named one of *TIME Magazine*'s 100 most influential people in the world.

**Betsy Fink** established Millstone Farm in Wilton, CT, an incubator for adaptive and resilient solutions for community-based food systems, dedicated to expanding the networks for local food production and consumption, working with local restaurants and markets to rebuild a regional food system. Previously, she held management positions at both Prodigy Services and Priceline.com, specializing in technical project management.

**Jesse Fink,** co-founder of MissionPoint Partners, is an entrepreneur committed to solving environmental challenges, in particular climate change mitigation and adaptation. He works in partnership with financial markets, academia, policymakers and NGO communities. His professional career involved developing innovative business models including co-founding Priceline.com, and serving as its founding Chief Operating Officer.

**Paul Lussier** leads a business/education collaborative of experts in media, science, technology and communications which provides the business and public policy sectors with science-based research for development and piloting of new information ecosystems, media planning solutions and brand messaging, with specific emphasis on sustainability and earth science communications. Me2U Media leverages all available platforms, technologies and entertainment genres, in all formats: print, digital, broadcast and live events. Lussier is also the Founder and Director of the Science Communications with Impact Network (SCWIN) for the development, piloting and deployment of coalition-building public communication strategies, public policy, and business sector engagement with planetary science, which counts among its partnerships government ministries and science institutions worldwide.

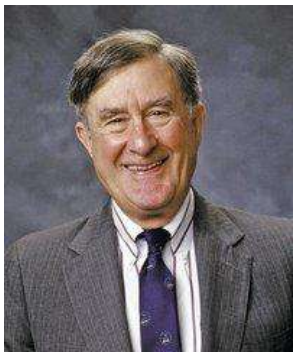

**Anthony Michaels**, CEO of Midwest BioAg, is a nationally recognized leader in sustainability, innovation, and environmental science. Before joining the Midwestern BioAg team, Dr. Michaels was co-founder of Proteus Environmental Technologies, chief scientist at Pegasus Capital Advisors, president of ReCommunity Energy, and CEO of PhycoSystems. Dr. Michaels is board chair for the National Council for Science and the Environment (NCSE) and a board member at the Global Institute on Sustainability at Arizona State University. Previously, he chaired the NCSE's Council of Environmental Deans and Directors, the Catalina Island Conservancy, and the NSF Advisory Committee on Environmental Research and Education.

**Juergen Voegele** is the Senior Director of Agriculture Global Practice at the World Bank. He joined the World Bank in 1991 and has served many roles, including Director for Agriculture and Environmental Services (AES) in the Bank's Sustainable Development Network (SDN); Sector Manager for Agriculture in the Bank's Europe and Central Asia region; and Principal Agricultural Specialist and Rural Sector Coordinator in Beijing. Additional work highlights include leadership of the acclaimed Loess Plateau watershed management project in China and shaping the global agenda on agriculture and food security. Dr. Voegele has also consulted for a number of agencies in various locations, including Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ, formerly GTZ) and the German Federal Ministry of Economic Cooperation and Development (BMZ) with assignments in the Caribbean, China, Myanmar, Niger, the Pacific Islands, and Togo.

**Carlos Rodríguez-Franco** has a doctorate in Forest Sciences from Yale University. In Mexico he worked 25 years for the National Institute of Forestry, Agriculture and Animal Husbandry Research (INIFAP). Currently, he works with the US Forest Service as Acting Deputy Chief for Research and Development. He has written 90 scientific articles related to silviculture and forest management, among other subjects. He authored a book in Spanish titled "Sampling designs applied to forest inventories". Other contributions are participation in the "Forestry Compendium" and the book "Pines of silvicultural importance" published by CAB International in 2002, and a chapter in the book "Urban air pollution and Forests: Resources at risk in the Mexico City Air Basin" published by SpringerVerlag in 2002.

# 16th Annual John H. Chafee Memorial Lecture

**Simran Sethi** is a journalist and educator focused on food, sustainability, and social change. Named environmental "messenger" by *Vanity Fair*, a top 10 eco-hero of the planet by the U.K.'s *Independent*, and one of the top eight women saving the planet by *Marie Claire*, Simran is the author of *Bread, Wine, Chocolate: The Slow Loss of Foods We Love*, about the story of changes in food and agriculture told through bread, wine, chocolate, coffee, and beer. She is an associate at the University of Melbourne's Sustainable Society Institute in Australia, a contributor for *Orion Magazine*, and a recent visiting scholar at the Cocoa Research Centre in St. Augustine, Trinidad. Lauded as an "environmental woman of impact" by *Daily Variety*, Simran was the host of the 2013-2014 PBS QUEST series on science and sustainability. She was the environmental correspondent for NBC News, which included contributions to CNBC, MSNBC, TODAY, and Nightly News. Simran was also the anchor and writer of the Sundance Channel's environmental programming "The Green," and has been featured on the History Channel and National Public Radio, as well as on media in Australia, India, and Italy. She was also the host of the Emmy Award-winning PBS documentary "A School in the Woods." Simran is the contributing author of *Ethical Markets: Growing the Green Economy*.



***Senator John H. Chafee (1922 – 1999)*** was born in Providence, Rhode Island. He earned degrees from Yale University and Harvard Law School. Upon the United States' entry into World War II, Chafee left Yale to enlist in the Marine Corps, and then served in the original invasion forces at Guadalcanal. In 1951 he was recalled to active duty and commanded a rifle company in Korea.

After six years in the Rhode Island House of Representatives, Chafee was elected Governor in 1962. He was reelected in 1964 and 1966. In January 1969 he was appointed Secretary of the Navy and served in that post for three and a half years. He was elected to the United States Senate in 1976. As Chairman of the Environment and Public Works Committee, the Senator was a leading voice in crafting the Clean Air Act of 1990. He led successful efforts to enact oil spill prevention and response legislation and a bill to strengthen the Safe Drinking Water Act. Senator Chafee was a longtime advocate for wetlands conservation and open space preservation and was the recipient of every major environmental award.

John Chafee was a Republican, a committed conservationist, and a political leader who worked across party lines to advance environmental protection.

# Lifetime Achievement Awardees

**Rita R. Colwell** is a distinguished university professor at both the University of Maryland at College Park and the Johns Hopkins Bloomberg School of Public Health. She also serves as senior advisor and chairman emeritus at Canon U.S. Life Sciences, Inc. Her interests are focused on global infectious diseases, water, and health. Colwell served as the 11th director of the National Science Foundation from 1998 to 2004.

In 2003, Dr. Colwell conducted a study in which 7,000 women in Bangladesh were trained to filter the water they gathered every day through a cotton sari folded four times, which reduced the spread of cholera by almost 48%. She also has held many advisory positions in the U.S. government, non-profit science policy organizations, private foundations, and the international scientific research community.

Dr, Colwell is a nationally respected scientist and educator, and has authored or co-authored 17 books and more than 800 scientific publications. Rita produced the award-winning film, "Invisible Seas" and has served on the editorial boards of numerous scientific journals.

**Veerabhadran "Ram" Ramanathan** is Distinguished Professor at the Scripps Institution of Oceanography. He discovered the greenhouse effect of halocarbons, particularly CFCs in 1975. In 1985, he led the first international NASA/WMO/UNEP assessment on the climate effects of non-$CO_2$ greenhouse gases and concluded that they are as important as $CO_2$ to global climate change. He was among a team of four which developed the first version of the U.S. community climate model in the 1980s. He led an international field experiment in the 1990s with Paul Crutzen, which discovered the widespread Atmospheric Brown Clouds (ABCs) over South Asia, which have devastating health and climate impacts. His recent finding is that mitigation of short lived climate pollutants (black carbon, methane, ozone, and HFCs) will slow down global warming significantly during this century.

Dr. Ramanathan now leads Project Surya, which mitigates black carbon and other climate warming emissions from solid biomass cooking in South Asia and Kenya and is documenting their effects on public health and the environment. He serves on Pope Francis' Council for the Pontifical Academy of Sciences and was co-organizer of a 2014 Vatican meeting on "Sustainable Humanity, Sustainable Nature," convening social and natural scientists, philosophers, and policy makers. Dr. Ramanathan has won numerous prestigious awards, including UNESCO's Climate and Policy Professorship at TERI Deemed University in New Delhi, India.

# Plenary 1: "Megatrends" and the Food-Energy-Water Nexus

**Kathleen Merrigan** is the Executive Director of Sustainability at George Washington University, where she leads the GW Sustainability Collaborative and the GW Food Institute and serves as Professor of Public Policy. From 2009-2013, Merrigan was U.S. Deputy Secretary and Chief Operating Officer of the U.S. Department of Agriculture, a $150-billion, 110,000-employee institution. As Deputy Secretary, Merrigan created and led the Know Your Farmer, Know Your Food Initiative to support local food systems; was a key architect of First Lady Michelle Obama's "Let's Move!" campaign; and made history as the first woman to chair the Ministerial Conference of the Food and Agriculture Organization (FAO) of the United Nations. Before joining the USDA, Merrigan held a variety of agriculture policy positions. Merrigan holds a Ph.D. in Environmental Planning and Policy from the Massachusetts Institute of Technology.

**Robert Engelman** is a Senior Fellow at the Worldwatch Institute, a globally focused environmental research organization, where he was President (2011-2014) and Vice President for Programs (2007-2011). Prior to joining Worldwatch, he was Vice President for Research at Population Action International, a policy research and advocacy group in Washington, and directed its program on population and the environment. He has written extensively on population's connections to environmental change, economic growth, and civil conflict. Bob is the author of *More: Population, Nature, and What Women Want*.

**Clive Mutunga** is Population, Environment and Development Technical Advisor at the U.S. Agency for International Development, where he focuses on the linkages between population, environment, and development, including the intersections and integration of family planning and the environment. Trained at the University of Nairobi and the University of Pretoria, Clive is an expert in environmental economics and has conducted research on linking population, gender, climate change, and the environment.

**Nebojsa Nakicenovic** is Deputy Director General of the International Institute for Applied Systems Analysis (IIASA) and former Professor of Energy Economics at the Vienna University of Technology. Among other positions, Professor Nakicenovic is Member of the United Nations Secretary General High-Level Technical Group on Sustainable for Energy for All Initiative; Member of the Advisory Council of the German Government on Global Change; Member of the Panel on Socioeconomic Scenarios for Climate Change Impact and Response Assessments; and Member of the Renewable Energy Policy Network for the 21st Century Steering Committee.

**Rebecca Shaw** is Associate Vice President and Senior Lead Scientist for the Environmental Defense Fund (EDF). Dr. Shaw is a leading scientist, recognized thought leader and strategist on issues related to climate change, biodiversity, ecosystems services, agriculture and water. She is a member of the U.N. Intergovernmental Panel on Climate Change, a lead author on the IPCC's Fifth Assessment Report, and a member of the steering committee of the Global Alliance for Climate Smart Agriculture. As associate vice president of EDF's Ecosystems Program, Rebecca oversees the development and implementation of major market, policy, and science initiatives.

# Plenary 2: Opportunities for New Science and Innovation

**John Thomas Nielsen** was born and raised in California, where he earned a BA in English Literature from Stanford University. After completing a Knight Science Journalism Fellowship at MIT, he spent 19 years with the Science Desk at National Public Radio, reporting on a wide range of national and international environmental issues. His reports on water problems in the Middle East were nominated for a Peabody Award and his investigation of a dolphin die-off won a AAAS award for outstanding Science Journalism. His book Condor: To The Brink and Back won a National Outdoor Book Award. Now a free-lance writer based in Washing DC, he is working another book.

**Daniel Kammen** is a Distinguished Professor of Energy at the University of California, Berkeley, with parallel appointments in Energy and Resources, Public Policy, and Nuclear Engineering. He was appointed the first Environment and Climate Partnership for the Americas Fellow by Secretary of State Hilary R. Clinton. Kammen is the founding director of the Renewable and Appropriate Energy Laboratory, Co-Director of the Berkeley Institute of the Environment, and Director of the Transportation Sustainability Research Center. During 2010-2011, Kammen served as the World Bank Group's Chief Technical Specialist for Renewable Energy and Energy Efficiency. He has authored or co-authored 12 books.

**Edwin "Ed" Piñero** is Senior Vice President for Sustainability for Veolia North America (VNA), and liaison to Veolia's worldwide Corporate Social Responsibility and Public Affairs departments. He oversees all efforts related to sustainability in regard to outreach, client issues, and internal practices (including the water, energy, and waste business lines). Over his more than 34 year career, Mr. Pinero has worked in the private and public sectors on sustainability, environment, and energy. He has also served at the state and federal level, including as the White House Federal Environmental Executive; the Pennsylvania State Energy Director; and the Director of the Bureau of Environmental Sustainability at the Pennsylvania Department of Environmental Protection.

**Richard Spinrad** is Chief Scientist of the National Oceanic and Atmospheric Administration. He is an internationally recognized scientist and executive with more than 30 years of experience, Dr. Spinrad is the senior scientist for the agency, driving policy and program direction for science and technology priorities. Until this appointment, Dr. Spinrad served as vice president for research at Oregon State University and was the head of NOAA's Office of Oceanic and Atmospheric Research and the head of the National Ocean Service

**Catherine Woteki** is Under Secretary for United States Department of Agriculture's Research, Education, and Economics mission area, as well as the Department's Chief Scientist. Her responsibilities include oversight of the Agricultural Research Service, National Institute for Food and Agriculture, Economic Research Service, and National Agricultural Statistics Service. Dr. Woteki is an advocate for accelerated innovation and technology transfer in the agricultural arena. Before joining USDA, Dr. Woteki served as Global Director of Scientific Affairs for Mars, Incorporated, and Dean of Agriculture and Professor of Human Nutrition at Iowa State University

# Plenary 3: Solutions from the Private Sector

**Terry F. Yosie** has served as President & CEO of the World Environment Center (WEC) since October 2006. His major responsibilities include development and implementation of strategies to advance business solutions for sustainability challenges. During his tenure, WEC has developed core competencies in supply chain management, innovation, and the preparation of the next generation of sustainability leaders. WEC's work in these areas has been recognized by the U.S. Department of State, United Nations Environmental Programme, and many global stakeholders.

**Greg Koch** has nearly 30 years of experience and is a globally recognized leader in water resource management. He leads Coca-Cola's global water stewardship program across some 1,000 facilities and numerous agricultural supply regions focusing on: efficiency and wastewater management; watershed protection and climate change adaptation; community water initiatives; and water policy engagement. Nexus analyses and modeling is part of business risk assessment and mitigation efforts, as well as a central theme in water policy engagement and reform efforts.

**Sanjeev Krishnan** is Managing Director of S2G Ventures, a multi-stage venture fund investing in transformative food and agriculture companies whose products and services meet shifting demands for healthy, sustainable, and local food. Krishnan was a co-founder of the life sciences practice of the International Finance Corporation, the $20 billion private investment arm of the World Bank. His previous investment roles include CLSA Capital Partners, Global Environment Fund, World Bank Group's IFC, and JPMorgan.

**Peter Williams'** focus areas are resilience to natural disasters and chronic stresses; Smarter Cities, with special reference to water management, covering entire water resources (such as entire rivers or aquifers), utility infrastructures, and enterprise water management; and cloud computing for government. Dr. Williams has had a major role in developing the intellectual foundation for IBM's "Smarter Planet" and "Smarter Cities" initiatives, and in identifying and integrating their technological components—both IBM-originated and from outside the company.

**Brandon Owens** is an economist, energy analyst, researcher and writer. Mr. Owens is currently the Director of Ecomagination Strategy at GE, where he helps guide the strategic direction of GE's flagship corporate sustainability program. Prior to this role, he was the manager of strategy and analytics within GE Energy's Global Strategy & Planning team. Before joining GE in 2007, Mr. Owens was director of research at Cambridge Energy Research Associates (IHS CERA). Earlier, he served as senior analyst for the National Renewable Energy Laboratory (NREL). Mr. Owens holds a MS degree in mineral economics from the Colorado School of Mines and a BA in mathematics and economics from the University of Colorado at Boulder.

# Plenary 4: Implementing Innovations

**Richard Harris** is on leave from National Public Radio to write a book. He has reported on a wide range of topics in science, medicine and the environment since he joined NPR in 1986. He has traveled to all seven continents for NPR, and he has covered stories such as the nuclear aftermath of the 2011 tsunami in Japan; the Earth Summit in Rio de Janeiro in 1992; and the United Nations climate negotiations in Kyoto (1997) and Copenhagen (2009). Harris was the first to report that the government vastly underestimated the volume of oil flowing into the Gulf of Mexico from the 2010 BP well blowout. Harris has been the recipient of many prestigious awards, including the 2013 AGU Presidential Citation for Science and Society, the 2009 National Academy of Sciences Communication Award, and the 1995 Peabody Award for investigative reporting.

**Chizuru Aoki** is the Lead Environmental Specialist for the Global Environment Facility (GEF) Programming Unit. She is responsible for leading GEF's strategy and representation in multiple global environmental agreements. She also plays a leading role in the climate change policy and finance arena. Prior to joining the GEF in 2010, she was a Senior Programme Officer at the United Nations Environment Programme (UNEP), where she coordinated one of the largest UN-led environmental interventions in Iraq to facilitate ecosystem management and technology transfer. Earlier in her career, she managed a program to promote cleaner production in developing countries.

**Rabi Mohtar**, TEES Endowed Professor at Texas A&M University, is the Founding Director of Qatar Environment and Energy Research Institute. His primary research priority is the development of a framework to quantify the interlinkages of the Food-Energy-Water Nexus, which is constrained by climate change and social, political, and technological pressures. He has received the Kishida International Award for contributions to agricultural research. He serves on the World Economic Forum Global Agenda Council and the board of governors of the World Water Council.

**Franklin "Lynn" Orr** is the Under Secretary for Science and Energy at the U.S. Department of Energy. He is the principal advisor to the Secretary and Deputy Secretary on clean energy technologies and science and energy research initiatives. He also oversees the majority of DOE's National Laboratories. Dr. Orr was the founding director of the Precourt Institute for Energy at Stanford University from 2009 to 2013. He was the founding director of the Stanford Global Climate and Energy Project from 2002 to 2008, and he served as Dean of the School of Earth Sciences at Stanford from 1994 to 2002.

**Alexander Müller** is the study leader of the UNEP project The Economics of Ecosystems and Biodiversity for Agriculture and Food (TEEB AgFood). Previously, Alexander was Senior Fellow in the cluster Global Contract for Sustainability of the Institute for Advanced Sustainability Studies (IASS) working on governance of sustainability, with a focus on soils and its role in the food-energy-water nexus and on the German Energiewende. From 2008 to 2011 he was chair of the United Nations System Standing Committee on Nutrition (UNSCN). At the Food and Agriculture Organization (FAO) of the United Nations, Alexander was was responsible for the Department for Natural Resources and Environment. He has also held significant political positions in Germany.

# Session Descriptions

## **Symposia A** (Tuesday 1:45 – 3:15 p.m.)

**S-A1 Opportunities for Science at the Nexus**
*(Ballroom E&F)*

This session will explore the diverse opportunities for science to address major challenges in the food-energy-water nexus, with each participant bringing a different scientific perspective. All have been involved in workshops supported by the National Science Foundation (NSF) to explore the intellectual foundations and fundamental science and engineering questions for a major new NSF initiative, "Innovations at the Nexus of Food, Energy, and Water Systems" (INFEWS). Issues to be explored will be advances in systems science, modelling, decision-support tools, sensors, data management, and other areas. The application of these advances to meet the food, energy, and water needs of a growing global population in a manner that is environmentally sustainable will also be explored.

Moderator: JoAnn S. Lighty, Division Director, Division of Chemical, Bioengineering, Environmental, and Transport Systems, National Science Foundation and and Professor of Chemical Engineering, University of Utah.
Speakers:

- Jae Edmonds, Chief Scientist and Battelle Laboratory Fellow, Joint Global Change Research Institute (JGCRI) and the Pacific Northwest National Laboratory
- Elena Irwin, Professor, Agricultural, Environmental, and Development Economics, The Ohio State University
- Fernando Miralles-Wilhelm, Executive Director, Cooperative Institute for Climate and Satellites, University of Maryland
- Joshua Newell, Assistant Professor, Natural Resources and the Environment, University of Michigan

**JoAnn S. Lighty** joined the NSF in October 2013 and serves as one of the key architects for the NSF research and education initiative INFEWS. Lighty's research has focused on the formation of fine particulate matter; the fate of mercury in combustion; carbon capture technologies; and the formation and oxidation of soot. While serving on committees for the EPA and the National Research Council, she contributed to reports on national issues such as air quality, hazardous waste management, and water quality.

**Jae Edmonds** is the principal investigator for the Global Energy Technology Strategy Program to Address Climate Change, an international, public-private research collaboration. His research in the areas of long-term global energy, economy, and climate change spans three decades, during which time he has made countless presentations and published several books and numerous scientific papers. His most recent book, *Global Energy Technology Strategy: Addressing Climate Change*, distills more than a decade of research on the role of technology in addressing climate change. Dr. Edmonds has served in the capacity of Lead Author on every major IPCC assessment to date and presently serves on the IPCC Steering Committee on "New Integrated Scenarios". (301-314-6749; jae@pnnl.gov)

**Elena Irwin** is an environmental and urban economist who specializes in land use economics and human-natural systems. Her research focuses on spatial modeling of land use and the development of integrated models of land use and ecosystem services at local and regional scales. Current projects include the development of empirical and simulation-based spatial models of urbanization and agricultural land use decisions to examine the influence of policies on land change patterns and impacts on ecosystem services in several U.S. study regions.

**Fernando Miralles-Wilhelm** is a hydrologist and water resources engineer who has developed an ability to view science with both a business and societal perspective. He gained experience with the business aspect of scientific research while working on a portfolio of water resources projects for the Inter-American Development Bank. He has also studied hydrology internationally and worked primarily in Latin American countries such as Nicaragua and Costa Rica with Engineers Without Borders, which serves the needs of disadvantaged communities through engineering solutions. Miralles-Wilhelm's primary scientific research focus is on hydrology and climate interactions, specifically pertaining to vegetative ecosystem issues in the Everglades, where he has worked for the past decade.

**Joshua Newell** is a broadly trained human-environment geographer, whose research focuses on questions related to urban sustainability, resource consumption, and environmental and social justice. Newell is the Principal Investigator of an NSF-funded workshop grant entitled "Scaling-up Urban Agriculture to Mitigate Food-Energy-Water Impacts." (jpnewell@umich.edu)

## S-A2 Feeding 9, 10, 11 Billion Sustainably (Part 1)

*(Potomac Rooms I, II, III, IV)*

Providing health nutrition for a global population projected to rise from 7.3 billion to 8.5 billion by 2030, to 9.7 billion by 2050, and to 11.2 billion by 2100 is one of the most fundamental and profound challenges facing humanity. This session focuses on the question of how to do so without depleting the water and energy needed for other purposes and devastating the world ecosystem.

There are many opportunities to address this problem through new approaches to agriculture and reduction of food waste. Issues discussed will include getting more food from existing farmed land, efficient use of water and energy, new forms of intensive agriculture such as aquaponics, the use of aquaponics in controlled environments, new food systems, addressing "diet gaps" and "food deserts," food waste, and efficiency.

This session is paired with S-D6. Brief opening and closing remarks will be given by the session organizers Jerry Miller, The National Academies of Sciences, Engineering and Medicine and Ron Sands, U.S. Department of Agriculture. Please see S-D6 for their bios.

Moderator: Ann Bartuska, Deputy Under Secretary for Research, Education, and Economics, U.S. Department of Agriculture
Speakers:

- Alexander Müller, Study Leader, The Economics of Ecosystems and Biodiversity Agriculture and Food (TEEB AgFood)
- Mark Oshima, Chief Marketing Officer and Co-Founder, AeroFarms
- Pedro Sanchez, Director, Agriculture and Food Security Center, Columbia University and World Food Prize Laureate
- Keith Wiebe, Senior Research Fellow, International Food Policy Research Institute

**Ann Bartuska** is Deputy Under Secretary for Research, Education, and Economics (REE) in the U.S. Department of Agriculture (USDA). Previously, she was Deputy Chief for Research & Development, for the USDA Forest Service, a position she began in January 2004. She recently served as Acting USDA Deputy Undersecretary for Natural Resources and Environment from January to October of 2009, and was the Executive Director of the Invasive Species Initiative in the Nature Conservancy. Prior to this, she was the Director of the Forest and Rangelands staff in the Forest Service in Washington, DC.

**Marc Oshima** has an extensive marketing background in retail, brand management, and media with leading companies including Toys R Us, L'Oreal, and Turner Broadcasting. He brings invaluable experience specifically from the food industry where he had headed up marketing for The Food Emporium, a leading NY metro grocery store chain and for Citarella gourmet markets which has been recognized as one of the Top 50 Specialty Food Retailers in the United States. Passionate about creating new businesses, Marc helped launch GameTap, the first on-demand broadband video game network and Beautyjungle.com, the first site authorized to sell both prestige and mass beauty products.

**Pedro A. Sanchez** is Director of the Agriculture and Food Security Center and Senior Research Scholar at Columbia University's Earth Institute. He served as Director General of the World Agroforestry Center (previously known as the International Centre for Research in Agroforestry, or ICRAF) headquartered in Nairobi, Kenya, from 1991 to 2001; as co-chair of the United Nations Millennium Project Hunger Task Force from 2002 to 2005; and as director of the Millennium Villages Project from 2004 to 2010. Sanchez is Professor Emeritus of Soil Science and Forestry at North Carolina State University. He has supervised research programs in over 25 countries in Latin America, Southeast Asia, and Africa. He is the 2002 World Food Prize Laureate and a 2004 MacArthur Fellow, and was elected to the American Academy of Arts and Sciences in 2008 and the National Academy of Sciences of the United States in 2012. (845-680-4452; psanchez@ei.columbia.edu)

**Keith Wiebe** leads a research program on Global Futures and Strategic Foresight at the International Food Policy Research Institute (IFPRI). Prior to joining IFPRI in October 2013, he was Deputy Director of the Agricultural Development Economics Division of the United Nations Food and Agriculture Organization (FAO) in Rome, where he managed a program of economic research and policy analysis for food security and sustainable development, and helped coordinate preparation of FAO's annual flagship reports on the State of Food and Agriculture and the State of Food Insecurity in the World. His areas of particular interest include land tenure, natural resource use and conservation, agricultural productivity, and food security.

**Alexander Müller** is the study leader of the UNEP project The Economics of Ecosystems and Biodiversity for Agriculture and Food (TEEB AgFood). Previously, Alexander was Senior Fellow in the cluster Global Contract for Sustainability of the Institute for Advanced Sustainability Studies (IASS) working on governance of sustainability, with a focus on soils and its role in the food-energy-water nexus and on the German Energiewende. From 2008 to 2011 he was chair of the United Nations System Standing Committee on Nutrition (UNSCN). At the Food and Agriculture Organization (FAO) of the United Nations, Alexander was was responsible for the Department for Natural Resources and Environment. He has also held significant political positions in Germany.

**S-A3 Opportunities for Innovative Applications in Sustainable Development**
*(Washington Room A)*

While the more developed nations of the world struggle with transforming their food, energy, and water systems to reduce adverse environmental impacts, the developing nations of the world face additional challenges. They must also meet the fundamental needs of their growing populations for nutritious food, clean water, and access to energy. Simply having these resources, often taken for granted by affluent populations, is a core aspiration for billions of people today and is embodied in the Sustainable Development Goals adopted by the United Nations in September. This session will explore the "chokepoints" confronting sustainable development and innovative solutions in different parts of the world for achieving these goals in an integrated manner.

Moderator: Kaitlin Yarnall, Deputy Creative Director, *National Geographic*
Speakers:

- Diego Rodriguez, Senior Economist, Water Global Practice, The World Bank
- Jennifer Turner, Director, China Environment Forum and Manager, Global Choke Point Initiative, Woodrow Wilson Center
- Richenda Van Leeuwen, Executive Director, Energy Access, United Nations Foundation
- Hugh Welsh, President and General Counsel, DSM North America

**Kaitlin Yarnall** is the Deputy Creative Director of *National Geographic* magazine, where she oversees staff charged with the magazine's maps and graphics. She is the lead editorial manager for *National Geographic*'s current food initiative and was deeply involved in conceptualizing the graphic storytelling for the recent series around urban impacts and population. Yarnall's work has been recognized by the Society for News Design's Malofiej competition, for which she has served as a juror. She has been with *National Geographic* for nine years.

**Diego Rodriguez** is the task team leader of the World Bank initiative on the quantification of the tradeoffs of the energy-water nexus (Thirsty Energy) and the Program Manager of the Water Partnership Program. He is currently also providing support to operational teams on the use of economic analysis in large water infrastructure investments under deep uncertainty. Prior to joining the World Bank, he worked at the Danish Hydraulic Institute and the Inter-American Development Bank. He has more than 20 years of experience in sectoral, operational, policy, and strategy development in water supply, sanitation, and water resources management. (202-473-3432; drodriguez1@worldbank.org; Twitter: @diegorod_water)

**Jennifer Turner** has been the director of the China Environment Forum at the Woodrow Wilson Center for 13 years. She has created meetings, exchanges, and publications focusing on a variety of energy and environmental challenges facing China. She particularly focuses on water, energy and climate challenges, as well as environmental nongovernmental organizations, environmental journalism, and environmental governance in China. Her current projects are: (1) Choke Point: China, a multimedia and convening initiative uncovering how energy is impacting water in China; (2) Cooperative Competitors, research and exchanges on U.S.-China energy and climate cooperation; and (3) Complex Connections, meetings and research examining the environmental impact of Chinese investment overseas.

**Richenda Van Leeuwen** leads the UN Foundation's work on energy access and engagement with the UN's Sustainable Energy for All Initiative. She founded UNF's Energy Access Practitioner Network (www.energyaccess.org): a 2,000+ member global network of private companies and public sector organizations supporting market-led solutions for decentralized energy access in developing countries. She joined the UN Foundation in 2010 from Good Energies, a global renewable energy private equity firm, and previously served as CEO of Trickle Up, a microenterprise development non-profit. She serves

on the board of SELCO India, and as an advisor to many off-grid energy companies. (202-758-5037; rvanleuuwen@unfoundation.org; Twitter: @VanLeeuwenR)

**Hugh Welsh** serves on several DSM global and regional management teams and is responsible for legal and government affairs; corporate communications; financial, HR, and other shared services; corporate partnerships; and sustainability, inclusion, and diversity initiatives in the region of North America. DSM joined forces with the World Food Programme (WFP) in 2007 to form the "Improving Nutrition, Improving Lives" partnership, lending its expertise to help improve the nutritional value of the food WFP distributes to those in need. Before joining DSM, Hugh worked for the American Standard Companies McCarter & English LLP and others. Hugh currently serves on the Board of Directors of the American Chemistry Council, Partners in Food Solutions, Safe America Foundation, Tri-State Diversity Council, and the U.S. Chamber of Commerce Foundation.

**S-A4 Cities at the Nexus**
*(Washington Room B)*

By 2050, two-thirds of the world's population will live in urban settings which will be hubs for food, energy, and water consumption. This session will explore how these core needs can be, and are being, integrated into the sustainable planning of cities and surrounding areas. Diverse cities around the world and in the United States will be considered, with a focus on how their food, energy, and water "supply chains" connect them to and profoundly impact other areas.

Moderator: William J. Cooper, Program Director, Division of Chemical, Bioengineering, Environmental, and Transport Systems, National Science Foundation
Speakers:

- Mazdak Arabi, Associate Professor, Department of Civil and Environmental Engineering, Colorado State University
- John Dickert, Mayor, City of Racine
- Carol Miller, Professor and Chair, Department of Civil and Environmental Engineering, Wayne State University
- Anu Ramaswami, Charles M. Denny, Jr. Chair of Science, Technology, and Public Policy, Humphrey School of Public Affairs and Professor of Bioproducts and Biosystems Engineering, College of Food, Agricultural, and Natural Sciences, University of Minnesota

**William J. "Bill" Cooper** directs the NSF program funds projects which look at the environmental engineering implications of energy and resource consumption; availability of high quality water supplies; and fate and transport of contaminants of emerging concern in air, water, and soils. Prior to joining NSF in 2013, Bill was a Professor and Director of the Urban Water Research Center at the University of California at Irvine.

**Mazdak Arabi** is teaching and actively conducting research in the areas of water resources management and planning and environmental engineering. His research primarily focuses on the development of scientific approaches and decision support systems for sustainable environmental planning and management. For example, Dr. Arabi is interested in investigating the impact of anthropogenic activities, such as land use change, and agricultural practices on the integrity of environmental systems, especially watersheds. Currently, Dr Arabi is involved with several projects sponsored by the USDA, National Resources Conservation Service (NRCS), and NSF to develop stakeholder driven multi-criteria watershed management support systems with purpose of enhancing decision makers' capacity to evaluate a range of agricultural and environmental policy alternatives. (970-491-4639; Mazdak.Arabi@Colostate.edu)

**John Dickert** is currently serving in his third term as Mayor of Racine, Wisconsin. He has also held a variety of positions in the offices of U.S. Representative Peter Barca (D-WI) and U.S. Representative Les Aspin (D-WI). He worked for both Republicans and Democrats in the Wisconsin State Assembly from 1987 to 1993, staffing the State budget and the Ways and Means Committee on taxation. He currently serves on the Board of the Great Lakes and St. Lawrence Cities Initiative, a partnership dedicated to protecting and restoring the Great Lakes. He has been appointed as Vice Chair to the United States Conference of Mayors' Metro Economies Committee and also serves on the U.S. Conference of Mayors' Water Council. He is the past President of the Urban Alliance of the League of Wisconsin Municipalities. (262-636-9111; mayor@cityofracine.org)

**Carol Miller** is an active water resources researcher, having received grants from the National Science Foundation, Great Lakes Protection Fund, and Engineering Foundation, amongst others. Her research includes both surface and subsurface water supplies and has recently focused on topics with a water/energy interface. She is especially interested in urban environmental issues, having helped launch the Urban Watershed Environmental Research Group (UWERG) at Wayne State University. Dr. Miller received all her academic degrees from The University of Michigan, Ann Arbor. She is a licensed Professional Engineer in the State of Michigan and past chair of the State Licensing Board. (313-706-9060; cmiller@eng.wayne.edu)

**Dr. Anu Ramaswami** is Charles M. Denny Chair Professor of Science Technology & Environmental Policy at the Humphrey School of Public Affairs, University of Minnesota. Her work is interdisciplinary, spanning areas of sustainable infrastructure, urban systems, environmental engineering, industrial ecology, public health & public affairs. She is lead PI on two NSF projects related to sustainability, Partnership in International Research and Education: "Developing Low-Carbon Cities in the USA, China & India through Inter-Disciplinary Integration Across Engineering, Environmental Sciences, Social Sciences & Public Health" and Sustainability Research Network: "Integrated Urban Infrastructure Solutions for Environmentally Sustainable, Healthy, and Livable Cities." Both are related to exploring sustainability at the Food-Energy-Water nexus. (303-523-8130, anu@umn.edu)

## S-A5 Metrics for Food-Energy-Water Projects

*(Presidents Quarters)*

The sheer size and geographical variance of food-energy-water issues make metrics essential in order to be able to take action. Without understanding metrics, the effectiveness of different innovations, technologies, business models, and policies cannot be placed into context, ranked, or evaluated for success or failure. This session will identify appropriate technical, bio-physical, economic, social, and policy metrics in a manner that would help to integrate the systems across food-energy-water areas. For those who are interested in implementation of new concepts, this session seeks to help quantify the performance of new approaches and to make decisions on which systems could work. This discussion aims to encourage local sustainability of new ideas because their fit was measured before implementation.

Moderator: Amul Dinesh Tevar, Faculty and Joint Appointee, The Ohio State University and Battelle National Laboratory
Speakers:

- Michael Carbajales-Dale, Assistant Professor, Clemson University
- Brian Fath, Professor, Department of Biological Sciences, Towson University
- David Wiberg, Acting Director, Water Program, International Institute for Applied Systems Analysis (IIASA)
- Bradley Zamft, Program Officer, Discovery and Translational Sciences, Bill and Melinda Gates Foundation

**Amul Tevar** holds a joint appointment at The Ohio State University and the Batelle Memorial Institute, where he finds new areas of collaboration between the two research institutions. He currently works on plant imaging technology, new battery electrolytes, and creating context for food-energy-water projects. Dr. Tevar was previously a fellow at the Department of Energy's Advanced Research Projects Agency–Energy (ARPA-E), where he helped to launch programs in dry power plant cooling. He also worked on the technological barriers for energy storage, creating energy from wastewater and designing membranes with decades of useful performance.

**Michael Carbajales-Dale** heads the Energy-Economy-Environment (E3) Systems Analysis group. He joined Clemson University in August 2014 as an Assistant Professor in the Environmental Engineering & Earth Sciences department. Before joining Clemson, Mik was an Energy Systems Analyst with Stanford's Environmental Assessment & Optimization Lab and with the Global Climate & Energy Project (GCEP). His research focuses on the long-term, large-scale evolution and dynamics of the energy-economy system, especially how development of energy resources affects social development and the effects of a future transition from fossil fuels to renewable energy sources. (864-656-0523; madale@clemson.edu)

**Brian D. Fath** is Professor in the Department of Biological Sciences at Towson University and a Research Scholar within the Advanced Systems Analysis Program at the International Institute for Applied Systems Analysis in Laxenburg, Austria. His research is in the area of systems ecology and network analysis applied to the sustainability and resilience of socio-ecological systems. He has published more than 130 research papers, reports, and book chapters; co-authored three books; and is Associate Editor-in-Chief for *Encyclopedia of Ecology*. He is also Editor-in-Chief for the journal *Ecological Modelling*; President of the North American Chapter of International Society for Ecological Modelling; Chair of the Ecosystem Dynamics Focus Research Group in the Community Surface Modeling Dynamics System; and member and past Chair of Baltimore County Commission on Environmental Quality. (410-704-2535; bfath@towson.edu)

**David Wiberg** manages the Water Futures and Solutions Initiative at the International Institute for Applied Systems Analysis (IIASA), applying systems analysis to build and explore with stakeholders consistent scenarios of the freshwater system across scales and sectors, and exploring the synergies and tradeoffs of intervention options in order to inform decisions focused on more effective and robust water management. Dr. Wiberg has PhD degrees in civil engineering, water resource engineering, and management. He designed river basin management software for the Bureau of Reclamation, U.S. Department of the Interior, and consulted with the EPA and DOE in the U.S. Dr. Wiberg's primary fields of interest are efficient and sustainable water management strategies, water modeling and the development of decision support tools, and climate change impact assessments. (+43(0) 2236 807 588; wiberg@iiasa.ac.at)

**Bradley Zamft** develops and runs open requests for proposals in the global health space through his role on the Grand Challenges team at the Bill & Melinda Gates Foundation. He co-led the New Interventions for Global Health Grand Challenges program aimed at developing disruptive technologies in vaccines, drugs, and diagnostics for developing countries, and designed and manages a Grand Challenges Explorations program aimed to at developing bacteriophage technologies to engineer newborn and infant gut microbiota as a means to combat environmental enteropathy in developing countries. He is the technical lead on a new Grand Challenges China partnership with the National Science Foundation of China. He also invests in technologies aimed at increasing chemical diversity in drug collections, mainly through synthetic biology. Brad was a Fellow at ARPA-E in the Department of Energy where he worked with stakeholders in industry, academia, government, and philanthropic organizations to support and advance transformative technologies in the energy sector, including performing an analysis of the water use and radiative forcing implications of modulating plant reflectivity.

## **Symposia B** (Tuesday 3:30 p.m. – 5:00 p.m.)

**S-B1 Innovations in Managing Water**
*(Ballroom E&F)*

The World Economic Forum identified water crises as two of the top ten global risks in 2015. Having too little or too much water leads to devastating impacts, and while these are often local, water security is now recognized as a systemic global risk. This session will explore innovative water stewardship strategies which integrate food and energy demands and prices, environmental, and social impacts. It will also explore tools to help understand the implications of different solutions under different socioeconomic, energy, and climate change scenarios in diverse countries at the national and transboundary levels.

Moderator: Jerad Bales, Chief Scientist for Water, U.S. Geological Survey
Speakers:

- Astrid Hillers, Senior Environmental Specialist, Program Manager, Global Initiatives and Africa International Waters, Global Environment Facility
- William Sarni, Enterprise Water Strategy Consulting Leader, Deloitte Consulting LLP
- Joshua Viers, Director, Center for Information Technology Research in the Interest of Society (CITRIS) and Associate Professor, Water Resources Engineering, University of California, Merced
- Paul Faeth, Director, Energy, Water and Climate, Institute for Public Research, CNA

**Jerad Bales** is responsible for the planning and development of national basic and applied research programs related to the hydrologic environment at the U.S. Geological Survey (USGS). He also oversees and evaluates the results of research efforts conducted by universities under the mandates of the Water Resources Research Act of 1984; coordinates the USGS Hydrologic Research and Development Program and the Water Resources Research Institutes Program; and assists other USGS leaders with external national and international programs. Bales represents the USGS on a number of external committees, including as co-chair of the Subcommittee on Water Availability of the National Science and Technology Council. He was Water Sector lead for the U.S. 2013 National Climate Assessment and is a member of many research coordinating and synthesis groups. (703-648-5044; jdbales@usgs.gov)

**Astrid Hillers** joined the Global Environment Facility (GEF) in 2012, coming from the World Bank where she has worked since 2000. She led the International Water Focal Area for two years and is now coordinator for Strategic Global Initiatives at the GEF while continuing to lead the GEF IW Program in Africa. Prior to joining the GEF, Astrid has been engaged in cooperation on river basins in Africa, especially the Nile, during most of her time at the World Bank and previous work at UNDP. Astrid is a German national and an environmental engineer by training and before coming to the U.S. in 1989, she worked for the German EPA in the water quality compliance program of the city/state of Hamburg. (202-458-8173; ahillers@thegef.org)

**William Sarni** is a director with Deloitte Consulting LLP and leader of its Water Strategy practice. For more than three decades he has been providing environmental and sustainability services to private- and public-sector enterprises. Will is also an internationally recognized author and thought leader in developing and implementing corporate-wide water stewardship and sustainability strategies. (720-341-7272; wsarni@deloitte.com)

**Joshua Viers** is an expert in water resource management and environmental decision making. He has over 20 years of professional experience in agroecology, landscape ecology, and watershed science. By leveraging geospatial technologies and informatics, he has developed innovative solutions in conservation, restoration, and sustainability. He has managed over $30M in applied research, and authored or co-authored over 120 scientific publications. (209-591-8423; jviers@ucmerced.edu)

**Paul Faeth** is Director, Energy, Water and Climate in the Institute for Public Research at CNA, where he is leading work exploring the policy synergies between these themes. Prior to joining CNA, Faeth was the President of Global Water Challenge, a coalition working on WASH in developing countries. Faeth worked for 18 years at WRI, where he led the Economics Program and then became the institute's Managing Director. Faeth also worked at the International Institute for Environment and Development and the USDA's Economic Research Service. He holds degrees in Agricultural Engineering and Resource Systems and Policy Design. (202-294-5471, faethp@cna.org)

## S-B2 Innovations in Framing Decisions

*(Washington Room A)*

The symposium will examine decision frameworks for sustainable solutions to food-energy-water challenges and how to ensure that solutions to particular challenges do not generate vulnerabilities elsewhere in food-energy-water systems. Speakers will explore both theoretical and practical components across natural, economic and policy sciences. Speakers will: (1) examine the theory behind and need for decision frameworks to address food-water-energy challenges; (2) discuss the application of decision frameworks to food-water-energy risks and trade-offs in the Colorado River basin; (3) connect science and decision-making through climate change adaptation to build resilience in coupled food-energy-water systems; and (4) examine integrated modelling and tools for decision-making in the Truckee-Carson Basin. The session is co-hosted by the Food, Energy, Environment, Water ($FE^2W$) Network.

Moderator: Nathanial Matthews, Global Research Coordinator, CGIAR Research Program on Water, Land and Ecosystems
Speakers:

- Dustin Garrick, Assistant Professor and Philomathia Chair of Water Policy, McMaster University, Food, Energy, Environment, Water ($FE^2W$) Network
- Katharine Jacobs, Director, Center for Climate Adaptation Science and Solutions, University of Arizona
- Greg Koch, Senior Director, Global Water Stewardship, The Coca-Cola Company
- Maureen McCarthy, Great Basin Program Director, University of Nevada, Reno
- Claudia Ringler, Deputy Division Director, National Resource Theme, International Food Policy Research Institute

**Nathanial Matthews** is the Global Research Coordinator of the CGIAR Program on Water, Land and Ecosystems (WLE). In his role with WLE, Nate manages teams and projects across WLE's four focal regions (West Africa, East Africa, the Ganges, and the Greater Mekong), working with over 175 partners to develop scalable solutions for reducing poverty, improving food security, and maintaining healthy ecosystems. A political and environmental scientist by training, Dr. Matthews has 14 years professional experience across business, education, research, and consulting that spans over 20 countries. In addition to his role with WLE, Nate is a Senior Visiting Fellow at King's College London, a Visiting Fellow at the University of East Anglia Water Security Centre, and a Fellow of the Royal Geographic Society. (+44 77489665; n.matthews@cgiar.org; Twitter: @Nate_Matthews_)

**Dustin Evan Garrick** specializes in water allocation policy and river basin governance in water stressed regions of Western North America and Southeast Australia. He holds grants from the Canadian and Australian Research Councils to investigate adaptation to climate extremes and water allocation reform in North America and Australia. He has a special interest in interdisciplinary and science-practitioner

networks that connect science and policymaking. He currently serves on the management committee of the Food, Energy, Environment and Water ($FE^2W$) Network. He recently served on the Global Water Partnership/OECD task force on Water Security and Sustainable Growth and is active on a number of international and comparative water policy projects.

**Katharine Jacobs** is the director of the Center for Climate Adaptation Science and Solutions and a professor at the University of Arizona. From 2010 to 2013, Jacobs worked in the White House, leading the National Climate Assessment and advising on water science and climate adaptation. Prior to her work in DC, Jacobs was the executive director of the Arizona Water Institute from 2006 to 2009, and she has more than 20 years of experience as a water manager for the Arizona's Department of Water Resources. Her research interests include water policy, connecting science and decision making, stakeholder engagement, and climate change adaptation. (520-626-5023; jacobsk@email.arizona.edu)

**Greg Koch** has nearly 30 years of experience and is a globally recognized leader in water resource management. He leads Coca-Cola's global water stewardship program across some 1,000 facilities and numerous agricultural supply regions focusing on: efficiency and wastewater management; watershed protection and climate change adaptation; community water initiatives; and water policy engagement. Nexus analyses and modeling is part of business risk assessment and mitigation efforts, as well as a central theme in water policy engagement and reform efforts. (404-676-7698; gkoch@coca-cola.com)

**Maureen McCarthy**, as Great Basin Program Director at the University of Nevada, Reno (UNR), coordinates transdisciplinary research and outreach programs with scientists, water and natural resource managers, and tribal communities in the Great Basin and American Southwest. She serves as Director of the Great Basin Cooperative Ecosystem Studies Unit and Chair of the Great Basin Landscape Conservation Cooperative Steering Committee. Dr. McCarthy is also Executive Director of the Tahoe Science Consortium, where she coordinates applied research and science-based decision-making in support of environmental management in the Lake Tahoe Basin. (775-784-8262; mimccarthy@unr.edu)

**Claudia Ringler** leads the Natural Resource Theme at the International Food Policy Research Institute (IFPRI) with a focus on policy analyses for enhanced resource use efficiency across water, land, and energy for more sustainable food production systems. Dr. Ringler is also a flagship co-lead of the CGIAR Research Program on Water, Land and Ecosystems on Managing Resource Variability and Competing Uses, which has ongoing nexus research in various developing country river basins. Claudia is also chairing the Food, Energy, Environment and Water network ($FE^2W$), which uses a risk-based approach to the nexus focusing on identifying solutions in six large river basins. Finally, Dr. Ringler is involved with the Sustainable Water Future's program (under Future Earth) on the Nexus. (202-862-5600; c.ringler@cgiar.org)

### S-B3 Integrating Nexus Policies at the State Level

*(Washington Room B)*

This session will examine policy approaches from several states to address potential conflicts and synergies between water and energy policies. Participants will consider a range of state approaches and take home recommendations and actions for their own states. They will address how issues such as drought, expansion of unconventional oil and gas production, or a focus on infrastructure investment can catalyze a more integrated policy approach. Discussion questions will include: common and distinct elements of state water and energy policies; extreme events; public financing for infrastructure; policy and impacts on water shortages; the energy intensity of water resources; impacts of droughts; synergies between energy and agricultural uses of water; and transferable policy lessons.

Moderator: Diana Bauer, Director, Office of Energy Policy and Systems Analysis, U.S. Department of Energy
Speakers:

- David Gipson, Energy Division Director, Georgia Environmental Finance Authority
- Mary-Anna Holden, Commissioner, New Jersey Board of Public Utilities
- Robert Wilkinson, Adjunct Professor, Bren School of Environmental Science and Management, University of California, Santa Barbara
- Kate Zerrenner, Manager, Energy-Water Initiatives, Environmental Defense Fund

**Diana Bauer** led a 2014 DOE report on challenges and opportunities in the energy-water nexus. Since issuing a 2014 report on challenges and opportunities in the energy-water nexus, the DOE has been identifying ways we can work together with partners to: (1) reduce vulnerability and improve reliability of water-dependent energy systems by increasing water efficiency, identifying substitutes, and expanding available water resources via improving water treatment; (2) reduce the energy footprint of water systems by increasing efficiency and extracting energy; and (3) identify productive synergies between water and energy systems. Work in the energy-water nexus relates to several dimensions of DOE's mission, including addressing climate change, energy security, and life cycle environmental responsibility.

**David Gipson** is the Director of the Energy Resources Division at the Georgia Environmental Finance Authority, where for eight years he has led a team focused on energy efficiency, renewable energy, energy emergency management and policy for eight years. He has 19 years of experience helping the public and private sector more efficiently manage natural resources and save money. David has a MPA in Natural Resource Management and a BS in Environmental Protection. David is a certified Professional Energy Manager, Project Management Professional and Certified Hazardous Materials Manager. He serves on the board of the National Association of State Energy Officials, served two terms on the State Energy Advisory Board, advising the U.S. DOE, and serves on the Mitigation Framework Leadership Group in support of homeland security goals. (404-584-1007, dgipson@gefa.ga.gov)

**Mary-Anna Holden** was appointed to the New Jersey Board of Public Utilities by Governor Chris Christie in January 2012. In her role as a Commissioner, in addition to her regulatory duties, the water sector is Holden's area of concentration. Currently, Holden serves as vice chair of the NARUC Water Committee and is a member of the NJ Clean Water Council, the NJ Urban Water Solutions Initiative, and "Jersey Water Works." Her areas of interest are water efficiencies through "grey" infrastructure monitoring and replacement; "green" infrastructure standards; water reuse; drip irrigation; and waste heat and methane capture — all as ways to address energy efficiency and carbon reduction. (609-633-9833; mary-anna.holden@bpu.state.nj.us)

Dr. **Robert C. Wilkinson**'s teaching, research, and consulting is on water, energy, and climate policy. Dr. Wilkinson is also a Senior Fellow with the California Council for Science and Technology. He co-chairs the U.S. Sustainable Water Resources Roundtable; advises government agencies, NGOs, and businesses in the U.S. and abroad; and serves on a number of advisory boards. (805-448-2915; wilkinson@es.ucsb.edu)

**Kate Zerrenner** leads the Environmental Defense Fund's (EDF's) multi-year campaign to influence and enact state and national energy and water efficiency policy, including breaking down financial, regulatory, and behavioral barriers. Her expertise includes a sound understanding of technologies and policies affecting traditional energy generation, energy efficiency business models, and the energy-water nexus. She collaborates with key stakeholders and legislative sponsors on the passage of clean energy and energy-water legislation, including drafting legislative language and providing oral and written

testimony. She serves on the City of Austin Integrated Water Resource Planning Community Task Force and the Advisory Board of the Smart Cities Council. (512-691 3423, kzerrenner@edf.org)

## S-B4 Innovations in Modeling and Big Data

*(Presidents Quarters)*

There are many conceptual and mathematical models that scientists, economists, engineers, and others use to describe the world around us. If people and ecosystems have sufficient and reliable access to food, energy, and water, then many other aspects of life can flourish. This session discusses the data and models that describe and project the criticality of this food-energy-water (FEW) nexus. How do we use different modeling approaches (macro vs. micro, socioeconomic vs. biophysical) that provide different viewpoints? What models and data do we need for different timescales in which we need to take action? These questions and more explore existing FEW modeling, data, and findings and indicate future needs for increased FEW sustainability and resilience.

Moderator: Marilu Hastings, Vice President, Sustainability Program, Cynthia and George Mitchell Foundation
Speakers:

- Mary Glackin, Senior Vice President of Public-Private Partnerships, The Weather Company
- Nils Johnson, Research Scholar, International Institute for Applied Systems Analysis (IIASA)
- Carey King, Assistant Director, Energy Institute, University of Texas at Austin
- Quanyan Zhu, Assistant Professor, Electrical and Computer Engineering, New York University

**Marilu Hastings** leads all of the Cynthia and George Mitchell Foundation's strategic grant making programs. Current programs include clean energy, shale sustainability, water, and sustainability education. She has a 25-year career specializing in the interaction of science, public policy, and philanthropic investment. Prior to moving to the foundation, Marilu held leadership positions from 1996 to 2008 at the Houston Advanced Research Center

**Mary Glackin** oversees The Weather Company's relationships with members of the weather enterprise, including government agencies, academia, and other private sector weather providers. Glackin has had a long and distinguished career in public service, including a five-year tenure as deputy undersecretary of Commerce for NOAA operations. She was responsible for the day-to-day management of operations for oceanic and atmospheric services, research, and coastal and marine stewardship.

**Nils Johnson**'s main research interest is modeling of transitions to new energy technologies. In particular, he is interested in combining techno-economic analysis, optimization tools, and geographic information systems (GIS) to explore how energy technologies might develop in real geographic regions. He also applies integrated assessment modeling to explore how the global energy system might change over the next century given different scenarios of the future. He is currently the scientific coordinator of a new project at IIASA to develop global modeling tools for assessing synergistic solutions for the sustainable management of water, energy, and land resources. (+43 2236 807 490, johnsonn@iiasa.ac.at)

**Carey W. King** performs interdisciplinary research related to how energy systems interact within the economy and environment as well as how our policy and social systems can make decisions and tradeoffs among these often competing factors. The past performance of our energy systems is no guarantee of future returns, yet we must understand the development of past energy systems. Dr. King's research goals center on rigorous interpretations of the past to determine the most probable future energy pathways. (512-471-5468; careyking@mail.utexas.edu; Twitter: @CareyWKing)

**Quanyan Zhu**'s work focuses on network models that provide a formal representation of interdependency relationships among different food-energy water (FEW) systems, allowing quantitative methods for impacts and resilient infrastructure design. These models capture relationships and pathways through which indirect impacts of disruptions ripple through society and economies. Meta-network models are given, capturing physical, cyber and human interconnections in individual infrastructures and across multiple critical infrastructures. Effects on outcomes of prototypical disastrous events are assessed. (646-997-3371; quanyan.zhu@nyu.edu)

## S-B5 Community Resilience and Sustainability at the Nexus

*(Potomac Rooms I, II, III, IV)*

U.S. communities all share a basic challenge: balancing the need for long-term sustainability and economic prosperity with the need for resilience and adaptive capacity in the face of turbulent change. In particular, many cities are concerned about the stresses associated with the food-energy-water nexus. The knowledge required to understand and manage these complex interdependencies is still emerging, and requires a blend of natural sciences, economics, social sciences, and information technology. This panel of experts will discuss how communities can adapt to the challenges of the nexus; how the uncertainties can be addressed through an integrated systems approach; and how both government and industry groups are responding to the need for resilience and sustainability.

Moderators: Joseph Fiksel, Executive Director, Sustainable and Resilient Economy Program, Discovery Themes, The Ohio State University and Richard Moore, Senior Fellow, National Council for Science and the Environment and Professor Emeritus, School of Environment and Natural Resources, The Ohio State University
Speakers:

- Russell Callender, Acting Assistant Administrator, Oceans and Coastal Services, National Oceanic and Atmospheric Administration
- Casey Hoy, Kellogg Chair in Agroecosystem Management and Faculty Director, Initiative for Food and Agricultural Transformation, The Ohio State University
- Louie Tupas, Deputy Director, National Institute of Food and Agriculture (NIFA), U.S. Department of Agriculture
- Peter Williams, Chief Technology Officer, Big Green Innovations, IBM Corporation

**Joseph Fiksel** integrates university-wide capabilities, recruits new faculty members, and works with external business and government partners to enable development of sustainable and resilient production and consumption systems. In order to capture the interdependencies among economic, social, and natural capital, he developed the Triple Value framework, adopted by the U.S. EPA for system-level modeling of sustainable solutions. In October 2015, Ohio State hosted a workshop, sponsored by NSF, entitled "Human Adaptations to Climate Change: Impacts on the Resilience of Regional Food, Energy, and Water Systems," which produced a research agenda for investigating the food-energy-water nexus. (614-226-5678; fiksel.2@osu.edu)

**Richard Moore** has been on the executive committee for the Council of Environmental Deans and Directors since 2012. At The Ohio State University (OSU) he served as executive director of the Environmental Sciences Network from 2011 to 2015. He designed and helped implement the first water quality trading project in Ohio that has been running since 2007 and is expanding to cover a quarter of the State of Ohio. As an anthropologist bridging the natural and social sciences, he is the leader for the Sugar Creek water quality project which teamed farmers and researchers to improve the local water quality. He was active in the Kuwait Climate Conference and is presently a PI on the USDA grant "Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems". (330-202-3538; moore.11@osu.edu)

**Russell Callender**'s work focuses on a critical piece of NOAA's portfolio which addresses ecological forecasting and research on harmful algal blooms, which impact food and water quality, as well as ecosystem health. He will discuss how the National Ocean Service is playing a leading role in promoting natural capital and demonstrating how critical natural systems are for overall community resilience. Natural systems and coastal ecosystems contribute to food and infrastructure security, as well as protect energy assets along our coasts. (301-713-3074; Russell.Callender@noaa.gov)

**Casey Hoy**'s work involves interdisciplinary leadership and work with scientists in many disciplines devoted to simultaneous ecological, economic, and social improvements in agricultural ecosystems toward advancements in agroecosystem health and sustainable communities. He also leads InFACT, the Ohio State University Discovery Themes Initiative for Food and AgriCultural Transformation, which seeks transformational solutions to resilient and sustainable food security in Ohio, the nation, and the globe. (330-263-3611; hoy.1@osu.edu)

Dr. **Louie Tupas** is responsible for providing leadership for Bioenergy, Climate and Environmental Systems at the Department of Agriculture's National Institute for Food and Agriculture. This USDA agency provides support for extramural research, education, and Extension in the food, agricultural, and environmental sciences to meet major needs and challenges in food and agricultural system productivity; development of new food, fiber, and energy sources; agricultural energy use and production; sustainable natural resources use; promotion of the health and welfare of people; human nutrition; and international food and agriculture. In addition, Louie's role is to help forge linkages with universities and colleges, stakeholders, and beneficiaries and other organizations including scientific and professional associations, research foundations, industries, and other government agencies. (202-401-4926; ltupas@nifa.usda.gov)

**Peter Williams'** focus areas are resilience to natural disasters and chronic stresses; Smarter Cities, with special reference to water management, covering entire water resources (such as entire rivers or aquifers), utility infrastructures, and enterprise water management; and cloud computing for government. Dr. Williams has had a major role in developing the intellectual foundation for IBM's "Smarter Planet" and "Smarter Cities" initiatives, and in identifying and integrating their technological components—both IBM-originated and from outside the company. (925-648-7975; peter.r.williams@us.ibm.com)

## **Symposia C** (Wednesday 11:00 a.m. – 12:30 p.m.)

### S-C1 Connecting Agricultural Science at the Nexus to Inform Policy
*(Potomac Rooms V, VI)*

This session will reflect upon interdisciplinary research projects sponsored by the USDA National Institute of Food and Agriculture that develop sound science that is being used to inform policy. Speakers will look at the impacts of water on food production and security, the intersection of the production of food and bioenergy crops, the impact of climate on water availability, and the impacts of water availability and climate on policy. Crosscutting issues include new tools and understanding of food production to reduce impact of these systems on and use of energy and water. This session will focus on a breadth of research that informs water, agriculture, and energy policy at the local, regional, and national levels.

Moderators: Nancy Cavallaro and Rachel Melnick, National Program Leaders, Division of Global Climate Change, National Institute for Food and Agriculture, U.S. Department of Agriculture
Speakers:

- Mazdak Arabi, Associate Professor, Civil and Environmental Engineering Colorado State University
- Matei Georgescu, Assistant Professor, School of Geographical Sciences and Urban Planning, Arizona State University
- Maureen McCarthy, Great Basin Program Director, University of Nevada, Reno
- Richard McNider, Distinguished Professor Emeritus, Mathematical Sciences, University of Alabama-Huntsville

**Nancy Cavallaro**'s primary work involves directing the competitive grants programs in the areas of soil science, watersheds and water resources, and global/climate change research. Cavallaro shares leadership in explaining, planning, developing, promoting, and evaluating programs in these and related areas. (202-401-5176; ncavallaro@nifa.usda.gov)

**Rachel Melnick** is a National Program Leader directing competitive grant programs in the area of agroclimatology; the agency representative to the USDA Regional Climate hub's Executive Council; and USDA representative to the Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) interagency working group. (202-401-4980; rmelnick@nifa.usda.gov)

**Mazdak Arabi** is teaching and actively conducting research in the areas of water resources management and planning and environmental engineering. His research primarily focuses on the development of scientific approaches and decision support systems for sustainable environmental planning and management. For example, Dr. Arabi is interested in investigating the impact of anthropogenic activities, such as land use change, and agricultural practices on the integrity of environmental systems, especially watersheds. Currently, Dr Arabi is involved with several projects sponsored by the USDA, National Resources Conservation Service (NRCS), and NSF to develop stakeholder driven multi-criteria watershed management support systems with purpose of enhancing decision makers' capacity to evaluate a range of agricultural and environmental policy alternatives. (970-491-4639; Mazdak.Arabi@Colostate.edu)

**Matei Georgescu**'s research aims to improve understanding and characterization of distinct phenomena related to urbanization-induced landscape change. He focuses on identifying hydro-climatic and air quality impacts resulting from large-scale urbanization, as well as potential adaptation and mitigation strategies. In addition, Dr. Georgescu addresses the environmental consequences (e.g., on climate and hydrology) of renewable energy expansion by integrating physical, agricultural, and socioeconomic elements. The range of tools used to investigate these topics include: climate models,

remote sensing data and associated applications, and in situ weather/climate observations. (480-727-5986; Matei.Georgescu@asu.edu)

**Maureen McCarthy**, as Great Basin Program Director at the University of Nevada, Reno (UNR), coordinates transdisciplinary research and outreach programs with scientists, water and natural resource managers, and tribal communities in the Great Basin and American Southwest. She serves as Director of the Great Basin Cooperative Ecosystem Studies Unit and Chair of the Great Basin Landscape Conservation Cooperative Steering Committee. Dr. McCarthy is also Executive Director of the Tahoe Science Consortium, where she coordinates applied research and science-based decision-making in support of environmental management in the Lake Tahoe Basin. (775-784-8262; mimccarthy@unr.edu)

## S-C2 Managing Public Lands for Ecosystems Services in the Energy-Water Nexus

*(Ballroom E&F)*

This session will first reflect upon the Forest Service's first interpretations of how the evolving interplay between climate change, energy demand, and fire would become a dominant driver of future state and federal policies. Shifting from policy to implementation, the Pennsylvania Department of Natural Resources will discuss an ecosystem services approach to natural gas development on state lands. Finally, the USDA will reflect on the role of environmental markets as potential solutions to provide incentives for land stewardship and reduce the risk of natural catastrophe through water quality trading and investment in biomass production.

Moderator: Jonas Epstein, Economic Research Fellow, Oak Ridge Institute for Science and Education (ORISE), USDA Forest Service
Speakers:

- Christopher Hartley, Senior Environmental Markets Analyst, Office of Environmental Markets, U.S. Department of Agriculture
- Ellen Shultzabarger, Chief, Conservation Science and Ecological Resources, Pennsylvania Bureau of Forestry
- Al Steele, Physical Scientist, USDA Forest Service
- Julie Tucker, National Lead for Renewable Wood Energy, USDA Forest Service

**Jonas Epstein** works on the Forest Service's multiple-use mission which requires a more consistent economic evaluation of tradeoffs and management alternatives as natural resource issues become increasingly complex and integrated. Jonas' primary objective is to help provide national direction in accounting for ecosystem services in decision-making, performance metrics, communications, and development of environmental markets. (202-697-1055; jonaskepstein@fs.fed.us)

**Christopher Hartley** is responsible for the development of policy, tools, and metrics to support landowner participation in markets for ecosystem services. He surveys current efforts to promote the development of ecosystem service markets and to improve the scope, accuracy, and applicability of conservation programs. (202 690-0832; chartley@oce.usda.gov)

**Ellen Shultzabarger**'s work has focused on ecological management programs on 2.2 million acres of state forest lands as well as oversight of the state's natural heritage and wild plant programs. Her work has expanded over the past few years, with concentrations on energy development, conservation planning and threatened and endangered species policy and regulation. Prior to joining the Bureau of Forestry, Ellen worked for the MA Natural Heritage Endangered Species Program, Tufts University's environmental program and the National Wildlife Federation. (717-705-2817, eshultzaba@pa.gov)

**Al Steele**'s background includes degrees in forest management, engineering, and an MBA. Before joining the Forest Service, he worked for Maine's forest industries; a marketing research firm serving national and international clients; and as forest manager on 300,000 acres of tribal lands in Maine. Al worked for many years to encourage sustainable natural resource-based economic development. His portfolio has been broadened in recent years to generate expertise regarding the interactions between energy development, carbon issues, and the protection and management of forested landscapes. In his spare time, he seeks out and then propagates nearly lost varieties of apples across the U.S. (304-285-1588; asteele@fs.fed.us)

**Julie Tucker** has worked as an environmental engineering consultant and attorney for a diverse public and private sector clients. Julie advocates shifting our country toward more sustainable use of natural resources by advancing efficient technologies, stimulating markets that enhance ecological restoration, promoting institutional behavioral changes, and reshaping national policies. She served as a Peace Corps volunteer in Mali, West Africa before joining the U.S. Forest Service as a Presidential Management Fellow, where she has been promoting renewable wood energy since 2005. Julie holds degrees in engineering and law from North Carolina Central University. (202-253-6483; julietucker@fs.fed.us)

### S-C3 The Water-Energy Nexus: A Federal Perspective

*(Potomac Rooms III, IV)*

The world faces two significant, and sometimes opposing, challenges: (1) providing sustainable supplies of freshwater for human consumption, agricultural irrigation, and ecological needs; and (2) ensuring adequate sources of energy for current and future generations. Water is in greater demand to support the production of biofuels, power hydroelectric plants, and provide cooling water for the generation of electricity. Energy development also has the potential to affect the quality and quantity of water resources through the extraction of coal-bed methane, natural gas from shale deposits, and shale oil. This session focuses on the water-energy nexus which is defined as the relationship between how much water is necessary to produce fuels and energy, and how much energy it takes to collect, clean, move, store, and dispose of water. The water-energy nexus is of great concern to decision makers at all levels of government.

Moderator: Paul Young, Deputy Associate Director, Energy and Mineral Resources, U.S. Geological Survey
Speakers:

- Jerad Bales, Chief Scientist for Water, U.S. Geological Survey
- Robie Lewis, Program Manager, Crosscutting Research, Office of Advanced Fossil Technology Systems, U.S. Department of Energy
- Suzanne Van Drunick, National Program Director, Safe and Sustainable Water Resources Research Program, U.S. Environmental Protection Agency
- Valerie Reed, Senior Advisor for Bioenergy, U.S. Department of Agriculture
- David Raff, Science Advisor, Bureau of Reclamation, U.S. Department of the Interior

**Paul Young**'s role at the U.S. Geological Survey (USGS) is to help oversee energy and mineral research and resource assessments as well as environmental health studies, including water and biological contamination. He has experience training and mentoring others as part of the USGS Leadership Development Program and over a decade teaching geographic information science at the continuing education and graduate level in a university setting. Paul's experience outside the federal government includes seven years service as officer in a professional society and six years executive management on a non-profit Board of Directors, including three years as Chairman of the Board.

**Jerad Bales** is responsible for the planning and development of national basic and applied research programs related to the hydrologic environment at USGS. He also oversees and evaluates the results of research efforts conducted by universities under the mandates of the Water Resources Research Act of 1984; coordinates the USGS Hydrologic Research and Development Program and the Water Resources Research Institutes Program; and assists other USGS leaders with external national and international programs. Bales represents the USGS on a number of external committees, including as co-chair of the Subcommittee on Water Availability of the National Science and Technology Council. He was the Water Sector lead for the U.S. 2013 National Climate Assessment and is a member of many research coordinating and synthesis groups. (703-648-5044; jdbales@usgs.gov)

**Robie Lewis** is Program Manager for DOE's Crosscutting Research program within Fossil Energy's Office of Advanced Fossil Technology Systems. This office focuses on improving the efficiency of coal-based power systems, enabling affordable CO2 capture, increasing plant availability, and maintaining the highest environmental standards. The Crosscutting Research program supports various aspects within these fossil systems including Water Management, Sensors and Controls, Materials R&D and Computational Modeling. (301-903-6166, robie.lewis@hq.doe.gov)

**Suzanne van Drunick's** role at EPA is to oversee the Safe and Sustainable Water Resources research program, which uses an integrated, systems approach to develop scientific and technological solutions to protect human health, and to protect and restore watershed and aquatic ecosystems. Suzanne was the Associate Director for Science at the Cooperative Institute for Research in Environmental Sciences at the University of Colorado Boulder.

Dr. **Valerie Sarisky-Reed** is the Deputy Director for the **Bioenergy Technologies Office** (BETO) in the Office of Energy Efficiency and Renewable Energy (EERE) with DOE and is also on detail to the Office of the Chief Scientist within USDA as the Senior Advisor for Bioenergy. In her 22 years of Federal Service, Dr. Sarisky-Reed has dedicated her time to developing sound innovative technologies to reduce the cost of conversion of cellulosic biomass to biofuels and chemicals, as well as establishing the algal biofuels program currently active at DOE. Her work addresses energy and environmental issues faced by the United States and globally looking to find sustainable solutions. She holds a Ph.D. in biochemistry from Georgetown University. In addition to her programmatic activities, Dr. Sarisky-Reed is a founding member of the Metabolic Engineering Working Group, which is an interagency effort to advance metabolic engineering technologies for industrial, agricultural, and human needs.

**David Raff** is the Science Advisor for the Bureau of Reclamation and Scientific Integrity Officer. He overseas Reclamation's Research and Development Office which institutes the Science and Technology Program which focuses on conserving or expanding water supplies, environmental issues in water delivery and management, water and power infrastructure reliability, and water operations decision support. The office also manages the Desalination and Water Purification Program which supports lab to demonstration scale advanced water treatment technology research and development. David represents Reclamation on a number of national committees and was responsible for Reclamation's first report to Congress under the authorities of Public Law 111-11 Section 9503(c) the SECURE Water Act in 2011. (202-513-0516, draff@usbr.gov)

### S-C4 Food Waste: Managing a Solvable Problem at the Food-Water-Energy Nexus

*(Washington Room A)*

Up to 40 percent of the food produced in the United States is wasted, all while one in five Americans is unsure of where their next meal is going to come from. Food waste represents about 5 percent of all greenhouse gas emissions in the United States and 25 percent of all water use. The issue of food waste touches on many varied social and environmental issues and is tucked behind other banner issues—

climate change, sustainable agriculture, drought, hunger, and poverty. It is this interrelated complexity that has caused food waste to remain behind the scenes before receiving increased attention only recently. This symposium will look at the drivers of food waste and how we can all work better with one another to drive change.

Organizers: Joan Briggs, Executive Director, Betsy and Jesse Fink Foundation and Sarah Vared, Associate, MissionPoint Partners and ReFED
Moderator: Danielle Nierenberg, President, Food Tank
Speakers:

- JoAnne Berkenkamp, Senior Advocate, Food & Agriculture Program, Natural Resources Defense Council
- Cheryl Coleman, Director, Resource Conservation and Sustainability Division, U.S. Environmental Protection Agency
- Christy Cook, Director of Sustainability Performance and Field Support, Office of Sustainability and Corporate Responsibility, Sodexo North America
- Elise Golan, Director for Sustainable Development, U.S. Department of Agriculture

**Danielle Nierenberg** is an expert on sustainable agriculture and food issues. Danielle has spent several years traveling to more than sixty countries across sub-Saharan Africa, Asia, and Latin America, where she has met with farmers and farmers' groups, scientists and researchers, policymakers and government leaders, students and academics, along with journalists, documenting what's working to help alleviate hunger and poverty, while protecting the environment. (202-590-1037; Danielle@foodtank.com)

**JoAnne Berkenkamp** focuses on improving the efficiency of our food system at the national level, particularly through food waste prevention and food recovery. JoAnne has nearly two decades of experience in the food systems arena, including regional food systems development, consumer education, policy advocacy, institutional food procurement, and food supply chain research and development. Her work on food waste has been featured by *National Public Radio*, *Huffington Post*, TODAY.com/*CNBC News*, *CNET News*/*CBS Interactive* and the *San Francisco Chronicle*, among others. JoAnne holds a Master's degree in Public Policy from Harvard University. (612-618-3419; jberkenkamp@nrdc.org)

**Cheryl Coleman** is Director of the Resource Conservation and Sustainability Division (RCSD) of US EPA's Office of Resource Conservation and Recovery. RCSD implements EPA's Sustainable Materials Management (SMM) program, which promotes long-term sustainable management of materials. She is responsible for collaborative partnerships with stakeholders across the lifecycle of materials and for developing policy, guidance, and outreach materials on SMM. Ms. Coleman has twenty-eight years of experience with materials management. She came to U.S. EPA from the South Carolina Department of Health and Environmental Control, where she was Director of Compliance and Enforcement for waste programs and mining. She also served in leadership roles for the Association of State and Territorial Solid Waste Management Officials (ASTSWMO), including Secretary/Treasurer and Co-Chair of the Hazardous Waste Subcommittee.

**Christy Cook** is responsible for implementing sustainability and corporate responsibility practices throughout Sodexo's 9,000 partnerships in North America. This includes leading all sustainability training initiatives as well as creating the tools and resources needed to implement sustainability practices and the measurement of Sodexo's sustainability performance. This work helps Sodexo and its clients reduce greenhouse gas emissions and energy use; conserve water resources; minimize waste; and promote sustainable agriculture and community development. Christy co-leads Sodexo's global strategy on waste reduction efforts. (christy.cook@sodexo.com)

**Elise Golan** provides leadership to the USDA's various policies, programs, and activities that impact and relate to sustainable agricultural, natural resource, and community development including food security. Prior to this position, Elise served as the Associate Director of the Food Economics Division at the Economic Research Service of tbe USDA. Dr. Golan's research has spanned a wide range of sustainability issues, including land tenure and sustainable land management in the Sahel and West Africa; rice-straw burning and sustainable land management in California; regional and U.S. food-system modeling; food labeling and market development; food access, affordability, and security; and the distributional consequences of food policy.

## S-C5 Lessons from California and the West

*(Roosevelt Room)*

Droughts focus attention on water management and the challenges of maintaining urban water uses, ecosystems, and agricultural uses. Groundwater is being relied upon more, but groundwater aquifers are often finite and their levels are dropping in response to withdrawals. Throughout the western United States, irrigated agriculture uses 85 percent of all water. Water markets are transferring water to higher paying uses, but not on a large scale. Agricultural policies drive multiple aspects of western agriculture, and, in turn, western water use. Corn production, for example, is responsible for declining water levels in the Ogallala Aquifer, but federal support for this crop is a greater incentive than federal policies to protect this aquifer. This session will examine some of the approaches that have been used in western states and in other arid nations concerning irrigated agriculture

Moderators: Mekonnen Gebremichael, Associate Professor, Hydrology and Water Resources**,** University of California, Los Angeles and Solomon Demissie, Postdoctoral Scholar, University of California, Los Angeles and Assistant Professor of Water Resources Engineering and Management, Addis Ababa University
Speakers:

- James Famiglietti, Professor, Earth System Science and Civil and Environmental Engineering, University of California, Irvine; Senior Water Scientist, National Aeronautics and Space Administration Jet Propulsion Laboratory
- Denise Fort, Research Professor, University of New Mexico School of Law
- Steve Lindley, Director, Fisheries Ecology Division, National Oceanic and Atmospheric Administration Southwest Fisheries Science Center
- Brad Udall, Director and Senior Water and Climate Research Scientist, Colorado Water Institute

**Mekonnen Gebremichael** works on understanding and prediction of hydrological fluxes on a range of spatial and temporal scales, advancing the use of satellite observations for water resource applications, uncertainty analysis of hydrological estimations and forecasts, transboundary river basin management, water resource management and governance in developing countries, and impact of hydrological and climate changes on vector-borne diseases. Dr. Gebremichael recently organized a workshop which addressed the scientific, engineering, and data challenges and opportunities in understanding the coupled food-energy-water systems in California. (310-794-4239; mekonnen@seas.ucla.edu)

**James "Jay" Famiglietti** and his team have been researching and communicating about water and climate change in academics, in business, in government, and to the general public for over 25 years. He was appointed by Governor Jerry Brown to the California State Water Boards in Region 8. He was the Founding Director of the UC Center for Hydrologic Modeling at the University of California, Irvine (UCI). Before joining UCI in 2001, Jay was on the faculty of the Geological Sciences Department at the University of Texas at Austin, where he helped launch the program in climate and the UT Environmental Science Institute**.** (949-824-9434; jfamigli@uci.edu)

**Denise Fort** has grappled with the paradox of agriculture in the desert for a number of years in her work on western water policy. California's experience of severe drought led to renewed questions about the agricultural sector's use of water. She has acted as chair of the Western Water Policy Review Advisory Commission, Director of New Mexico's Environmental Improvement Division, an attorney with New Mexico Public Interest Research Group (PIRG) and Southwest Research and Information Center, Executive Director of Citizens for a Better Environment (CBE, CA), and member of the National Research Council's Water, Science, and Technology Board. Her research and publications address environmental law, water policy, river restoration, and climate policy. Denise was also Secretary of Finance and Administration for New Mexico and Assistant Attorney General in the Taxation and Revenue Department. (505-238-8539; fortde@law.unm.edu)

**Steve Lindley**'s research interests include population dynamics, ecosystem ecology, quantitative methods, and the linkages between physical and biological processes. His research with the National Marine Fisheries Service (NMFS) has focused on endangered anadromous fish such as Chinook salmon, steelhead, and green sturgeon. He chaired the technical recovery team for Chinook salmon and steelhead in California's Central Valley, has participated in numerous biological review teams to determine the conservation status of anadromous fishes, and led the investigation into the 2007-2009 collapse of the Chinook salmon fishery off California. (831-420-3921; steve.lindley@noaa.gov)

**Brad Udall** has extensive experience in water and climate policy issues, most recently as the director of the Getches-Wilkinson Center for Natural Resources, Energy, and the Environment and the Western Water Assessment at the University of Colorado, Boulder. He has authored numerous peer-reviewed publications on water management and climate change, which have been published by the federal government and major journals. He has researched water problems on all major Southwestern U.S. rivers, including the Rio Grande, Colorado, Sacramento-San Joaquin, and Klamath, and has spent six months in Australia studying their recent water reforms. (720-984-2723; bradley.udall@colostate.edu)

## S-C6 The Nexus in Cities: Measuring Impact and Exploring Solutions

*(Potomac Rooms I, II)*

More than two-thirds of the world's people will be living in cities by the year 2050, requiring basic amenities of food, energy, and water (FEW). At the global scale, FEW flows are noted to have large impacts on energy & greenhouse gas emissions, water sustainability, and public health. But little is known about how urban residents, city planners, and policymakers can shape the sustainability of FEW demand and supply to cities, which requires a trans-boundary urban systems perspective. This session will present: (1) emerging analytic tools to assess environmental sustainability and health impacts of the FEW nexus from an urban systems view; and (2) field experiences of urban planners, researchers, and practitioners to identify solutions offered by cities to enhance sustainability at the FEW nexus.

Moderators: Anu Ramaswami, Charles M. Denny Chair and Professor of Science Technology & Environmental Policy, Humphrey School of Public Affairs, University of Minnesota and Patricia Culligan, Professor, Civil Engineering and Engineering Mechanics, Columbia University
Speakers:

- Dana Boyer, PhD Candidate and Research Assistant, Humphrey School of Public Affairs, University of Minnesota
- Oliver Gao, Associate Professor, Civil and Environmental Engineering, Cornell University
- Debbie Goettel, Mayor, City of Richfield, Minnesota
- Joshua Newell, Assistant Professor of Natural Resources and the Environment, University of Michigan

- Timothy Smith, Professor of Bioproducts and Biosystems Engineering and Sustainable Systems Management and Director, NorthStar Initiative for Sustainable Enterprise at the Institute on the Environment, University of Minnesota

Dr. **Anu Ramaswami** is Charles M. Denny Chair Professor of Science Technology & Environmental Policy at the Humphrey School of Public Affairs, University of Minnesota. Her work is interdisciplinary, spanning areas of sustainable infrastructure, urban systems, environmental engineering, industrial ecology, public health & public affairs. She is lead PI on two NSF projects related to sustainability, Partnership in International Research and Education: "Developing Low-Carbon Cities in the USA, China & India through Inter-Disciplinary Integration Across Engineering, Environmental Sciences, Social Sciences & Public Health" and Sustainability Research Network: "Integrated Urban Infrastructure Solutions for Environmentally Sustainable, Healthy, and Livable Cities." Both are related to exploring sustainability at the Food-Energy-Water nexus. (303-523-8130; anu@umn.edu)

**Patricia Culligan** is a leader in the field of water resources and urban sustainability. Culligan has worked extensively with The Earth Institute's Urban Design Lab at Columbia University to explore novel, interdisciplinary solutions to the modern day challenges of urbanization, with a particular emphasis on the City of New York. Culligan is the director of a joint interdisciplinary Ph.D. program between Columbia Engineering and the Graduate School of Architecture, Planning, and Preservation that focuses on designs for future cities, including digital city scenarios. Her research group is active in investigating the opportunities for green infrastructure, social networks, and advanced measurement and sensing technologies to improve urban water, energy, and environmental management. (212-854-3154; pjc2104@columbia.edu)

**Dana Boyer** is pursuing a PhD in the area of Sustainable Cities at the University of Minnesota. Her research studies urban food systems in India and the United States and the systems' reliance on water and energy resources. The research works to assess both environmental resource impact of, and risk to, the urban food supply. The work also assesses how urban food system design interventions can mitigate potential supply risk and decrease water and energy resource intensity of food use. Before Minnesota, she earned a Master's in Engineering from the University of Cambridge and a Bachelor's in Environmental Engineering from the University of Connecticut.

**Oliver Gao** is an Associate Professor in the graduate fields of (1) Civil and Environmental Engineering (Transportation Systems Engineering); (2) Systems Engineering; (3) the Cornell Institute of Public Affairs (CIPA); and (4) Air Quality in Earth and Atmospheric Science at Cornell University. His research focuses on transportation systems, environment (especially air quality and climate change), energy, and sustainable development. He also studies sustainable food systems, quantifying and mitigating greenhouse gas emissions from food supply chains. Before joining Cornell, Gao was a quant in the mathematical and econometrical modeling division at the Rohatyn Group, LLG, a Wall Street hedge fund specializing in emerging markets. (607-254-8334; HG55@cornell.edu)

**Joshua Newell** is a broadly trained human-environment geographer, whose research focuses on questions related to urban sustainability, resource consumption, and environmental and social justice. Newell is the Principal Investigator of an NSF-funded workshop grant entitled "Scaling-up Urban Agriculture to Mitigate Food-Energy-Water Impacts." (jpnewell@umich.edu)

**Timothy Smith's** work focuses on policy and market adoption of technologies that enhance environmental performance, public and private governance of sustainability, and sustainability systems modeling in decision-making. Work directly related to the food-energy-water nexus includes the linking of econometric and bio-physical models of food value chains. Specifically, Smith's current work assesses environmental and economic impacts of spatially explicit grain, animal, and food waste flows across production-consumption systems. (612-624-6755; timsmith@umn.edu)

**S-C7 Connecting Education to Practice and the Workforce at the Nexus**
*(Conference Theater)*

This session will explore the diverse ways in which higher education can advance integrated food, energy, and water solutions. It will draw on examples in education and training programs at both two-year and four-year institutions, with regard to training young professionals to support communities and work with local organizations and businesses; campus sustainability; and support from the federal government for such activities.

Moderator: Laurie Ristino, Director, Center for Agriculture and Food Systems (CAFS) and Associate Professor, Vermont Law School
Speakers:

- Lifang Chiang, Research Strategies Manager, University of California Office of the President
- Robert Franco, Director of Institutional Effectiveness and Professor of Pacific Anthropology, Kapi'olani Community College, University of Hawaii
- Frank Niepold, Climate Education Coordinator, NOAA Climate Program Office
- Gayle Zydlewski, Associate Professor, School of Marine Sciences, University of Maine

**Laurie Ristino** is responsible for the Vermont Law School's (VLS's) Center for Agriculture and Food Systems (CAFS) vision and direction, including curriculum development, teaching, outreach, and advocacy. Professor Ristino is also the faculty advisor to VLS's Food and Agriculture Law Society. Before joining VLS, Professor Ristino was a senior counsel with the Office of the General Counsel, United States Department of Agriculture, where she also served in various administrative leadership capacities. (802-831-1230; lristino@vermontlaw.edu)

**Lifang Chiang** works to bring together diverse knowledge and resources at the University of California to tackle society's grand challenges, aiming to revolutionize understanding beyond currently existing knowledge paradigms. In service to the University's motto to "Teach for California; Research for the World," her responsibilities encompass: actively advising on teaching, learning, research, innovation, and public service engagements at ten campuses, three national laboratories, and an agricultural and natural services division; shaping research strategies, providing evidence-based analysis, and pooling intellectual talent to harness the unrivaled strengths of a world class, US $20B infrastructure; and working with campus constituencies and the public to ensure that our shared future will continue to be better than our past. (510-987-0623; lifang.chiang@ucop.edu)

**Robert Franco** is an ecological anthropologist who has published scholarly and policy research on the changing meaning of work, service, schooling, housing, and leadership for Samoans at home and abroad; health disparities confronting Samoan, Hawaiians, and Micronesians in the United States; the meaning and management of water in ancient Hawai'i; and factors affecting fishery sustainability in Samoa and the Northern Marianas. He has also published on community college reform efforts while Kapi'olani has emerged as a leader in community-based service and research for sustainable food, energy, and water resources. He leads a Teagle Foundation project to develop commitment to civic and moral responsibility for diverse, equitable, healthy, and sustainable communities, and serves on the Executive Board for NCSE's Community College Affiliate Program. (808-734-9514; bfranco@hawaii.edu)

**Frank Niepold** is a co-chair of the U.S. Global Change Research Program's Education Interagency Working Group, and the U.S. Climate Action Report Education, Training, and Outreach chapter lead. At NOAA, he develops and implements NOAA's climate goal education and outreach efforts. Additionally, he is the managing lead of the USGCRP document, "Climate Literacy: The Essential Principles of Climate Science." Frank is a founding member of the Climate Literacy and Energy Awareness Network (CLEAN)

and a co-developer of President Obama's Climate Action Plan's Climate Education and Literacy initiative. (240-429-0699; frank.niepold@noaa.gov; Twitter: @FrankNiepold)

**Gayle Zydlewski** studies the conservation of marine resources, focusing on fish populations. Dr. Zydlewski approaches this work from an interdisciplinary perspective, recognizing the need for input from natural and social sciences to reach conservation goals that balance human needs for food, energy, and water (FEW). She believes the points of intersection among coastal FEW systems, institutions, and disciplines can be used to link fundamental scientific knowledge to evidence-based decisions. Such linkages need to be incorporated in graduate training so the next generation can solve the developing problems of this nexus. Dr. Zydlewski works with others to involve key stakeholders in the center of research to infuse real-world experience in graduate education. (207-581-4365; gayle.zydlewski@maine.edu)

## S-C8 Considerations and Challenges Associated with a Vibrant Bioeconomy

*(Jefferson Room)*

Development of a vibrant bioeconomy provides a rational, transdisciplinary approach for addressing the 21st century Food, Energy, and Water Nexus by focusing on identifying, producing, recycling, converting, and using renewable aquatic and terrestrial biomass resources to produce biofuels, biochemicals, biopower, and a multitude of other bioproducts in an economically, environmentally, and socially sustainable manner. This symposium will provide a balanced perspective on the critical considerations and challenges. Presentations will examine the: (1) multiple approaches and pathways leading to a sustainable bioeconomy; (2) dimensions of sustainability and resource management influencing the bioeconomy and food security; (3) land use competition (is there enough arable land for meeting food, feed, fiber, and fuel needs?); and (4) examples of integrated systems.

Moderator: Donna Perla, Senior Advisor, U.S. Environmental Protection Agency
Speakers:

- Virginia Dale, Director, Center for BioEnergy Sustainability, Oak Ridge National Laboratory
- Stephen Kaffka, Director, California Biomass Collaborative and Extension Specialist, Department of Plant Sciences, University of California, Davis
- Douglas Karlen, Distinguished Senior Research Scientist, Agricultural Research Service, U.S. Department of Agriculture
- Bryce Stokes, Senior Advisor, CNJV/U.S. Department of Energy (Billion Ton Study)

**Donna Perla** has 32 years of EPA experience including sustainable development of biomass & waste-to-energy systems in the Office of Research & Development, where she led ORD's sustainable biofuels research strategy and co-led an EPA-wide Biofuels Strategy. As Division Director of EPA's Project XL Program she led regulatory flexibility/innovation for energy, water, and agricultural systems. She has worked closely with USDA & DOE as USDA's Senior Advisor for Bioenergy in the Chief Scientist's Office and as USDA Acting Director of the Financial Assistance Program Division in the Natural Resource Conservation Service. For the past ten years, she has represented EPA on the inter-agency Biomass R&D Board and currently works with the Farm, Ranch, and Rural Communities Committee in the EPA Administrator's Office with the Agricultural Counselor. (202-564-0184; donnaperla52@gmail.com)

Dr. **Virginia Dale** is Director of the Center for Bioenergy Sustainability at Oak Ridge National Lab. Her primary research interests are environmental decision making, land-use change, landscape ecology, sustainable agriculture, and bioenergy systems. Virginia has authored 10 books and more than 235 articles and served on national scientific advisory boards for five agencies of the United States. She has a B.A. and M.S. in math from the University of Tennessee and a PhD in mathematical ecology from the University of Washington. Her presentation builds from a workshop sponsored by the International Food Policy Research Institute (IFPRI) on “Biofuels and food security interactions” that defined key

issues and underscored the importance of clear definitions consistent terminology, and context-specific solutions. (865-576-8043; dalevh@ornl.gov)

**Stephen Kaffka** is Director of the California Biomass Collaborative and extension specialist in the Department of Plant Sciences at the University of California, Davis. He is also chair of the BioEnergy Work Group for the University of California's Division of Agriculture and Natural Resources. He participates on several advisory committees for the California Energy Commission and California Air Resources Board and has carried out research on water quality, agriculture, and the reuse of saline drainage water for crop, forage, energy biomass feed stocks and livestock production. He has M.S. and Ph.D. degrees from Cornell University in agronomy and a B.S. from the University of California at Santa Cruz in biology. He is a co-author of the chapter on Bioenergy and Food Security in the recent SCOPE book on "Bioenergy & Sustainability: Bridging the Gaps." (530-752-8108, srkaffka@ucdavis.edu)

Dr. **Douglas L. Karlen** uses soil quality assessment to quantify the effects of landscape position, tillage, crop rotation, and nutrient, manure, and crop residue removal on the sustainability of the food-energy-water nexus. He is a native of Wisconsin and has his BS, MS and PhD degrees from the University of Wisconsin–Madison, Michigan State University, and Kansas State University, respectively. Doug is author or co-author of 218 refereed journal articles; a Fellow of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, and the Soil and Water Conservation Society; and a 2015 recipient of the Hugh Hammond Bennett award for national and international leadership in natural resources conservation. (515-294-3336; Doug.Karlen@ars.usda.gov)

Dr. **Bryce Stokes** is a Senior Advisor for the U.S. Department of Energy(Billion Ton Study) with Allegheny Allegheny Science & Technology, a DOE contractor in Washington, DC. His education includes engineering and forestry degrees. Work experiences include forest industry, U.S. Forest Service research, and 6 years as an energy consultant. His forestry research focused on harvesting machine and system design and management; biomass recovery and utilization; reducing environmental impacts; and, developing specialty harvesting. Other activities were biomass production and assessment, carbon sequestration, climate change, and environmental quality such as soil carbon and structure, water, and biodiversity impacts. He has over 140 scientific and technical publications. He was one of the authors of the 2005 Billion ton Report and co-led the 2011 update. (202-586-6471; bryce.stokes@ee.doe.gov)

## S-C9 Measuring Natural Capital to Inform Policy and Management

*(Virginia Room)*

This symposium will introduce Natural Capital Accounting (NCA) focusing on the UN Statistical Commission's System of Environmental and Economic Accounts (SEEA) – Experimental Ecosystem Accounts (EEA). Presenters will show how the SEEA–EEA approach is being used to inform policy management and programmatic decisions. Case studies will draw from work addressing the food-energy-water nexus by the World Bank-Wealth Accounting and the Valuation of Ecosystem Services (WB-WAVES) partnership and Conservation International in Africa, Asia, the Americas, and Europe. The symposium will examine the use of various methodological approaches to quantify, map, and value ecosystem service stocks and flows and the development and application of decision-support tools designed to enhance the assessment, valuation, and communication of ecosystem services and their contribution to economies.

Moderator: John Matuszak, Senior Policy Advisor, Bureau of Oceans international Environmental and Scientific Affairs (OES), U.S. Department of State
Speakers

- Sofia Ahlroth, Senior Environmental Economist, The World Bank Group

- Ken Bagstad, Research Economist, Geosciences & Environmental Change Science Center, U.S. Geological Survey
- Glenn-Marie Lange, Senior Economist with the World Bank and Chief Technical Advisor for the Global Partnership for Wealth Accounting and Valuation of Ecosystem Services (WAVES)
- Rosimeiry Portela, Ecological Economist and Senior Director, Economics Team, Moore Center for Science and Oceans, Conservation International

**John Matuszak** provides leadership on environment and natural resource assessment and monitoring, as well as on the integration of environmental information with economic and social data for policy considerations. He is responsible for cooperation with the United Nations Environment Programme (UNEP) on the Science Policy Interface and represents the U.S. on the High Level Group advising on UNEP Global Environmental Outlook (GEO-6). John is the State Department representative to the U.S. Group on Earth Observation. He advises the State Department and U.S. Agencies on Natural Capital Accounting (NCA), supporting State Department and interagency efforts on NCA and the UN System of Economic and Environmental Accounts. (202-647-9278; matuszakjm@state.gov)

**Sofia Ahlroth** is part of the secretariat for Wealth Accounting and Valuation of Ecosystem Services (WAVES), a global partnership dedicated to mainstreaming Natural Capital Accounting into development planning, and is working with developing countries to build capacity and develop policy-relevant natural capital accounts. Dr. Alroth manages the Policy and Technical Experts Committee, as well as WAVES's interaction with private sector natural capital accounting. Previous to joining the World Bank, Sofia was head of the Environmental Economics unit at the Swedish EPA. (sahlroth@worldbank.org)

**Ken Bagstad** is a Senior Environmental Specialist seconded to the Wealth Accounting and Valuation of Ecosystem Services (WAVES) program. He is developing and testing ecosystem services models to inform national accounts in Africa and Latin America. Since 2010, Dr. Bagstad has worked with the U.S. Geological Survey (USGS) to account for nature's value in decision-making by U.S. federal government agencies. He has partnered with other agencies on ecosystem service assessments at sites across the U.S. For the last eight years Ken has also served as a lead modeler for the Artificial Intelligence for Ecosystem Services (ARIES) program, and has led the comparative analysis of ecosystem services using multiple other assessment tools. (kbagstad@worldbank.org)

**Glenn-Marie Lange** led the World Bank's new work to estimate Comprehensive Wealth Accounting, including natural capital, for 150+ countries from 1995 to 2014. Dr. Lange joined the World Bank in 2009, coming from the Earth Institute at Columbia University; from 1985 to 2004 she worked at the Institute for Economic Analysis at New York University. She is currently Chief Technical Advisor for the Global Partnership for Wealth Accounting and Valuation of Ecosystem Services (WAVES), which works in eight developing countries to mainstream natural capital accounting in development planning, based on the System of Environmental-Economic Accounting (SEEA): the Philippines, Indonesia, Madagascar, Botswana, Rwanda, Colombia, Costa Rica, and Guatemala. (glange1@worldbank.org)

**Rosimeiry Portela**'s research focuses primarily on nature's provision of ecosystem services and their contribution to the human economy and well-being. Her current research explores the integration of environmental-economic information into national accounting systems, as well as into business management and decision-making. She is co-Principal Investigator of Ecosystem Values and Accounting, a pilot research project on the implementation of experimental ecosystems accounting in Peru, and the lead of the Technical Group developing the Natural Capital Protocol, a framework for business to integrate natural capital information into business management and decision-making. (rportela@conservation.org)

**S-C10 Engineering Solutions for Food-Energy-Water Systems: It's More Than Engineering**
*(Washington Room B)*

This session is organized by the American Society of Agricultural and Biological Engineers (ASABE) to bring together engineering expertise for solving complex problems at the food-energy-water (FEW) nexus with physical, agricultural, and social scientists to focus on facilitating solutions that are technically and socially sound. One specific objective of the session is to provide the basis for creating a framework for facilitating collaboration among engineering practitioners, scientists, and policymakers, including defining the role of professional societies. The presentations by the distinguished panel of speakers and the subsequent discussion will form the basis for the initiation and deepening of partnerships among ASABE, the Soil Science Society of America (SSSA), and peer organizations, as well as among individual participants.

Moderator: Mary Leigh Wolfe, Head, Department of Biological Systems Engineering, Virginia Polytechnic Institute and State University and President, American Society of Agricultural and Biological Engineers
Speakers:

- James W. Jones, Director, Florida Climate Institute; Distinguished Service Professor Emeritus, Agricultural and Biological Engineering Department, University of Florida
- Andrew Sharpley, Distinguished Professor, Soils and Water Quality, University of Arkansas
- Norman Scott, Professor Emeritus, Biological and Environmental Engineering Department, Cornell University

**Mary Leigh Wolfe**'s research and teaching activities have focused on hydrologic modeling, nonpoint source pollution control strategies, and decision support tools for watershed management. She has also advanced engineering education through more than 20 years of leadership in the Accreditation Board for Engineering and Technology Inc., the accrediting organization for academic programs in engineering, engineering technology, applied science, and computing. (540-231-6615 mlwolfe@vt.edu)

**James W. Jones** works on models of crop production responses to soil, water, climate, and management and integration with economic models for evaluating climate risks, water requirements, and nutrient use efficiencies at field to global scales. Jones also conducts research aimed at incorporating gene-based components in crop models and on the development of harmonized networks of agricultural data for evaluating and improving crop models. He is Co-PI of the global Agricultural Model Intercomparison and Improvement Project (AgMIP). (352-392-1864 ext. 289; jimj@ufl.edu)

**Andrew Sharpley** is Distinguished Professor of Soils and Water Quality with the University of Arkansas. His research investigates nutrient cycling of in-soil plant-water systems in relation to agricultural production and water quality, including the management of manures, fertilizers, and crop residues, as a critical part of the food-energy-water nexus and security. He also evaluates the role of stream and river sediments in modifying the amounts and forms of nutrients transported to lakes and reservoirs. He works closely with producers, farmers, and action agencies, stressing the dissemination and application of his research, and is leading an on-farm program to show the benefits of conservation practices that protect water quality and promote sustainability of farming systems. (479-575-5721; sharpley@uark.edu)

**Norman Scott** is interested in the exploration of how convergence can be adopted and applied within the agriculture, food, and natural resources systems (AFNS) to address the FEWS nexus. Specifically, Scott believes that we need to create teams that address the complex problems of AFNS with approaches of convergence through emerging platforms of nanotechnology, biotechnology, information science, and cognitive science. Scott is also interested in developing sustainable communities in the context of today's depressed economies, aging infrastructure, shifting demographics, environmental stresses, changing climate, and uncertain energy prices and availability. A key to meeting these challenges is integration of a system-based approach to address food, water, energy, wastes, buildings, economic development, transportation, urban design, and community governance. (607-351-3147; nrs5@cornell.edu)

## **World Cafés Round 1** (Wednesday 2:00 p.m. – 3:30 p.m.)

**WC-1 Models, Metrics and Data**
*(Washington Room A)*

Models are simplified representations of the real world as well as tools to guide decision-making. Data, both socioeconomic and biophysical, are what we measure occurring in the real world. Matching data to models is crucial if we are to understand the criticalities of the food-energy-water nexus and the conditions in which technologies, policies, or management practices can create increased resilience, efficiency, and/or sustainability. This session will explore issues such as: choosing models that reflect the actions we should take to achieve desired future conditions; collecting data which reflects our values in terms of what we choose to model; and developing models which replicate the data we collect.

Moderator: Michael Carbajales-Dale, Assistant Professor, Clemson University
Speakers:

- Brian D. Fath, Professor, Department of Biological Sciences, Towson University
- Günther Fischer, Senior Researcher, Food and Water Thematic Area, International Institute for Applied Systems Analysis (IIASA)
- Elke Hodson, Policy Analyst, Office of Climate, Environment, and Efficiency, Office of Energy Policy and Systems Analysis, U.S. Department of Energy
- Carey King, Assistant Director, Energy Institute, University of Texas at Austin
- Robin Newmark, Associate Laboratory Director, Energy Analysis and Decision Support, National Renewable Energy Laboratory
- Laixiang Sun, Professor, Department of Geographical Sciences, University of Maryland
- Quanyan Zhu, Assistant Professor, New York University
- David Brown, Fellow, Advanced Research Projects Agency – Energy (ARPA-E), U.S. Department of Energy

**Michael Carbajales-Dale** heads the Energy-Economy-Environment (E3) Systems Analysis group. He joined Clemson University in August 2014 as an Assistant Professor in the Environmental Engineering & Earth Sciences department. Before joining Clemson, Mik was an Energy Systems Analyst with Stanford's Environmental Assessment & Optimization Lab and with the Global Climate & Energy Project (GCEP). His research focuses on the long-term, large-scale evolution and dynamics of the energy-economy system, especially how development of energy resources affects social development and the effects of a future transition from fossil fuels to renewable energy sources. (864-656-0523; madale@clemson.edu)

**Brian D. Fath** is Professor in the Department of Biological Sciences at Towson University and a Research Scholar within the Advanced Systems Analysis Program at the International Institute for Applied Systems Analysis in Laxenburg, Austria. His research is in the area of systems ecology and network analysis applied to the sustainability and resilience of socio-ecological systems. He has published more than 130 research papers, reports, and book chapters; co-authored three books; and is Associate Editor-in-Chief for *Encyclopedia of Ecology*. He is also Editor-in-Chief for the journal *Ecological Modelling*; President of the North American Chapter of International Society for Ecological Modelling; Chair of the Ecosystem Dynamics Focus Research Group in the Community Surface Modeling Dynamics System; and member and past Chair of Baltimore County Commission on Environmental Quality. (410-704-2535; bfath@towson.edu)

**Günther Fischer** is an expert in mathematical modeling of ecological-economic systems, econometrics, optimization, applied multi-criteria decision analysis, integrated systems and policy analysis, spatial agro-ecosystems modeling, and climate change impacts and adaptation. Professor Fischer helped develop the International Institute for Applied Systems Analysis's (IIASA's) world food systems. He is collaborating with the United Nations Food and Agriculture Organization and has contributed to many

major UN studies, including Climate Change and Agricultural Vulnerability. In recent years, he has been conducting regional land use systems studies for policy support. (+43(0) 2236807292; fisher@iiasa.ac.at)

**Elke Hodson** is a policy analyst in the Office of Energy Policy and Systems Analysis at the U.S. Department of Energy (DOE). Elke has led a diverse portfolio of activities at the DOE, including energy modeling for the Quadrennial Energy Review, Clean Power Plan, and the Paris Agreement; strategies for reducing methane emissions from natural gas systems, and long- and short-term strategies and analysis to achieve U.S. goals for economy-wide greenhouse gas mitigation. Before joining DOE in 2011 as an AAAS Science & Technology Policy Fellow, she was a postdoctoral researcher at the Swiss Federal Research Institute WSL. Elke graduated from the Massachusetts Institute of Technology in 2008 with a Ph.D. in climate physics and chemistry. (202-586-3622; Elke.Hodson@hq.doe.gov)

**Carey W. King** performs interdisciplinary research related to how energy systems interact within the economy and environment as well as how our policy and social systems can make decisions and tradeoffs among these often competing factors. The past performance of our energy systems is no guarantee of future returns, yet we must understand the development of past energy systems. Dr. King's research goals center on rigorous interpretations of the past to determine the most probable future energy pathways. (512-471-5468; careyking@mail.utexas.edu; Twitter: @CareyWKing)

**Robin Newmark** leads the National Renewable Energy Laboratory's organization that develops analytic insights and information to inform energy systems policy and investment decisions, both domestically and internationally. Leading or contributing to programs involving energy, water and climate issues, she also advises such diverse groups as the U.S. – China Expert Carbon Capture and Sequestration (CCS) Steering Committee, the Union of Concerned Scientists and the national laboratory Energy-Water Nexus consortium, is on the editorial board for Current Sustainable/Renewable Energy Reports (Springer) and a guest editor for Environmental Research Letters. (Robin.Newmark@nrel.gov)

**Laixiang Sun** has produced more than 120 research publications in environmental sciences and management, regional sciences and regional economics, integrated modelling, and ecological economics. He has been a leading scientist in a number of research projects sponsored by the EU; the British Academy, the Royal Academy of Engineering, and the Royal Society in the UK; and the Chinese Academy of Sciences and National Natural Sciences Foundation of China. (301-405-8131; lsun123@umd.edu)

**Quanyan Zhu**'s work focuses on network models that provide a formal representation of interdependency relationships among different components, allowing quantitative methods for impacts and resilient infrastructure design. These models capture relationships and pathways through which indirect impacts of disruptions ripple through society and economies. Meta-network models are given, capturing physical, cyber and human interconnections in individual infrastructures and across multiple critical infrastructures. Effects on outcomes of prototypical disastrous events are assessed. (646-997-3371; quanyan.zhu@nyu.edu)

Dr. **David Brown** currently serves as an ARPA-E Fellow, where he works on developing new research programs. His particular focus is on the acceleration of agricultural breeding viaautomated, predictive and systems-level approaches: for improved biomass yield via the new TERRA program and for improved crop ecosystem impact and soil carbon sequestration via a forthcoming solicitation. The development of data analysis linkages and model representations between phenotypes, genotypes, and the environment is essential to realizing these goals. Prior to joining APRA-E, Dr. Brown was a Resnick Sustainability Institute Fellow at the California Institute of technology, where he developed novel thermoelectric materials. (David.R.Brown@hq.doe.gov)

**WC-2 Integrating Food-Energy-Water Systems across Space and Time**
*(Prince William Room)*

*Additional organizers: Erica Smithwick, Pennsylvania State University and Rhonda Kranz, Sustainable Water Resources Roundtable (SWRR) and Kranz Consulting*

Food-energy-water systems are connected both within and among regions as well as across different timescales. Yet as we continue to face increasingly complex problems there is limited acknowledgement of these cross-scalar interactions. As a result, narrowly focused attention on within-region dynamics alone miss critical dynamics of feedbacks that lead to unintended consequences (a.k.a. adverse outcomes). Critically, recognition of these dynamics locally and over short timescales is insufficient to understanding longer term responses. Our session will use case studies of energy, nutrient, food, and water systems to explore the most important flows, agents, causes, and effects of these resources, and explore emerging frontiers for sustainable policy at multiple spatial and temporal scales.

Moderator: Tom Richard, Professor, Agricultural and Biological Engineering and Director, Institute for Energy and the Environment, Pennsylvania State University
Speakers

- Inés del Valle Asis, Senior Research Professor, Universidad Nacional de Córdoba
- William Ball, Executive Director, Chesapeake Research Consortium
- Erica Brand, Director, California Energy Program, The Nature Conservancy
- Jean Brennan, Coordinator and Senior Scientist, Appalachian Landscape Conservation Consortium
- Charles Curtin, Researcher, Resources and Environmental Policy, University of Montana
- T. Brady Halligan, Director of Strategic Partnerships and Enrollment, The Green Program
- Larry Kapustka, Senior Ecologist and Senior Ecotoxicologist, LK Consultancy
- Ron McCormick, Ecologist, Bureau of Land Management

Dr. **Tom Richard** is a Professor of Agricultural and Biological Engineering and Director of Penn State's Institutes for Energy and the Environment. His research and teaching focuses on the intersection of agriculture and the environment, investigating the impacts of crop, livestock, and biomass energy systems on carbon and nutrient cycling, soil and water quality, energy use, and greenhouse gas emissions. His recent work attempts to illuminate the ethical choices implicit in framing system boundaries with respect to space (air, water) and time (soil, forests, climate). Tom received a B.S. from the University of California at Berkeley, an M.S. and Ph.D. from Cornell University, and is a Fellow and Past President of the Institute of Biological Engineering. (814-865-3722; trichard@psu.edu)

**Inés del Valle Asis** is an expert in business and environmental economics. She is currently leads a research program on Integrated Management of the Water Resources Research Institute and works on projects related to Resource Economics and Environmental Economics. She has published textbooks of General Economics and Business Economics and contributed to book chapters on issues related to their specialty. In the private sector, she has been involved in capital budgeting and advising businesses in Cordoba Province. (iasis@eco.unc.edu.ar)

**William (Bill) Ball** (P.E., Ph.D.) has been Executive Director of the Chesapeake Research Consortium (CRC) since January 2015 and is a Professor within the Department of Geography and Environmental Engineering at Johns Hopkins University. Bill has over 30 years of experience investigating physical-chemical processes controlling water quality, as related to both natural aquatic systems and engineered processes, and is currently Director of a multi-university project under NSF's Water, Sustainability and Climate program that focuses on linking changing agricultural practices with water quality impacts to Chesapeake Bay. In his position with the CRC, Bill is excited to help foster collaborative research and integrate science among the many federal, state, academic, and other non-governmental organizations involved in the Chesapeake Bay Program partnership. (410-798-1283; ballw@si.edu)

**Erica Brand** serves as Director of the California Energy Program at The Nature Conservancy. In this role, she leads a team that works to integrate the protection of nature into planning for California's clean energy future and find solutions for facilitating this transition in a manner that protects important natural resources and ecosystems. Prior to joining The Nature Conservancy, she served as a Senior Environmental Policy Specialist at Pacific Gas & Electric Company, and has spent 12 years in the energy and environmental sector. Erica holds an M.S. degree in Environmental Management from the University of San Francisco, and a B.S. degree in Biological Sciences from Cal Poly, San Luis Obispo.

**Jean Brennan** is Coordinator and Senior Scientist for Appalachian Landscape Conservation Cooperative (LCC). LCCs are part of a national conservation network established by the Department of the Interior in 2009. The Appalachian LLC covers parts of fifteen States: New York to Alabama, Illinois to Virginia. LCCs forge strategic collaborative science-management partnerships among individuals and organizations to achieved shared goals. Such partnerships are intended to promote innovative, practical, landscape-level strategies for managing large-scale impacts on natural systems due to climate and land-use changes such as agricultural land conversion and energy development. Brennan holds a PhD in Population Biology and Genetics from the University of Tennessee, an MFS in Forest Ecology from Yale University, and a Msc in Anthropology from the University of Pennsylvania. (540-553-4337; jean_brennan@fws.gov)

**Charles Curtin** is a researcher and practitioner who works at the nexus of science and policy, with a long-term interest in environmental change, large-scale experiments, and conservation design. Though working in a diversity of arenas, the bulk of his work has focused on near shore marine systems in the Gulf of Maine and rangelands in the U.S., Mexico, East Africa, and the Middle East with a focus on applying complex systems theory and resilience science to developing place-based, community-driven science and conservation. This work is highlighted in a recent book from Island Press entitled *The Science of Open Spaces*. He holds a PhD. in Zoology and Master's in Land Resources, both from the University of Wisconsin–Madison. (505-429-3601; ccurtin@earthlink.net)

**T. Brady Halligan**, a 2012 graduate from Rutgers University with a degree in Environmental Policy, has since successfully completed the Strategic Design MBA from Philadelphia University. Brady helped launch The GREEN Program (TGP), a short-term, SDG-focused, career & entrepreneurial abroad program provider. With opportunities in Iceland, Peru, and Philadelphia, these programs are geared toward student leaders and young professionals passionate about climate action. The mission is to inspire and connect these thought leaders through hands-on, experiential learning opportunities. The aim is to help populate the workforce with qualified leaders determined to create solutions. Six years later, TGP has more than 1,600 GREEN Alumni spanning across 450+ universities globally and is commitment partner with the U.N. Sustainable Development Solutions Network.

Dr. **Larry Kapustka** works at the interface of ecological risk assessment policies and practices from a holistic perspective and incorporates ecosystem services endpoints as a way to foster dialogue pertaining to sustainability. In this regard, he sees an urgent need to consider the interactions that occur and to work to avoid addressing single issues. For example, addressing food needs without considering the total energy and water consequences creates more problems than it solves, and the same goes for each of the other topics. (403-354-2468; kapustka@xplornet.com)

**Ron McCormick** approaches problems in ecology and sustainability from a complex systems perspective, and uses technology in combination with extensive consulting experience to produce unique, adaptive solutions. His current interests include the use of hierarchy theory in assessing and solving problems by taking equity, economics, and ecology into account and developing adaptive systems to support and implement management decisions. (202-912-7135; rmccormi@blm.gov)

**WC-3 Innovative Partnerships for Decision-making at the Nexus**
*(Conference Theater)*

This session will focus on how business and government deal with the food-energy-water nexus. Discussion will focus on what partnerships we need to address these nexus issues. Looking ahead, we will also discuss what innovations in science and/or policy are needed for success in dealing with the nexus. Speakers are drawn from both government and business.

Moderator: Alan Hecht, Director for Sustainable Development, Office of Research and Development, U.S. Environmental Protection Agency
Speakers:

- Diana Bauer, Director, Office of Energy Systems Analysis, U.S. Department of Energy
- Rich Berkland, Vice President, Valmont Industries
- Arthur Cotton, Program Manager, Energy Research & Development, GE Global Research
- Christopher Lindsay, Government Relations, International Association of Plumbing and Mechanical Officials (IAPMO) Group
- Tim Prewitt, CEO, International Development Enterprise (iDE)
- Robert J. Rose, Office of Water, Policy Office, U.S. Environmental Protection Agency

Summarizer: Chuck Chaitovitz, Principal, U.S. Water Partnership and Principal, Global Environment and Technology Foundation (GETF)

**Alan Hecht,** a recipient of the Presidential Rank Award for Meritorious Service, is Director for Sustainable Development in the Office of Research and Development (ORD) at the U.S. Environmental Protection Agency (EPA). Since 2003 he has actively advanced the concept of systems science and sustainability within the EPA and with business leaders. Now he is working on advancing tools and approaches to reflect the nexus of air, water, and land. On detail to the White House, he was Associate Director for Sustainable Development at the Council on Environmental Quality from 2002 to 2003 and Director of International Environmental Affairs for the National Security Council from 2001 to 2002, where he served as White House coordinator for preparations for the World Summit on Sustainable Development. Dr. Hecht has a PhD in geology and geochemistry from Case Western Reserve University.

**Diana Bauer** led a 2014 DOE report on challenges and opportunities in the energy-water nexus. Since issuing a 2014 report on challenges and opportunities in the energy-water nexus, the DOE has been identifying ways we can work together with partners to: (1) reduce vulnerability and improve reliability of water-dependent energy systems by increasing water efficiency, identifying substitutes, and expanding available water resources via improving water treatment; (2) reduce the energy footprint of water systems by increasing efficiency and extracting energy; and (3) identify productive synergies between water and energy systems. Work in the energy-water nexus relates to several dimensions of DOE's mission, including addressing climate change, energy security, and life cycle environmental responsibility.

**Rich Berkland** is Vice President at Valmont Industries, which partners with the U.S. Water Partnership (USWP) alongside International Development Enterprise (iDE). They are creating unique partnerships that promote development outcomes through collaborative efforts and innovations impacting the food-water nexus. Berkland and Prewitt (see above) will briefly outline the trends, current challenges, and opportunities for promotion of sustainable agriculture, water resources management, and value chain engagement in the developing world. In addition to setting this context, these panelists will introduce their projects and technologies aimed to alleviate the pressure that smallholder farmers currently face with improving production beyond subsistence.

**Arthur 'Chip' Cotton** is Program Manager for Energy Research & Development at GE Global Research, which provides innovative technology for all of GE's businesses. This includes merging physical and digital characteristics of sustainable energy and water solutions, efficient turbines and a resilient

electrical grid—creating a new frontier in resource productivity. Over the past decade, GE has invested more than $15 billion in R&D. By the end of 2014, GE had generated more than $200 billion in revenue and reduced its greenhouse gas emissions by 31 percent compared to its 2004 baseline, and water use by 42 percent as compared to the 2006 baseline. GE is committed to public-private partnerships.

**Christopher Lindsay** is the Manager of Government Relations at the International Association of Plumbing and Mechanical Officials (IAPMO) Group, which helps cities address energy-water nexus issues at the community level through appropriate levels of regulation and enforcement. In 2015, the IAPMO Group partnered with the U.S. Chamber of Commerce Foundation to create an Energy-Water Nexus Toolkit designed to help corporate leaders identify best practices in overcoming nexus challenges—solutions that can translate into real cost savings, greater profits, and positive environmental impacts.

**Tim Prewitt** is the CEO at International Development Enterprise (iDE), which partners with the U.S. Water Partnership (USWP) alongside Valmont Industries. IDE views productive water as the entry point to creating income opportunities for 900 million small scale farmers in Africa, Asia and Latin America. For many of them, access to irrigation water provides a substantial productivity gain and increase in food production. iDE identifies locations where improved access to water can have a positive impact, and then offer affordable technologies for lifting, storing, and distributing that water. IDE also looks for ways to reduce on-farm costs and increase margins available from market access and post harvest activities. Mr. Prewitt has worked in more than 15 countries in Asia, Africa, and the Middle East, for the Soros Foundation, UNESCO European Center for Higher Education, the New American School Development Corporation, as well as for private equity investors in China.

**Robert Rose** serves in the Office of Water, Policy Office of the U.S. Environmental Protection Agency (EPA), which is directly engaged in energy-water issues through many programs. ENERGY STAR and WaterSense respectively address end-user energy and water consumption. Long-standing grants and loans may be used to recover energy and nutrients from municipal wastewater plants. Tools, resources, and training are promoted to make drinking water and water plants more energy efficient. As a core mission, rules and regulations address the energy sector's impact on water use and quality. Also, community grants and multi-agency programs exist to help revitalize urban waters and the communities that surround them. These and other activities, along with working relationships with federal and local stakeholders, will be discussed.

**Chuck Chaitovitz** is a Principal at the Global Environment & Technology Foundation, Chuck helped facilitate the launch, management and growth of the U.S. Water Partnership – a public-private partnership of more than 109 U.S. private sector, government and civil society organizations to mobilize the "best" of U.S. expertise, ingenuity and resources to address global water challenges. He will lead a panel of public and private stakeholders on the importance of cross-sector collaboration and knowledge sharing, through platforms such as H2inf0, to advance towards our common goal of sustainable agriculture and improved water management for smallholder farmers at home and worldwide. (703-379-2713, chuck@getf.org)

### WC-4 Future Challenges and Solutions at the Water-Agriculture Nexus (Part 1)
*(Potomac Rooms V, VI)*

Agricultural irrigation is vital to food production in many parts of the globe and is a critical tool for ensuring food security. Irrigation serves both to reduce risk of crop loss and to build resiliency and yield stability in food production systems. Irrigated agriculture provides 40 percent of the world's food while being used on only 18 percent of the cultivated land. The United Nations Food and Agricultural Organization estimates that the world currently consumes about 70 percent of available fresh water for

irrigation. Significant improvements in agricultural water use efficiency, leading to more crop per drop, must be a high priority across multiple disciplines of science in order to achieve sustainability. This session examines a variety of unique partnerships, initiatives, and technologies which address this issue.

Moderator: George Vellidis, Professor, Crop and Soil Science Department, University of Georgia
Speakers:

- Rick Cruse, Professor of Agronomy, Iowa State University; Director, Iowa Water Center; and President, National Institutes for Water Resources
- Casey Cox, Executive Director, Flint River Soil and Water Conservation District
- Dan Devlin, Director, Kansas Center for Agricultural Resources and the Environment, Kansas Water Resources Institute, Kansas State University
- Jonathan Radtke, Water Sustainability Program Director, Coca-Cola North America
- George Vellidis, Professor, Crop and Soil Science Department, University of Georgia

Dr. **George Vellidis** applies principles of engineering and science to measure, model, and manage the interaction between agricultural production systems and the environment. Under this umbrella, he has developed two areas of emphasis—water resources and precision agriculture. Often these two areas blend. In this presentation he will discuss his partnership with the Flint River Soil & Water Conservation District and how they are working together to develop technological solutions to improve irrigation water use efficiency. The solutions include dynamic control of variable rate-enabled center pivot irrigation systems with embedded low-cost wireless soil moisture sensors. He will present a case study from the Lower Flint River Basin of Georgia. (229-402-1278; yiorgos@uga.edu)

**Rick Cruse's** research program focuses on quantifying real-time soil erosion rates across the Midwest and its impact on crop yields. Additional efforts address soil erosion and water runoff impacts on water quality as well as soil management impacts on these environmental parameters. (515-294-7850; rmc@iastate.edu)

**Casey Cox** is the Executive Director of the Flint River Soil and Water Conservation District (SWCD). In this role, she manages the Flint River Partnership, an agricultural water conservation initiative formed by the Flint River SWCD, USDA Natural Resources Conservation Service, and The Nature Conservancy of Georgia. Located in southwest Georgia, the Flint River Partnership's primary objective is to strike a balance between the unique biodiversity of the Lower Flint River Basin and the region's multi-billion dollar, irrigation-driven agricultural economy. Working with a diverse team of partners ranging from universities to corporations, the Flint River Partnership has secured millions of dollars to implement conservation-driven technology on hundreds of thousands of acres in the region through pilot projects and special Farm Bill Programs.

Dr. **Daniel Devlin** is a professor of agronomy and currently serves as the Director of the Kansas Center for Agricultural Resources and the Environment at the Kansas Water Resources Institute at Kansas State University. In his current position, his responsibilities include coordinating and enhancing research, extension, and teaching initiatives pertaining to new and emerging environmental issues from an agricultural perspective. He has responsibility for water quality and quantity programs as well as other environmental concerns, such as climate change, soil fertility, irrigation, watershed management, and interactions with state and federal agencies. Devlin is a native of Smith County, Kansas and has a BS and MS in from Kansas State University and a PhD from Washington State University. (785-532-9351; ddevlin@ksu.edu)

**Jonathan Radtke** is the Water Resource Sustainability Director for Coca-Cola North America in Atlanta, GA. In this role, he manages the company's water stewardship program, which focuses on water conservation initiatives within manufacturing facilities, source water protection strategies, community water partnerships and sustainable agriculture initiatives within the supply chain. The company aims to

return to nature and to communities an amount of water equivalent to the water used in Coca-Cola's beverages and their production. Mr. Radtke's leadership has helped position Coca-Cola as an industry leader in water stewardship.

**WC-5 Solutions to Energy-Water Conflicts (Part 1)**
*(Kennedy Room)*

Water and energy networks are inextricably linked. Energy production and electricity generation both require water. Conversely, distributing water to consumers and wastewater treatment depends on energy. The global population is projected reach 9 billion by 2050, increasing demands on water and energy networks. New paradigms are therefore needed for increased usage efficiencies to optimize the provision of energy and water supplies for future generations. The focus of this world café will be water and energy interdependencies, together with cost-effective and innovative solutions for the sustainable management of both.

Moderator: Kenneth Reardon, Professor, Department of Chemical and Biological Engineering, Colorado State University
Speakers:

- Hector Bravo, Professor, University of Wisconsin-Milwaukee
- Kenneth Carlson, Professor of Civil and Environmental Engineering, Colorado State University
- Junhong Chen, Director, Industry-University Cooperative Research Center on Water Equipment and Policy and Professor of Mechanical Engineering, University of Wisconsin-Milwaukee; Regent Scholar, University of Wisconsin-System
- Jennifer Cherrier, Professor, Department of Earth & Environmental Sciences, Brooklyn College of the City University of New York; President and Founder, Waterway Ecologics
- Yehuda Klein, Professor and Chair of Economics, Brooklyn College of the City University of New York
- Adel Nasiri, Associate Dean for Research and Director, Center for Sustainable Electrical Energy Systems, College of Engineering and Applied Sciences, University of Wisconsin-Milwaukee
- Alan Perlstein, Executive Director and CEO, Mid-West Energy Research Consortium
- Jose Pillich, City University of New York Graduate Center and Fellow, National Oceanic and Atmospheric Administration-Cooperative Remote Sensing Science and Technology (NOAA-CREST)
- Ashwin Dhanasekar, Assistant Director, Center for Energy Water Sustainability, Colorado State University

**Kenneth Reardon** is a professor in the Department of Chemical and Biological Engineering at Colorado State University and am involved in several interdisciplinary educational and research activities. Most of his current research is in the area of bioenergy and biomass-derived chemicals, always with non-food biomass and oriented toward improving the water footprint and overall process economics. A specific focus is on algal biotechnology, since algae can be grown on non-arable land and can produce fuels, chemicals, and protein. He has also designed sustainable energy courses and a minor, and was the PI of an NSF IGERT program in bioenergy.

**Hector Bravo** is a Professor at the University of Wisconsin-Milwaukee focusing on conflicts between energy production and water uses. Thermoelectric powerplants withdraw water from rivers or lakes to cool down their units and return warmer water. The temperature increase can produce changes in the

habitat, affecting the aquatic biota. Hydropower is a clear example of the energy production-water use nexus. Conflicts result from construction of dams and reservoirs that change surface and groundwater flows and heat and pollutant fluxes, prevent navigation and fish migration, and induce accumulation of sediments. Bravo has worked on incorporating environmental criteria in the operation of thermoelectric power plants, and on retrofitting dams for hydropower. (414-229-6756; hrbravo@uwm.edu)

Dr. **Kenneth Carlson** is Professor of Civil and Environmental Engineering at Colorado State University with over 25 years of experience in water related issues. He is director of the Center for Energy Water Sustainability and in this role directs research related to optimizing how water is best utilized in the oil and gas industry. Current projects include reducing the cost of recycle treatment technologies, real-time ground water monitoring, optimizing recycled water quality interactions with frac fluids and understanding the most efficient approach for water management (recycling, disposal, hybrids). He has a BS in chemical engineering from the University of Wisconsin, MS in Civil Engineering from Colorado State University and a PhD in Environmental Engineering from the University of Colorado – Boulder. (970-491-8336, kcarlson@engr.colostate.edu)

**Junhong Chen** heads the Industry-University Cooperative Research Center (I/UCRC) on Water Equipment and Policy supported by the U.S. National Science Foundation and water-based industrial partners. Chen is also the founder of NanoAffix Science, LLC. Dr. Chen's research focuses on novel nanomaterials for sustainable energy and environment. In particular, he is developing real-time sensors that can enable continuous monitoring of various chemical and biological species in water relevant to the energy-water nexus. Dr. Chen is also a Distinguished University Professor, a Professor of Materials Science and Engineering, and an Excellence in Engineering Faculty Fellow in Nanotechnology at the University of Wisconsin-Milwaukee. (414-229-2615; jhchen@uwm.edu)

**Jennifer Cherrier**'s 26 years of research experience are in aquatic carbon and nitrogen cycling and flux with a more recent focus on water resource sustainability and ecosystem-based approaches for offsetting the human impacts on aquatic systems. Jennifer's research group has developed a novel and cost effective 'blue' technology (eco-WEIR, patent pending) that augments green infrastructure to maximize stormwater runoff-related pollutant removal and also allows for water storage and reuse. She is a Leopold Leadership Fellow for Sustainability as well as a National Academy of Sciences Frontiers of Science Kalvi Fellow. (jennifer.cherrier18@brooklyn.cuny.edu)

**Yehuda Klein** teaches courses in statistics, ecological economics, and urban sustainability. His research interests include environmental economics and policy, regulatory economics, and applied econometrics. His current research projects address issues related to sustainability and resilience at urban and regional scales. He is currently investigating the impact of green infrastructure on neighborhood and urban electric grids, on the wastewater system, and on urban micro climates. (718-951-5153; yklein@brooklyn.cuny.edu)

**Adel Nasiri**'s research interests are renewable energy interfaces, energy storage, and microgrids. Dr. Nasiri has conducted many sponsored research projects in these fields and published numerous technical journal and conference papers and patents on related topics. Nasiri is currently an Editor of IEEE Transactions on Smart Grid, Associate Editor of IEEE Transactions on Industry Applications, an Editor of Power Components and Systems, and Associate Editor of the International Journal of Power Electronics. (414-229-4955; nasiri@uwm.edu)

**Alan Perlstein:** The Mid-West Energy Research Consortium is focused on the growth of the Energy, Power & Control industry across the Midwest. Alan has 35 years of experience in ship building, power electronics, design development and program control functions. He has been responsible for the design development, contract administration, business planning and program control functions for navy nuclear, ship controls, propulsion and power distribution programs.

**Jose Pillich** is currently pursuing a PhD degree in Environmental Science specializing in GIS/Remote Sensing. He focuses on understanding the interdisciplinary impacts of green infrastructure in New York City, while his research interests include environmental planning, green infrastructure, ecosystem services, and geospatial analysis. Past work has primarily focused on analyzing the impacts of different green initiatives. For the EPA, his primary research entailed developing an environmental accounting system that accounted for environmental footprint reduction. (347-237-7084; pillich@gmail.com)

**Ashwin Dhanasekar** is a Research Associate at Colorado State University and the Assistant Director for the Center for Energy Water Sustainability (CEWS). He has a Masters in Environmental Engineering from Colorado State University and an undergrad in Chemical Engineering from Anna University (India). He is currently working through the CEWS with operators and service companies to help manage their water more efficiently solving energy-water issues. His previous work includes modeling integrated systems to optimize water management with an integral focus on beneficial reuse of wastewater to promote the Food-Energy-Water relationship. (970-492-4858, ashwin.dhanasekar@colostate.edu)

## WC-6 Innovative Solutions in Cities (Part 1)

*(Jefferson Room)*

This session will explore innovative solutions for addressing the water-food-energy nexus in urban settings, focusing on the emerging collaborative framework and practice method of Bioregional Urbanism. This framework is designed to support scientists, design, policy and community practitioners as they collaboratively evaluate bioregional resources of food-water-energy, and develop projects to improve stewardship of these resources in urban contexts. Bioregional Urbanism aims to 1) improve understanding of water-food-energy resource systems at urban and regional scales; 2) facilitate innovation for living and thriving within renewable limits of these resource systems; 3) translate understanding and innovation into action scale projects 3) benchmark towards one planet living. Representing different disciplines, each panelist will present perspectives on bioregional urbanism theory, practice and case studies.

Moderator: Carol Miller, Professor and Chair, Department of Civil and Environmental Engineering, Wayne State University
Speakers:

- John Berg, Professor of Government and Director of Environmental Studies, Suffolk University
- Antje Danielson, Director, Institute of the Environment, Tufts University and President, Council of Environmental Deans and Directors
- Sarah Howard, Executive Director, Earthos Institute
- Philip Loheed, President, AIA, Earthos Institute

- Ninian Stein, Director, Earthos Institute and Professor, Environmental Studies Program, Tufts University

**Carol Miller** is an active water resources researcher, having received grants from the National Science Foundation, Great Lakes Protection Fund, and Engineering Foundation, amongst others. Her research includes both surface and subsurface water supplies and has recently focused on topics with a water/energy interface. She is especially interested in urban environmental issues, having helped launch the Urban Watershed Environmental Research Group (UWERG) at Wayne State University. Dr. Miller received all her academic degrees from The University of Michigan, Ann Arbor. She is a licensed Professional Engineer in the State of Michigan and past chair of the State Licensing Board. (313-577-3842; cmiller@eng.wayne.edu)

**John Berg** is a Professor of Government and the Director of Environmental Studies at Suffolk University. He is interested in the development of new political forms that can move humanity ahead toward solutions when the ordinary political channels are blocked or dominated by anti-environmental forces. His current projects include a book titled *Leave It in the Ground: The Politics of Coal and Climate* and an evaluation of the environmental policies of the Obama Administration. (617-899-7324; jberg@suffolk.edu)

**Antje Danielson** is the Administrative Director at the Tufts Institute of the Environment, as well as the graduate interdisciplinary Water: Systems, Science and Society(WSSS) program. She came to Tufts from Durham University (UK), where she served as the Deputy Director for Sustainability, in May 2008. Previously, she worked with the Harvard Green Campus Initiative. A long-time resident of Cambridge, Massachusetts, Antje co-founded the innovative carsharing company Zipcar. She holds a Ph.D. in Geology from Free University, Berlin.

**Sarah Howard,** LEED AP, is a Co-founder and Executive Director of Earthos Institute. Howard brings expertise in community education and planning, regional resource planning and resiliency, and sustainable design tools and protocols. Her current research focus is the development and usability of the Bioregional Resiliency Index, an index that measures a region's current resource security in food, water, energy, land and biodiversity. Howard is currently authoring a book chapter titled "bioregional perspectives on transformative harmony for sustainable development," exploring the importance of developing citizen-practioner tools for managing core resources such as water, energy and food at different scales to reduce conflict and improve just sustainability. (401-787-1686, sarah-earthos@LDParch.com)

**Philip Norton Loheed**, AIA, NCARB, Assoc ASLA, is co-founder and President of Earthos, and award winning practicing architect, educator, and researcher. Loheed has master planned, designed and built hundreds of projects worldwide over the last forty years including Union Station in Washington, Grand Central Terminal in NYC, residential projects, mixed use waterfront urban designs. He is also principal of DP+ Architects and a member of the academic and practice faculties of the Boston Architectural College, teaching architecture since 1972. With expertise in architecture, urban design and natural systems analysis for land planning, he has contributed core principles and concepts to Earthos' Bioregional Urbanism methodology, actively applying it to community projects. He is currently co-authoring a book on the method and design applications. (617-312-0717, phil.loheed@earthos-institute.us)

Dr. **Ninian R. Stein** is a Director at Earthos Institute and a Professor in the Environmental Studies Program at Tufst University. Trained as an anthropological-archaeologist and environmental scientist, Stein's research and teaching spans environmental policy and communication, landscape change, and environmental justice. Her work focuses on the idea of "landscape literacy"— if we can read the past of a place we are better able to plan for its future. Stein has taught at Smith College, Wheaton College, University of Massachusetts Boston and San Jose State University. Her current research draws on systems thinking, science and design to create collaborative frameworks and methods for communities

seeking to increase sustainability and effectively utilize and preserve environmental resources. Her team is partnering with communities in the New England bioregion to co-develop the methodology, with a manuscript in progress titled 'Bioregional Urbanism 1.0'. (617-710-5937, Ninian.Stein@tufts.edu)

### WC-7 Connecting Education to Practice and the Workforce at the Nexus
*(Lincoln Room)*

The 21st century requires comprehensive and sustainable solutions to the integrated challenges of the food, water, and energy security nexus. Population growth, climate change, and associated environmental impacts provide challenges and opportunities for educational efforts that counter entropic human behaviors with collaborative-based economic and community models. This session examines different educational response models and approaches to energy literacy and "green" food and water systems, including traditional-based local and regional models of community development. Discussants provide a reflective social, business, legal, and policy-driven discussion of the complexities of human interactions and impacts on sustainable and healthy human and biophysical environments. Questions are posed regarding both long- and short-term human impacts on environment and generated educational and workforce solutions, including technology-based outreach and social engineering.

Moderator: Christopher Dyer, CEO, University of New Mexico-Gallup and Maria Boccalandro, Sustainability Director, Cedar Valley College, Dallas County Community College District
Speakers:

- Halley Aelion, Lecturer, University of Maryland
- Michael Dworkin, Professor and Director, Institute for Energy and the Environment, Vermont Law School
- Tamara Shapiro Ledley, Senior Scientist and Chair, Center for STEM Teaching and Learning, TERC/CLEAN Network
- Greg Morris, Vice President, Academic Affairs, El Centro College, Dallas County Community College District
- Brandon Morton, Sustainability Coordinator, North Lake College, Dallas County Community College District
- Eddy Rawlinson, Executive Dean of Math, Science, and Allied Health, Cedar Valley College, Dallas County Community College District

**Christopher Dyer** serves as the Chief Executive Officer of the University of New Mexico, Gallup and as President of the Community College Alliance for Sustainability Education (CCASE). He is an applied anthropologist and received his PhD in anthropology from Arizona State University. Besides resource management, human ecosystem modeling, and disaster assessment research in the U.S., he has directed field research teams in seventeen countries and is the author of numerous publications in his field. Dyer is a member of two professional organizations, the National Council for Science and the Environment and the American Anthropological Association, as well as a Fellow of the Society for Applied Anthropology. (505-863-7501; cdyer@unm.edu)

**Maria Boccalandro** is an Urban Planner with an MSc in Urban Transportation and a PhD in Political Science. As the Sustainability Director at Cedar Valley College, she coordinates campus-wide sustainability strategies and programs, including specific sustainable projects such as the Living Labs, the Butterfly & Edible Garden, and the Solar Power Project. Boccalandro works with local and federal governmental agencies on resolving environmental challenges and collaborates in obtaining funds to achieve the sustainability goals of the college. She develops and implements environmental messaging, education, and promotion both internally and for the community, which includes reporting greenhouse gas emissions and climate action plans for the American College & Universities President's Climate Commitment. (972-860-5204; mboccalandro@dcccd.edu)

**Halley Aelion** is a researcher at the University of Maryland focusing on how food-energy-water gains can be achieved through the education and engagement of citizens in a corporate setting. She investigates best practices in corporate social responsibility (CSR) that aim to involve employees in environmental stewardship through strategies such as community volunteer programs, leadership training and rotations, health and wellness campaigns, and internal gamification. Aelion also manages clean energy programs, advises corporations on CSR strategies and theory, and teaches CSR fundaments to undergraduate business majors. (halley.aelion@gmail.com)

**Michael Dworkin** was a utility regulator, environmental litigator, and small businessman before becoming a professor. At Vermont Law School, he also directs the Institute for Energy and the Environment. The Institute offers an advanced curriculum on energy and regulatory law, provides forums and conferences for professional education and issue development, publishes on environmental and energy issues, and serves as a center for commissioned research on these topics.

**Tamara Ledley** chairs the Climate Literacy and Energy Awareness Network (CLEAN) and the Center for STEM Teaching and Learning at TERC. Climate change is impacting and will continue to impact our complex societal systems, which encompass the food-energy-water nexus. There are many climate literacy efforts that work to enable individuals, professionals, organizations, and governments to make effective decisions that address the impacts of climate change on this nexus. However, individually these efforts have limited reach and duration. Ledley will discuss what is needed to build a climate literacy collective impact effort to enable the plethora of climate literacy efforts to share experience and expertise and coordinate/leverage resources to extend their reach and impact. (617-873-9658; Tamara_Ledley@terc.edu)

**Brandon Morton** is the Sustainability Coordinator at North Lake College (NLC) in the Dallas County Community College District (DCCCD). North Lake College bridges education and practice to workforce development with triple-bottom-line sustainability. NLC's Campus as a Living Lab Model integrates classroom learning with college operations and community service by offering a Green Diploma, an undergraduate emphasis degree for all majors that incorporates sustainability curriculum. More than 65 different faculty across all divisions integrate sustainability into their Academic, Technical and Workforce courses. Morton is responsible for coordinating sustainability initiatives in Academic Affairs, Business Services, and Student Affairs, and is also an adjunct professor of biology. (972-273-3392; bmorton@dcccd.edu)

**Eddy Rawlinson** currently serves not only the students, faculty and staff of the Math, Science and Allied Health Division but serves as Chair, Co-Chair and or member on numerous college committees including the Director of the recently awarded PBI Grant from the US Department of Education, Co-Chair of the Cedar Valley College QEP Committee, the CVC Sustainability Committee, among others. He coordinated the approval for the location and funding of the STEAM Center at Cedar Valley College, the first STEAM Center in the DCCCD, with minimum costs associated with opening the location as well as the redesign with new equipment of four Mathematics Classrooms for the launch of the ALEKS Software Instructional Support Software for student success in DMAT and College Algebra. He previously served as Associate Dean and Interim Executive Dean of Arts & Sciences at El Centro College. He holds a MFA from Texas Christian University and a BFA from the Visual School of Art, University of North Texas. (972-860-5211, ebrawlinson@dcccd.edu)

### WC-8 Advancing Sustainable Development through FEW Integration
*(Arlington & Fairfax Rooms)*

This session will explore the integration of food, energy, and water systems in developing regions. Some speakers will explore population as a food-energy-water connector. Others will describe efforts to

produce policy insights into difficult global challenges by modeling some of the key environmental, economic, political, and social systems that interact to make these problems complex. Finally, some speakers will explore how development programming can progress from a single sector focus to address cross-sector challenges, and act as a catalyst to changing government policy. Most case studies will focus on Africa. Speakers will also address climate change as a cross-cutting challenge.

Moderator: Robert Engelman, Senior Fellow, Worldwatch Institute
Speakers:

- Elliott Cappell, Principal Manager, Infrastructure and Climate Change, Adam Smith International
- Kathleen Mogelgaard, Adjunct Professor, University of Maryland/US Climate Action Network
- Clive Mutunga, Population, Environment and Development Technical Advisor, U.S. Agency for International Development
- Rosanna Marie Neil, Director, Sustainable World Initiative

**Robert Engelman** is a Senior Fellow at the Worldwatch Institute, a globally focused environmental research organization, where he was President (2011-2014) and Vice President for Programs (2007-2011). Prior to joining Worldwatch, he was Vice President for Research at Population Action International, a policy research and advocacy group in Washington, and directed its program on population and the environment. He has written extensively on population's connections to environmental change, economic growth, and civil conflict. Bob is the author of *More: Population, Nature, and What Women Want*.

**Elliott Cappell** has experience in planning, design, delivery, project management and economic analysis of development projects worldwide. Elliott brings a strong track record of recent and current projects across the developing world related to economic development and infrastructure. He has worked in a range of development contexts including in East, West, and Southern Africa; the Middle East; South Asia; East Asia; and Latin America. Elliott has experience working with a range of donors, including DFID, the World Bank, the IFC, and CIDA. Elliott also held various roles in the Government of Ontario managing economic development programs. Elliott previously worked as an academic and media researcher on economic policy issues in Costa Rica and Israel. (416-254-9848, elliott.cappell@adamsmithinternational.com)

**Kathleen Mogelgaard** is an independent consultant with 20 years of experience in policy analysis, advocacy, and teaching on global environmental challenges and solutions. As an adjunct professor at the University of Maryland Honors College, she piloted an undergraduate course called "Hungry, Hot, and Crowded: Global Challenges of the 21st Century," which focuses on trends and responses to the interlinked challenges of food security, climate change, and population growth. Her writing on these issues has appeared in *Grist*, *New Security Beat*, and *RH Reality Check*.

**Clive Mutunga** is Population, Environment and Development Technical Advisor at the U.S. Agency for International Development, where he focuses on the linkages between population, environment, and development, including the intersections and integration of family planning and the environment. Trained at the University of Nairobi and the University of Pretoria, Clive is an expert in environmental economics and has conducted research on linking population, gender, climate change, and the environment.

**Rosanna Marie Neil** is the Director of the Sustainable World Initiative (SWI), a global advocacy program that educates political leaders and the general public about the relationship between human society and natural systems and the changes that will be required to achieve lasting progress. She played an active role in influencing the negotiations of the 2030 Agenda for Sustainable Development at the United Nations, and will be supporting governments as they implement the global agenda. Rosanna spent several years practicing law in Washington, DC before dedicating her career to advocating for socioeconomic and environmental sustainability.

**WC-9 Integrating Food, Energy and Water Systems to Eliminate Waste**
*(Roosevelt Room)*

Food, energy, and water (FEW) systems use technologies developed to address the needs of a given sector (e.g. energy or agriculture), and wastes from each sector are usually managed separately. Production systems underlying FEW have traditionally treated pollution and waste as externalities that are diluted into the ambient environment, and the infrastructure for FEW has consequently developed with unnecessary inefficiencies that are increasingly problematic. This session will explore how FEW systems can be optimized to: (1) repurpose or cycle waste products; (2) internalize traditional externalities; and (3) integrate wastes with resource inputs across systems—for example, by deploying integrative management strategies and providing clean energy production to displace water intense fossil fuel based energy production that generates large carbon emissions.

Moderators: Sarah Davis, Assistant Professor, Environmental Studies Program, Voinovich School of Leadership and Public Affairs, Ohio University and Serpil Guran, Director, Rutgers EcoComplex and Associate Professor of Plant Biology and Pathology, Rutgers University

Introduction: Sarah Davis, Environmental Studies Program, Voinovich School of Leadership and Public Affairs, Ohio University
Speakers

- David Babson, Senior Engineer, Union of Concerned Scientists
- Geoffrey Dabelko, Professor and Director of Environmental Studies, Voinovich School of Leadership and Public Affairs, Ohio University
- Serpil Guran, Director, Rutgers EcoComplex and Associate Professor of Plant Biology and Pathology, Rutgers University
- Yelda Hangun-Balkir, Director, Center for Urban Resilience and Environmental Sustainability, Manhattan College
- Natalie Kruse, Associate Professor of Environmental Studies, Voinovich School of Public Affairs and Leadership, Ohio University
- Scott Miller, Director, Center for Energy, Economics & the Environment, Ohio University
- Michael Zimmer, Appalachian New Economy Partnership Fellow, Voinovich School of Public Affairs and Leadership, Ohio University and President and CEO, International Economic Development Council (IEDC)

Dr. **Sarah Davis** studies integrative land management that simultaneously promotes carbon sequestration, water quality, biodiversity, bioenergy production, and agricultural improvement. Major areas of research currently include drought tolerant CAM plants for agriculture; carbon sequestration in advanced cellulosic cropping systems; and biogas generation from anaerobic digestion of food waste and agricultural residues. She maintains an interdisciplinary research program investigating basic science and applied questions related to ecosystem dynamics, advanced bioenergy systems, forest ecology, and environmentally sustainable land management. (740-597-1459; daviss6@ohio.edu)

**David Babson**'s work focuses on understanding and improving fuel production processes, including biofuel sustainability, and analyzing associated fuel policy. Dr. Babson has extensive research and policy experience. He served as an AAAS Science and Technology Policy Fellow in the Environmental Protection Agency's Transportation and Climate Division, where he reviewed fuel pathways and policy related to initiatives such as the Renewable Fuel Standard. Before that he studied sustainable biofuel systems at both the U.S. Naval Research Laboratory and the University of Minnesota's Biotechnology Institute. (202-331-5457; DBabson@ucsusa.org)

**Geoffrey D. Dabelko** is Professor and Director of Environmental Studies at the Voinovich School of Leadership and Public Affairs at Ohio University in Athens, Ohio. He teaches and conducts research on

natural resources, conflict, & peacebuilding; global environmental politics; and climate change and security. He is currently focusing on the conflict and peacebuilding potential of climate change responses. From 1997 to 2012, he served as director of the Environmental Change and Security Program (ECSP) at the Woodrow Wilson International Center for Scholars in Washington, DC. Dabelko is co-editor of *Green Planet Blues: Critical Perspectives on Global Environmental Politics* (5th ed., 2014) and was a lead author for the fifth assessment of the Intergovernmental Panel on Climate Change Working Group II Chapter 12 on Human Security. (740-593-2117; dabelkog@ohio.edu)\

**Serpil Guran**'s responsibilities include management of the EcoComplex operations, programs, business incubator and facilities, as well as providing vision and leadership in establishing the EcoComplex as a clean energy innovation center for the commercialization of clean energy and environmental technologies. Dr. Guran specializes in research, development and assessment of sustainable clean energy; biofuels recycling technologies; and life cycle analysis of clean energy production systems, such as food waste to low carbon energy and assessment of biomass energy potentials to quantify carbon and water savings. She teaches Sustainability and Bioenergy Technologies classes at Rutgers University. (609-499-3600 ext. 4225; guran@aesop.rutgers.edu)

Dr. **Yelda Hangun-Balkir** is an assistant professor of chemistry & environmental science as well as the Director for the Center for Urban Resilience and Environmental Sustainability at Manhattan College. She received her PhD in chemistry from Carnegie Mellon University. Her graduate work was funded by the DOE and she is a co-recipient of the U.S. Presidential Green Chemistry Challenge Award. Balkir's presentation will focus on the production of biofuels by waste seashells as catalysts and unedible oils from waste such as used coffee, since the seafood industry generates a large amount of shell waste that is simply sent to landfills, leading to the need to burn the shells, an environmentally costly activity. (718-862-7818; yelda.hangunbalkir@manhattan.edu)

Dr. **Natalie Kruse** is an associate professor of Environmental Studies at Ohio University. She earned her doctorate in Civil Engineering and Geosciences at Newcastle University and completed post-doctoral research on energy systems with the Sir Joseph Swan Institute for Energy Research. Her expertise is in characterizing, modeling, and remediating water pollution from coal, oil, and gas extraction. Dr. Kruse has been instrumental in identifying physical and chemical factors that control the recovery of biological communities in acid-stressed environments and has conducted studies into failing acid mine drainage treatment systems. She has made advancements in the treatment of hydraulic fracturing wastewater for reuse and discharge and has spearheaded community efforts to collect baseline groundwater quality data as oil and gas drilling advance. (krusen@ohio.edu)

**Scott Miller**'s team elevates and enhances Ohio University research by improving the natural environment of the region; accelerating the transition to a more sustainable and resilient local economy; and serving as liaisons to connect state and federal agencies and local stakeholders to the university's resources. The Consortium on Energy, Economics, and the Environment (CE3) is an integrated energy research and ecological assessment team housed within the Voinovich School of Leadership and Public Affairs. CE3 is a strategic partnership between the Voinovich School, the Russ College of Engineering, and the College of Arts and Sciences. The 45 consulting practitioners in CE3 offer applied research, technical assistance, and teaching in water quality assessment; the future of our energy systems; landscape ecology; zero waste management; and geospatial and web-enabled data management. (740-593-0827; millers1@ohio.edu)

**Michael Zimmer** practiced law for over 30 years in regional, national, Wall Street, and international law firms before retiring in 2013. He concentrated on clean tech, energy and environment, renewables, water, and project finance. At Ohio University his research focuses on water, energy, climate change, advanced manufacturing, and public-private partnerships. He has worked on projects in over 30 states and 20 foreign countries, representing a combined investment exceeding $15 billion. He was outside editor to a recent American Bar Association (ABA) book on climate change law, and is currently serving

as an editor in 2016 for a new ABA book on environmental ethics. He has completed two recent NIB white papers as a co-author on energy efficiency financing and new ways to access the capital markets for renewables and efficiency in 2015-16. (571-331-4206; zimmerm@ohio.edu)

**WC-10 Managing Nutrients, Water, and Energy for Producing More Food with Low Pollution**
*(Washington Room B)*

Growing more food while conserving water and air resources is a "wicked" problem, due to complex interactions among sectors and among stakeholders who stand to win or lose from evolving environmental, energy, and food security policies. While management practices already exist to advance the dual goals of agricultural productivity and environmental sustainability, their widespread adoption by farmers is often impeded by economic and social barriers. The objective of this session is to explore what success for this problem would look like from the varying perspectives of several stakeholders. We will explore metrics and milestones that could be agreed upon on the road to improving nutrient, water, and energy use efficiency in a world of increased and sustainable food production.

Moderators: Eric Davidson, Director and Professor, Appalachian Laboratory, University of Maryland Center for Environmental Science and Deanna Osmond, Professor and Soil Science Department Extension Leader, North Carolina State University
Speakers:

- Jill Baron, Director, North American Nitrogen Center, U.S. Geological Survey
- Richard Ferguson, Associate Department Head and Soil Fertility Specialist, University of Nebraska-Lincoln
- Brandon Hunnicutt, Farmer
- John McGuire, Technology Advisor, Simplified Technology Services (S2 Partners, LLC)
- Rachel Nifong, Researcher, University of Maryland Center for Environmental Science, Appalachian Laboratory
- Cheryl Palm, Senior Research Scientist and Director of Research, Agriculture and Food Security Center, The Earth Institute, Columbia University
- Pedro Sanchez, World Food Prize Laureate and Director, Agriculture and Food Security Center, Columbia University
- Jon Slutsky, Dairy Producer, La Luna Dairy and Member, Colorado State Water Quality Control Commission
- Allison Thomson, Science and Research Director, Field to Market: The Alliance for Sustainable Agriculture

**Eric A. Davidson** is Director and Professor at the Appalachian Laboratory of the University of Maryland Center for Environmental Science in Frostburg, MD. He studies nutrient cycling in a variety of ecosystems, including forests and agricultural lands in North and South America. Davidson holds a PhD in forestry from North Carolina State University. He is a Fellow of the American Association for the Advancement of Science, past President of the Biogeosciences section of the American Geophysical Union (AGU), and President-Elect of AGU. He served as the Coordinator of the North American Center for the International Nitrogen Initiative and is the leader of a Research Coordination Network on Reactive Nitrogen in the Environment. (301-689-7204; edavidson@umces.edu)

Dr. **Deana Osmond** works at the interface of nutrient management, crop productivity, conservation practices, and water quality. The focus of her research and extension program is to work with farmers on implementing nutrient management that optimizes yield while reducing environmental losses. In addition, research and extension activities focus on in-field and edge-of-field practices, such as tillage, riparian buffers, and exclusion fencing to reduce nutrient losses. Finally, Dr. Osmond works on

watershed-scale issues to help determine the most cost-effective solutions for reducing nutrient loss. (919-515-7303; deanna_osmond@ncsu.edu)

Dr. **Jill S. Baron** is an ecosystem ecologist with the U.S. Geological Survey (USGS) and a Senior Research Ecologist with the Natural Resource Ecology Laboratory at Colorado State University. Her interests include applying ecosystem concepts to the management of human-dominated regions, understanding the biogeochemical and ecological effects of climate change, and atmospheric nitrogen deposition to mountain ecosystems. As Director of the North American Nitrogen Center, her interests are in facilitating dialogue, policy, and research to optimize the beneficial use of nitrogen in food production while minimizing damage to human health and environment. Baron also co-directs the USGS Powell Center for Earth System Studies Synthesis and Analysis. (970-491-1968; jill_baron@colostate.edu)

**Richard Ferguson** is a Professor of Soil Science, Extension Soils Specialist, and Associate Head in the Department of Agronomy and Horticulture of the University of Nebraska-Lincoln. His research focuses on site-specific nutrient management and improving nitrogen use efficiency of irrigated cropping systems. He teaches undergraduate and graduate courses on site-specific crop management and spatial variability of soil. He coordinates Extension educational programs in Nebraska focused on improving nitrogen use efficiency of irrigated corn and minimizing nitrate loss to groundwater. Dr. Ferguson's current research addresses the use of crop canopy sensors for improved spatial and temporal management of nitrogen and irrigation water inputs. Dr. Ferguson is a Fellow of the American Society of Agronomy and Soil Science Society of America. (402-472-1144; rferguson@unl.edu)

**Brandon Hunnicutt** farms in Giltner, Nebraska with his dad Daryl and brother Zach. They raise corn, soybeans, popcorn, and seed corn on highly productive, fully irrigated ground. He has led the initiative on the farm to research and utilize different technologies to better manage irrigation and plant nutrients. This has been done through research with both the Univeristy of Nebraska-Lincoln and private industry. The ultimate goal is to become more sustainable both from a utilization standpoint for nutrients and to maximize productivity. (402-604-9199; dirtpoorfarmer@gmail.com)

**John McGuire** has spent nineteen years in the Precision Agriculture Industry. Currently, he co-owns and co-operates S2 Partners, LLC. Before S2 he worked in many positions within the agricultural supply chain for several companies. In each of his roles, John has broadened his precision agricultural expertise and developed many sustainability related skills. He gained experience in the agriculture retail fertilizer sales during his time with Terra Industries; in genetics through environmental research with Monsanto; in large scale on-farm production with Spatial Ag Systems; and in agronomic consulting with Brookside Laboratories. S2 Partners, LLC is a broad based consulting company that assists clients in creating and implementing plans to achieve maximum return on their agronomic and technology investments. (419-212-0479; mcguire9@gmail.com)

Dr. **Rachel Nifong** is a postdoctoral researcher at the Appalachian Laboratory, a University of Maryland Center for Environmental Science research facility. Dr. Nifong was a 2012 U.S. EPA STAR Graduate Fellow and recently received her Ph.D. in Interdisciplinary Ecology from the University of Florida. Previously, she received her BS from North Carolina State University and her MEM from Duke University. She uses an integrative approach, combining aspects of empirical observation, modeling, hydrology, and ecological stoichiometry to address broad-scale ecological questions and inform conservation policy of organisms and the ecosystems they inhabit. Broadly, her research interests focus on understanding how variation in the use and availability of water and nutrients impact the structure and function of ecosystems through time and across scales. (301-689-7127; rnifong@umces.edu)

**Cheryl Palm** is Senior Research Scientist and Director of Research of the Agriculture and Food Security Center at Columbia University's Earth Institute. A tropical ecologist and biogeochemist, Dr. Palm's research focuses on land use change, land degradation and rehabilitation, and ecosystem processes in tropical agricultural landscapes. Dr. Palm received her PhD in soil science from North Carolina State

University after completing her Bachelor's and Master's degrees in zoology at the University of California, Davis. She has served on the faculties of North Carolina State University, Colorado State University. She is a Fellow of the American Society of Agronomy and served as chair of the global International Nitrogen Initiative (INI) from 2008 to 2011. (845-680-4462; cpalm@ei.columbia.edu)

**Pedro A. Sanchez** is Director of the Agriculture and Food Security Center and Senior Research Scholar at Columbia University's Earth Institute. He served as Director General of the World Agroforestry Center (previously known as the International Centre for Research in Agroforestry, or ICRAF) headquartered in Nairobi, Kenya, from 1991 to 2001; as co-chair of the United Nations Millennium Project Hunger Task Force from 2002 to 2005; and as director of the Millennium Villages Project from 2004 to 2010. Sanchez is Professor Emeritus of Soil Science and Forestry at North Carolina State University. He has supervised research programs in over 25 countries in Latin America, Southeast Asia, and Africa. He is the 2002 World Food Prize Laureate and a 2004 MacArthur Fellow, and was elected to the American Academy of Arts and Sciences in 2008 and the National Academy of Sciences of the United States in 2012. (845-680-4452; psanchez@ei.columbia.edu)

**Jon Slutsky** is a first generation dairy farmer who, with his wife, owns and operates a 1,500 cow dairy in Northern Colorado. He has a bachelor's degree in biology from the University of California, Riverside (1972). Jon is General Manager of the dairy and oversees the management of the farm, including 2,900 cows and calves and 27 employees. Jon is a producer member of a Colorado committee working on reducing nitrogen deposition in Rocky Mountain National Park. He is also a member of a USDA funded group producing a web-based tool to help livestock producers reduce air emissions. Jon was a member of the Colorado Air Quality Control Commission from 2007 to 2012 and is currently a member of the Colorado Water Quality Control Commission. (jslutsky@lalunadairy.com)

**Allison Thomson** brings 15 years of interdisciplinary research on agricultural systems interactions with energy systems and the environment to the implementation of sustainable agriculture at scale in the U.S. Field to Market is a non-profit, multi-stakeholder organization that unites the commodity crop supply chain (food and retail companies, agribusiness, farmer organizations, conservation groups, universities, and government) around common definitions, measurements, and standards for sustainable agriculture. Using environmental outcome and science based metrics and benchmarks, Field to Market and member organizations are measuring, benchmarking, and working to advance sustainable production. (202-499-4397; athomson@fieldtomarket.org)

## WC-11 Urban Food Systems

*(Potomac Rooms I, II)*

This session will explore the nexus though various approaches to urban food systems in Philadelphia, PA; Washington, DC; and Tallahassee, FL. Case studies will include: (1) indoor vertical farming at Tower Garden, with a demonstration model; (2) the Urban Food Hubs concept of the College of Agriculture, Urban Sustainability, and Environmental Sciences (CAUSES) of the University of the District of Columbia (UDC); and (3) the Tallahassee Food Network and community engagement. All three examples illustrate ways of providing urban communities with fresh produce which conserving water and energy.

Moderator: Sabine O'Hara, Dean and Director of Landgrant Programs, University of the District of Columbia (UDC)
Speakers:

- Mchezaji ("Che") Axum, Director, Center for Urban Agriculture and Gardening Education
- Stephanie Berardi, Principal, Sustainable in the City

- Tolessa Deksissa, Director, Water Resources Research; Director, Professional Science Master's Program in Water Resources Management and Environmental Quality Testing Laboratory, University of the District of Columbia
- Richard Gragg, Associate Director and Associate Professor, Florida A&M University
- Dwane Jones, Director, Center for Sustainable Development, University of the District of Columbia
- Thomas Kakovitch, Chairman, KI International
- Duane McCarthy, Founder, Land Design & Construction Mgrs., Inc.
- Bakari McClendon, Florida State University and Network Director, Tallahassee Food Network

**Sabine O'Hara** is responsible for academic, research, and community outreach programs in the tradition of the landgrant university, and is leading UDC's efforts to build a cutting-edge model for urban agriculture that improves the quality of life and economic opportunities for urban populations. Dr. O'Hara is a respected author, researcher, and higher education executive well known for her expertise in sustainable economic development, global education, and executive leadership. Dr. O'Hara was previously President of Roanoke College, and also served as Executive Director of the Council for International Exchange of Scholars, which administers the Fulbright Scholar Program. She is the founder of Global Ecology, LLC. (202-274-7011; sabine.ohara@udc.edu)

**Mchezaji "Che" Axum** leads a team of researchers at the UDC Research Farm in Beltsville, Maryland, and oversees UDC's Master Gardening, Specialty, and Ethnic Crops programs. He spent 20 years with the USDA Agricultural Research Service Plant Sciences Institute, has taught middle school, and has worked as a successful farmer and sustainable farming consultant. He is also a certified nutrient management consultant for the state of Maryland. (202-495-8990; mchezaji.axum@udc.edu)

**Stephanie Berardi** holds a Masters Degree in Sustainability from the University of Pennsylvania and Bachelors Degree in Communications from Temple. She studied commercial vertical farming across the globe and offers a tangible incite to an innovative aeroponic garden system. Sustainability in the City leads the way on alternative growing methods commercially viable to urban landscapes and non traditional locations. She demonstrates how to grow a lot of food in a smaller space, in half the time of soil-based agriculture, using a fraction of the water with cutting edge technology. Stephanie is a Future Leader and Sustainability expert driven by making positive environmental impacts. (215-884-5962, Berardi.Steph@gmail.com)

**Tolessa Deksissa**'s research expertise includes: water quality assessment and modeling; emerging contaminants; GIS-based modeling of green infrastructure; trace metal analysis in urban soils; fate and transport of organic contaminants in water; modeling integrated urban wastewater systems; adaptive water resources management; and fostering significant learning in sciences. Dr. Deksissa is a member of the Chesapeake Bay Watershed Research and Outreach Collaborative Steering Committee. (202-274-5273; tolessa.deksissa@udc.edu)

**Richard Schulterbrandt Gragg** is an environmental science and policy professor at the Florida A&M University (FAMU) School of the Environment. He is engaged in the nexus through community-based participatory research in environmental justice and health disparities, the Tallahassee Food Network, and the FAMU Energy-Water-Food Nexus International Summit, held in March 2015. Dr Gragg collaborated with others across disciplines and sectors in applying the economic, social, and environmental principles of sustainability supported by the conviction that food is the foundation of sustainable communities. (850-345-8468; richel225@gmail.com)

**Dwane Jones** is a nationally recognized expert in low-impact development. His research interests include complete streets, active transportation, public health, and social interaction in public spaces. He has also taught and conducted research in the areas of water quality management, urban planning and design, low impact development, conservation design, and urban sustainability. The Center for

Sustainable Development also includes a world-class water quality research lab as part of its Water Resources Research Institute. (202-274-7182; dwane.jones@udc.edu)

**Thomas Kakovitch,** Chairman of Kakovitch Industries, LLC (International), holds 26 patents whose uses enhance environmental productivity, measurement, and remediation. His inventions range from air ejectors for power plants to top-efficiency fish farming and aquaponics, to injecting oxygen into large bodies of water, including oceans. Kakovitch, a former UDC professor, is the Principal Investigator of an NSF grant and author of four books: *The Fifth Force*, *Collegium*, *Anthropogenics*, and *Physics and Economy*, co-authored with Sabine O'Hara. He serves as Chairman of the Board of Terra Forma and Director of Applied Sciences of the distinguished McLean Project. (703-869-2076; tkakovitch@yahoo.com)

**Duane McCarthy** is a graduate Landscape Architect from Penn State University and the founder of Land Design & Construction Mgrs., Inc. During the past 30 years Duane's company (LDC) was a major exhibitor in the Philadelphia Flower Show, has built rooftop landscapes in New York City and has been recognized for numerous awards throughout his career. Duane is National Marketing Director for the Tower Garden Company, a state of the art Aeroponic Vertical Garden. Technology developed at Epcot, Duane supports *Tower Gardens* in Schools, Restaurants, commercial facilities, and Private homes across North America.

## World Cafés Round 2 (Wednesday 3:45 p.m. – 5:15 p.m.)

**WC-12 Capacity Building through Strategic Partnerships: Leveraging Innovative Tools, Applied Research and Big Data**

*(Conference Theater)*

The most urgent challenges at the food-energy-water nexus disproportionately impact low- and middle-income countries (LMICs). Effective strategies to address these challenges must utilize cross-sectoral partnerships and build capacity in LMICs. This session will highlight specific efforts aimed at strengthening LMICs' capacity to address nexus challenges through partnerships that leverage innovative tools, support applied research activities, and harness the use of big data. It will be comprised of three main activities: (1) highlighting interagency and intergovernmental initiatives led by NASA and USAID; (2) presentations on optimal practices, opportunities, and challenges by representatives from the private sector and interdisciplinary collaborators at research institutions; and (3) networking and facilitated discussions to identify further areas of collaboration and priorities for upcoming efforts.

Moderators: Clare Muhoro, Science Partnerships Advisor, U.S. Agency for International Development and Department of Chemistry, Towson University; Christine Lee, Scientific Applications Engineer, National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory and Associate Program Manager, National Aeronautics and Space Administration Applied Sciences Water Resources

Speakers:

- Marc Dettmann, Project Manager, U.S. Water Partnership
- Mekonnen Gebremichael, Associate Professor, Hydrology and Water Resources, University of California, Los Angeles
- Stephanie Granger, Technical Staff, NASA Jet Propulsion Laboratory Land Surface Hydrology Group
- Ku McMahan, Team Lead, Securing Water for Food GCD, U.S. Global Development Lab, U.S. Agency for International Development
- Forrest Melton, Senior Research Scientist, Ames Research Center, National Aeronautics and Space Administration
- Esther Obonyo, Associate Professor of Engineering Design and Architectural Engineering, Pennsylvania State University
- Nancy D. Searby, Capacity Building Program Manager, Applied Sciences Program, National Aeronautics and Space Administration Headquarters Earth Sciences Division

Professor **Clare Muhoro** is the Science Partnerships Advisor in the U.S. Global Development Lab at USAID. She is activity manager for the Partnerships for Enhanced Engagement in Research (PEER) and U.S.-Pakistan Science and Technology Cooperation Programs. Prof. Muhoro is also Associate Professor of Chemistry at Towson University, Maryland. Her research focuses on the aquatic chemical fate of organic pesticides in tropical environments in Mexico, Ecuador, and Kenya. Her group seeks to understand the organic mechanisms of pesticide decay under pre-determined field conditions using spectroscopic techniques. She serves on the board of the Committee for the Advancement of Women in Science (COACh) to provide career-success training to women scientists around the world. Prof. Muhoro received her PhD in organometallic chemistry from Yale University. (240-626-3771; cmuhoro@usaid.gov)

**Christine Lee** has a Ph.D. in Civil and Environmental Engineering from UCLA, studying coastal water quality issues and developing rapid, viability-based methods for testing water for bacteria. Currently, Christine focuses on supporting and pursuing program and applied research opportunities in water resources and water quality. Her work includes developing improved

approaches to monitoring water quality (in situ and using remote sensing), improving access to and use of NASA data to address water resources challenges, and leading applications for ECOSTRESS (2017 launch window), a thermal instrument with drought monitoring and agriculture applications.

**Marc Dettmann** currently manages a portfolio of water, sanitation and hygiene projects in Ethiopia, Rwanda, Malawi and Nigeria for The Coca-Cola Africa Foundation's Replenish Africa Initiative. In addition he executes U.S. Water Partnership activities and develops concepts for partner engagement. He researched water and sanitation issues for the Centre for Applied Legal Studies (CALS) and also worked on water and climate change issues for the UNDP Water Governance Program-Arab States in Cairo, Egypt. He holds a Master of Public Policy from the Humphrey School of Public Affairs, University of Minnesota, where he focused on water resources.

**Mekonnen Gebremichael** works on understanding and prediction of hydrological fluxes on a range of spatial and temporal scales, advancing the use of satellite observations for water resource applications, uncertainty analysis of hydrological estimations and forecasts, transboundary river basin management, water resource management and governance in developing countries, and impact of hydrological and climate changes on vector-borne diseases. Dr. Gebremichael recently organized a workshop which addressed the scientific, engineering, and data challenges and opportunities in understanding the coupled food-energy-water systems in California. (310-794- 4239; mekonnen@seas.ucla.edu)

**Stephanie Granger** has more than twenty-five years of experience in Earth science remote sensing studies, ranging from large satellite missions to airborne experiments. Her research interests include connecting science and decision-making, stakeholder engagement, and use of Earth science information for water management and climate adaptation. She is focused on developing programs and projects in support of agriculture and water supply sustainability. She leads a project to build capacity to apply remote sensing observations for drought and agriculture applications in East Africa. (818-354-5683; Stephanie.L.Granger@jpl.nasa.gov)

Dr. **Ku McMahan** leads the Securing Water for Food Grand Challenge for Development, which was launched by USAID and the Government of Sweden the first week of September 2013 during World Water Week in Stockholm. Over the last two years, of the Kingdom of the Netherlands and the Republic of South Africa have joined as Founding Partners. Through Securing Water for Food, the partners have worked to identify and accelerate science and technology innovations and market-driven approaches that improve water sustainability to boost food security and ultimately alleviate poverty. Securing Water for Food aims to increase access to innovations that help farmers produce more food with less water, enhance water storage, and improve the use of saline water and soils to produce food. (571-309-8859; lmcmahan@usaid.gov)

**Forrest Melton** is a Senior Research Scientist with the NASA Ames Cooperative for Research in Earth Science and Technology (ARC-CREST) and with California State University, Monterey Bay. Since 2003, he has worked in the Ecological Forecasting Lab at NASA Ames Research Center on the development of modeling and data assimilation frameworks including the Terrestrial Observation and Prediction System (TOPS) and the NASA Earth Exchange (NEX). His research addresses applications of satellite data, climate data, and high performance computing to improve management of natural resources and increase resiliency to climate change. (forrest.s.melton@nasa.gov)

**Esther Obonyo** is an Associate Professor of Engineering Design and Architectural Engineering at the Department of Architectural Engineering, Pennsylvania State University. Prior to that she was an Associate Professor at the University of Florida's (UF) Rinker School of Construction Management and also a faculty entrepreneurship Fellow at UF's Warrington College of Business. She has worked as a Construction Engineer, Project Manager and Innovations Analyst in several Engineering and Construction Companies in Kenya, the UK and the US. She holds a BA in Building Economics from

University of Nairobi, MA in Architecture from University of Nottingham and a Doctor of Engineering from Loughborough University. Esther's research interest cuts across the following themes: climate change and extreme weather events, environmental sustainability, intelligent information and knowledge-based systems for productivity improvement and entrepreneurship. Prof. Obonyo is a Jefferson Science Fellow andserves as a senior science advisor on the Research Partnerships for Development Team under the Center for Data, Analysis, and Research on issues related to improving the generation and use of scientific research to address development challenges. (eobonyo@usaid.gov)

**Nancy Serby** leads ASP's efforts to build skills touse Earth observations and models to make decisions in the US and developing countries. Nancy oversees three NASA Center-based projects - DEVELOP, SERVIR, and Applied Remote Sensing Training. These projects and international capacity building efforts through the Group on Earth Observations (GEO) and the Committee on Earth Observation Satellites (CEOS) aim to improve the ability of local, regional, state, national, and multi-national stakeholders to use Earth observations to address disasters, ecosystems, biodiversity, weather, water, climate, health, energy, and agriculture decisions. Nancy is also leading efforts to develop alliances with non-traditional partners. (nancy.d.searby@nasa.gov)

**WC-13 The Institutional Overlay of Food-Energy-Water Systems: Law, Economics and Decision-making Under Uncertainty**

*(Washington Room A)*

The utility of the future is faced with a tension between incentivizing efficiency to reduce water consumption and greenhouse gas emissions and raising rates to sustain revenue generation and cover fixed costs. This tension may play out differently in water and power utilities and in public versus investor owned utilities. In the first part of this session we will share lessons learned across the water and energy sectors on this issue. In the second part of this session we will expand the discussion to include food. Specifically, we will explore the role of the private sector in enhancing collaboration across institutional divides in food energy and water sectors to reduce food waste, carbon emissions and enhance water use efficiency.

Moderator: John Sabo, Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability, Arizona State University
Speakers:

- Lyle Beefelt, Director of Management and Budget, Prince William County Service Authority
- Erica Brown, Director of Sustainability and Climate Programs, Association of Metropolitan Water Agencies (AMWA)
- Kristina M. Johnson, Co-Founder and CEO, Cube Hydro Partners LLC and former Under Secretary, U.S. Department of Energy
- Jonathan Radtke, Water Resource Sustainability Director, Coca-Cola North America

**John Sabo** is a Professor in the School of Life Sciences and Senior Sustainability Scientist at Arizona State University's (ASU's) Global Institute of Sustainability (GIOS). At GIOS Sabo led an effort to create ASU's Food Systems Transformation Initiative and is now leading an initiative to create a campus-wide water center that will focus on, among other things, the interplay between food-energy-water systems and developing solutions that harness the opportunities for coupling two or more of these systems. His primary scientific research lies at the interface between stochastic hydrology and fisheries. Sabo is currently an adviser to the Mekong River Commission where he is helping them develop forecasting tools for an inland fishery that feeds 60M people but that is at risk from changing climate and flow regime and hydropower development in the Mekong Basin.

**Lyle Beefelt** is the Director of Management and Budget for the Prince William County Service Authority. Mr. Beefelt has over 28 years of water industry experience in rate setting, budgeting, capital planning, utility financing, and performance measurement and is responsible for developing the annual budget, budgetary control over expenditures, management and statistical reports, investment management, and the performance measurement program. Prior to his promotion to Director of Management and Budget in June 2006, Mr. Beefelt worked for 18 years as the Financial Analyst and Senior Financial Analyst in the Service Authority's Finance Division. Mr. Beefelt is a graduate of Brigham Young University in Provo, UT and received a BA in Economics.

**Erica Brown** is Director of Sustainability and Climate Programs at the Association of Metropolitan Water Agencies (AMWA) in Washington, D.C. AMWA is an association of the largest publicly owned drinking water utilities in the U.S. Member representatives are the CEOs and general managers of those organizations. Erica works with federal agencies, and other organizations to advocate for actionable information and science to support water utility decision-making in climate resilience and sustainability. Related to the food-energy-water nexus, in her work, Erica considers the water-energy nexus more specifically, such as the synergies between water conservation and energy use and the subsequent impact that has on utility rates and rate structures. The food component of the nexus is something that AMWA is beginning to address.

**Kristina M. Johnson** is the Co-Founder and CEO of Cube Hydro Partners LLC. Each kwh of electricity produced by fossil-fuels emits more than one pound of C02 and uses a gallon of water for cooling. Renewable energy is a non-carbon emitter and a consumes little, if any, water in producing electricity. However, different renewable energy technologies vary by orders in magnitude in the land required to produce electricity. As Under Secretary of Energy in the U.S. Department of Energy, Johnson testified to Congress on the energy-water nexus and will update this testimony during this session. In addition, she will summarize the opportunity to responsibly expand the nation's largest renewable-hydroelectric generation by powering the tens of thousands of dams that exist for flood control, navigation, recreation, and irrigation, and could easily add renewable energy as a fifth use for these existing dams.

**Jonathan Radtke** is the Water Resource Sustainability Director for Coca-Cola North America in Atlanta, GA. In this role, he manages the company's water stewardship program, which focuses on water conservation initiatives within manufacturing facilities, source water protection strategies, community water partnerships and sustainable agriculture initiatives within the supply chain. The company aims to return to nature and to communities an amount of water equivalent to the water used in Coca-Cola's beverages and their production. Mr. Radtke's leadership has helped position Coca-Cola as an industry leader in water stewardship**.**

**WC-14 Innovation in Bioenergy and the Bioeconomy**
*(Roosevelt Room)*

Development of a vibrant bioeconomy provides a rational, transdisciplinary approach for addressing the 21st century food-energy-water nexus by focusing on identifying, producing, recycling, converting, and using renewable aquatic and terrestrial biomass resources to produce biofuels, biochemicals, biopower, and a multitude of other bioproducts in an economically, environmentally, and socially sustainable manner. World Café presentations will provide an overview of the vast amounts of ongoing public and private sector research and development of opportunities that are being conducted to ensure the food-energy-water nexus is making progress toward sustainability without producing unanticipated consequences. The focus would include agriculture potential to produce food, fiber, and fuel and reduce wastes by an integrated approach.

Moderator: Donna Perla, Senior Advisor, U.S. Environmental Protection Agency; Virginia Dale, Director, Center for BioEnergy Sustainability, Oak Ridge National Laboratory; and Doug Karlen, Agricultural Research Service, U.S. Department of Agriculture
Speakers:

- Sorrel Brown, Program Evaluator, Agriculture and Natural Resources Extension & Outreach, Iowa State University
- Kevin Comer, Associate Principal, Antares Group Inc.
- Nora Haider, Extension Coordinator, Washington State University
- May Wu, Environmental Scientist, Argonne National Laboratory

**Donna Perla** has 32 years of experience at the EPA including sustainable development of biomass & waste-to-energy systems in the Office of Research & Development (ORD), where she led ORD's sustainable biofuels research strategy and co-led an EPA-wide Biofuels Strategy. As Division Director of EPA's Project XL Program, she led regulatory flexibility and innovation for energy, water, and agricultural systems. She has worked closely with USDA & DOE as USDA's Senior Advisor for Bioenergy in the Chief Scientist's Office and as USDA Acting Director of the Financial Assistance Program Division in the Natural Resource Conservation Service. For the past ten years, she has represented the EPA on the interagency Biomass R&D Board and currently works with the Farm, Ranch, and Rural Communities Committee in the EPA Administrator's Office with the Agricultural Counselor. (202-564-0184; donnaperla52@gmail.com)

Dr. **Virginia Dale** is Director of the Center for Bioenergy Sustainability at Oak Ridge National Lab. Her primary research interests are environmental decision making, land-use change, landscape ecology, sustainable agriculture, and bioenergy systems. Virginia has authored 10 books and more than 235 articles and served on national scientific advisory boards for five agencies of the United States. She has a B.A. and M.S. in math from the University of Tennessee and a PhD in mathematical ecology from the University of Washington. Her presentation builds from a workshop sponsored by the International Food Policy Research Institute (IFPRI) on "Biofuels and food security interactions" that defined key issues and underscored the importance of clear definitions consistent terminology, and context-specific solutions. (865-576-8043; dalevh@ornl.gov)

Dr. **Douglas L. Karlen** uses soil quality assessment to quantify the effects of landscape position, tillage, crop rotation, and nutrient, manure, and crop residue removal on the sustainability of the food-energy-water nexus. He is a native of Wisconsin and has his BS, MS and PhD degrees from the University of Wisconsin–Madison, Michigan State University, and Kansas State University, respectively. Doug is author or co-author of 218 refereed journal articles; a Fellow of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, and the Soil and Water Conservation Society; and a 2015 recipient of the Hugh Hammond Bennett award for national and international leadership in natural resources conservation. (515-294-3336; Doug.Karlen@ars.usda.gov)

**Sorrel Brown s**upervises students in early field experiences and internships in the Ag Education & Studies Dept. In Extension, focus is evaluation of statewide programs in Agriculture and Natural Resources Extension, as well as annual reporting to NIFA. Served as Extension crop specialist 8 years, working with producers, agribusinesses and Extension staff to conduct research and demonstrations in crop systems, develop educational programs in crop production, and crop troubleshooting. Also managed the Pesticide and the Environment Program which oversaw pesticide applicator training. Served as State Liaison to the National Pesticide Impact Assessment Program. (515-294-8802, sorrel@iastate.edu)

**Kevin Comer** is a mechanical engineer and associate principal of the Antares Group with 15 years of professional engineering experience. Mr. Comer has eight years of experience in industrial/commercial energy efficiency analyses and techniques. While working with the Department of Energy's Industrial

Assessment Center program (formerly the Energy Analysis and Diagnostic Center program), he was the lead engineer on over 50 industrial audits, which resulted in energy conservation, waste minimization, and productivity improvements for the host manufacturers. He is also one of the ANTARES solar application staff and has been part of the photovoltaic design team. His experience includes specialized formal training in PV applications analysis and design.

**Nora Haider** is an Extension Coordinator at Washington State University working on the Advanced Hardwood Biofuels (AHB) Northwest project. Nora is contributing to the development of bioenergy outreach material and is implementing key project activities to inform and educate stakeholders. Nora is focusing outreach efforts to municipal and industrial wastewater treatment facilities across the Pacific Northwest as potential early adopters of hybrid poplar trees grow as a bioenergy feedstock. She holds a degree in Planning and Environmental Policy from Western Washington University, where she studied land use planning, environmental science, and environmental policy. (425-741-9962; nora.haider@wsu.edu)

Dr. **May Wu** is an environmental scientist at Argonne National Laboratory. As a Principal Investigator of a DOE-supported multi-year biofuel water sustainability analysis project, she is the principal author of a spatial-explicit online tool, Water Analysis Tool for Energy Resources (WATER), which provides the county-level water footprint of biofuels in the United States. Dr. Wu's research interests include water consumption, water footprint, and water quality in the production of bioenergy. She is leading efforts in watershed modeling and analysis for biofuel feedstock production in tributaries of the Mississippi river basin and in the assessment of fresh and alternative water resource use in biofuel produced from various feedstocks via biochemical and thermochemical conversion processes. Her recent work examines the impact and adaptation of climate change on biofuels. (630-252-6658; mwu@anl.gov)

### WC-15 Data Creation, Access and Utilization for Energy Development and Water Conservation

*(Kennedy Room)*

Unconventional oil and gas development often competes with agriculture and municipalities for water resources. Concerns about environmental and human health impacts of water use, as well as treatment and disposal of produced fluids also accompany energy development. Innovative technologies and processes that reduce overall water use, prevent or mitigate contamination, and increase re-use can conserve resources and reduce negative environmental impacts of energy production. However, identifying, vetting, and assessing these potential opportunities requires systematic collection and transparent access to water quality. This session will focus on the role of data collection and access initiatives in supporting best management practices by the oil and gas industry, other water users, and state and local governments. It will also address the hurdles to access to and use of data in support of decision-making processes.

Moderator: Beth Kinne, Assistant Professor of Environmental Studies, Hobart & William Smith Colleges
Speakers:

- John Amos, President, SkyTruth
- Kristen Brubaker, Assistant Professor of Environmental Studies, Hobart & William Smith College
- Jennifer Considine, Honorary Lecturer and Member, Global Academic Team, Centre for Energy, Petroleum, and Mineral Law and Policy, University of Dundee, Scotland
- Cynthia Hsu, Consultant
- John Smith, Co-founder, Smith Butz LLC
- Alfred Sorensen, President and CEO, Pieridae Energy
- David Yoxtheimer, Extension Associate, Marcellus Center for Outreach and Research, Pennsylvania State University

**Beth Kinne** is an Assistant Professor of Environmental Studies at Hobart and William Smith Colleges in Geneva, NY where she teaches environmental and natural resource law. She has experience in water law development in Taiwan and Mainland China, and practiced water rights and municipal law in western Colorado. Her current research interests include changes in water resource law in response to pressures on water resources from competing uses, and municipal land use and natural resource management decision-making processes. (315-781-3913, kinne@hws.edu)

**John Amos** is an expert in the use of satellite images and other remote sensing data to understand and communicate local, regional and global environmental issues. Educated as a geologist with an MS from the University of Wyoming and a BS from Cornell University, he spent 10 years applying image processing, image analysis, and digital mapping techniques to conduct environmental, exploration and resource assessment studies for the energy and mining industries and government entities. In 2001 John founded SkyTruth, a non-profit organization dedicated to strengthening environmental conservation by illuminating environmental problems and issues through the use of satellite images, aerial photographs, and other kinds of remote sensing and digital mapping. As President, he directs day-to-day operations, develops and manages projects and programs, and is responsible for fundraising and administration. Prior to founding SkyTruth, he worked as an exploration geologist for Advanced Resources International and Earth Satellite Corporation.

**Jennifer Considine** is an expert in Global Energy Policy. She currently holds the position of Chief Editor, Energy Politics, an energy newsletter dealing with commercial strategies, and strategic planning in the global energy industry. She has led a number of projects involving real options valuations of physical assets. Dr. Considine has worked with a number of international energy companies. She holds a Ph.D. in resource economics. On the research side, Dr. Considine has published a number of books and numerous articles concerning the global energy industry, with a focus on the history and development of the upstream petroleum industry in the Russian Federation. (646 531 7341, j.considine@dundee.ac.uk)

**Cynthia Hsu** has a background in agricultural pest management, spatial analysis/statistics, and soil/water science. She held a postdoctoral position in the Department of Entomology at Cornell University before entering public policy. For the past three years she has worked on challenges facing the electric grid, two years as a AAAS Science and Technology Policy Fellow at the Department of Energy, and one year as a Congressional Fellow working on energy legislation for the House Committee on Science, Space, and Technology. Prior to her graduate work, Cynthia worked as a reporter and in social welfare non-profits. (hsux0049@umn.edu)

Attorney **John Smith** is the co-founder of the Law Firm of Smith Butz, LLC in Washington County, Pennsylvania. Attorney Smith was the Lead Attorney who successfully argued on behalf of Pennsylvania local Municipalities in the "Landmark" decision Robinson Township vs. Commonwealth, wherein the Pennsylvania Supreme Court found several provisions of Act 13, the Pennsylvania Oil and Gas Act of 2012, unconstitutional. He was listed in the "Best Lawyers" 2015 survey results for Pittsburgh. His article, "*The Prodigal Son Returns: Oil and Gas Drillers Return to Pennsylvania with a Vengeance. Are Municipalities Prepared*?" was published in the Duquesne Law Review in 2011. (jmsmith@smithbutzlaw.com)

**Alfred Sorensen** is President and CEO of Pieridae Energy. He has over 25 years of experience in the natural gas business both in Canada and internationally. He has started several businesses over the course of his career, including Galveston LNG which was the first new liquefaction facility in North America in 40 years.

**David Yoxtheimer,** P.G. serves as a liaison to advise stakeholders on key environmental issues. He earned his B.S. in Earth Science from Penn State, where he is currently completing his Ph.D. in Geosciences. Previous to joining MCOR he spent 18 years as a consulting hydrogeologist with expertise in water supply development, karst hydrogeology, geophysical surveying, environmental permitting, shale energy geology, and integrated water resource management. (814-865-1587, day122@psu.edu)

**WC-16 Future Challenges and Solutions at the Agriculture-Water Nexus (Part 2)**
*(Potomac Rooms V, VI)*

Food production and biofuels-based energy demand in the face of changing water availability are significant global challenges in modern society. These manifest uniquely at different scales, from the farm field to global food distribution, and require innovative composite solutions in terms of policy, education, science, and technology. Solutions to water use for food and biofuel crops require resource management based upon socioeconomic and scientific understanding. This session focuses on mitigation of drought effects which are being directly met through interdisciplinary teams utilizing targeted research, policy outreach, dynamic modeling, and leading edge technology. From the Midwest to India, key accomplishments and remaining gaps in research will be examined to leverage innovations to meet these national and global challenges changing the nexus of food, energy, and water systems.

Moderator: Patrick Morgan, Senior Scientist, LI-COR Biosciences and Tess Russo, Assistant Professor, Department of Geosciences, Pennsylvania State University
Speakers:

- Tala Awada, Professor and Associate Dean, School of Natural Resources, University of Nebraska-Lincoln
- Nicholas Brozovic, Director of Policy, Robert B. Daugherty Water for Food Institute, University of Nebraska
- Naresh Devineni, Assistant Professor, Department of Civil Engineering, City College of New York
- Joshua Elliott, Research Scientist and Fellow, University of Chicago
- Michael Hayes, Director, National Drought Mitigation Center, University of Nebraska-Lincoln
- Christopher Neale, Director of Research, Water for Food Institute, University of Nebraska
- Sasmita Sahoo, Postdoctoral Student, Department of Geosciences, College of Earth and Mineral Scienes, Pennsylvania State University
- Tara Troy, Assistant Professor, Water Resources Engineering, Lehigh University
- Andrew VanLoocke, Assistant Professor, Department of Agronomy, Iowa State University

**Patrick Morgan** is a research scientist focused on advancing scientific discovery by developing solutions, applications, and instruments for measuring plant responses to environmental conditions. He specializes in plant-level measurements with emphasis on water and carbon by employing novel instrumentation to better predict and assess plant responses to a changing environment. His research focuses on scientific instruments for measuring leaf-level gas exchange, leaf area, leaf area index, and solar radiation. His team develops new applications for existing product lines to augment existing capabilities. Morgan also has an adjunct appointment in the School of Natural Resources, University of Nebraska-Lincoln. He earned a PhD in Plant Biology at the University of Illinois-Urbana Champaign and an MS and BS at the University of Wyoming. (402-467-3576; pat.morgan@licor.com)

**Tess Russo** is a hydrologist who researches hydrologic system responses to environmental change with the objective of informing restoration and management decisions. She is currently an Assistant Professor in the Department of Geosciences at Penn State. Her work includes quantifying components of the groundwater budget, modeling vadose zone infiltration rates, optimizing managed recharge projects, and assessing impacts of agricultural intensification on water resources. Tess is primarily a physical hydrologist who uses numerical and statistical models to characterize and project hydrologic system behavior; however she also works on several projects measuring and modeling the fate and transport of nutrients and trace metals. Tess has projects in east Africa, India, Papua New Guinea, Colombia, and the US. (814-865-7389, russo@psu.edu)

**Tala Awada** is a Professor of Plant Ecophysiology in the School of Natural Resources, and serves as the Interim Associate Dean of the Agricultural Research Division, Institute of Agriculture and Natural Resources at the University of Nebraska-Lincoln (UNL). Tala co-leads the Consortium for Integrated Translational Biology and the NE Long-Term Agroecosystem Network (LTAR) at UNL. She conducts research in the areas of plant ecophysiology, crop abiotic stresses, forest and grasslands ecology, ecology of invasive species, vegetation cover change as impacted by climate variability and change, and anthropogenic management. (402-472-3471; tawada2@unl.edu)

**Nicholas Brozovic** is the Director of Policy at the Robert B. Daugherty Water for Food Institute at the University of Nebraska. He works to ensure that the Institute's scientific and policy research effectively informs policy and decision makers. He also oversees the Institute's social innovation and entrepreneurship programs. Brozovic has extensive experience in water policy and management worldwide. Within the food-energy-water nexus, he is working on the design and implementation of environmental markets, on understanding needs for good resource governance, and on the analysis of real-time data to improve agricultural water use. Brozovic holds PhD and MS degrees in agricultural and resource economics from the University of California, Berkeley, an MS in geology from the University of Southern California, and a BS in geology from Oxford University. (402.472.5145; nbrozovic@nebraska.edu)

**Naresh Devineni** is an Assistant Professor in the Department of Civil Engineering and a Faculty Affiliate at NOAA-Cooperative Remote Sensing Science and Technology Center in The City University of New York's City College. He holds an MS and PhD in Civil Engineering from North Carolina State University. He did his post-doctoral studies at Columbia University. He also worked as a Consultant for the World Bank for brief period in 2009. He has diverse interests in hydro-climate modeling and extremes analysis, statistical methods, water sustainability and risk assessment and water systems analysis. (212-650-8440, ndevineni@ccny.cuny.edu)

**Joshua Elliot**, University of Chicago, works on topics at the interface of global change, environmental, and social sciences through applied modeling and computational projects. Elliot is Co-Principal Investigator and Impacts Team lead at the NSF-funded center for Robust Decision-making in Climate and Energy Policy (RDCEP) and leads the Global Gridded Crop Model Intercomparison (GGCMI) project. He uses large-scale high-resolution models enabled by big data and computing to improve global change vulnerability assessments and tools, and also works on predictions of agriculture at seasonal scales, effects of large-scale drought and heat events, and with socio-economic modeling and scenario analysis in the context of integrated assessment models. (773-896-6044; joshuaelliott@uchicago.edu)

**Michael Hayes** is Director of the National Drought Mitigation Center, University of Nebraska–Lincoln. He researches drought monitoring, impact assessment, and planning methodologies, and has assisted local, state, tribal, and federal officials. Recent droughts demonstrate the global connectedness of agriculture, markets, and the worldwide impacts that droughts can have. The 2012 drought in the central U.S. illustrated that American agriculture is vulnerable and can contribute to global food security issues. Corn yields illustrate how technology and irrigation are important strategies to fight droughts. These will become more important as climate variability may increase. Efforts to improve soil health can help central U.S. agriculture better prepare for both increased wetness and severe droughts, and is currently being promoted by USDA's National Resources Conservation Service. (402-472-6702; mhayes2@unl.edu)

**Christopher Neale** is the Director of Research at the Robert B. Daugherty Water for Food Institute at the University of Nebraska. He oversees the Institute's research efforts, engages faculty in new projects, and initiates partnerships with organizations and universities worldwide. Neale has extensive experience developing remote sensing applications for irrigated agriculture, hydrology and natural resources monitoring. Prior to joining the University of Nebraska in 2013, Neale spent 25 years as a

professor of irrigation engineering at Utah State University. He is president of the International Commission on Remote Sensing of the International Association of Hydrological Sciences and has worked on the ground in the western U.S., Africa, South America and the Caribbean. He holds a PhD in Agricultural Engineering from Colorado State University. (402-472-5145; cneale@nebraska.edu)

Dr. **Sasmita Sahoo** is a postdoctoral research associate in the Department of Geosciences, Pennsylvania State University, working with Dr. Tess A. Russo. Her research focuses on studying the impacts of climate change on groundwater fluctuation patterns through natural and human-induced processes. Dr. Sahoo uses historical observations of climate and hydrological variables and modeled irrigation-water demand to develop empirical and statistical models. The results will help us to understand the dynamic relationship between climate change and groundwater in both space and time. Overall, this study will help in sustaining groundwater resources in climate adaptation strategies, as the value of groundwater for global water and food security tends to escalate under climate forcing. (814-826-4230; sasmita@psu.edu)

**Tara Troy** is an Assistant Professor for Water Resources Engineering at Lehigh University. Dr. Troy's research lies at the intersection of climate, water, and food, with a particular interest in understanding the role of climate variability on water supply and demand across a variety of scales. To do this, she uses a computational hydrologic model, remote sensing, in situ measurements, and reanalysis products with work focusing on developing numerical models that include human activities, such as irrigation, and high resolution flood modeling. Prior to joining Lehigh's faculty, Dr. Troy was an associate research scientist for the Columbia Water Center at Columbia University. She is an author on more than 15 papers in peer-reviewed journals and has presented her work at both domestic and international conferences. She is a guest editor for a special issue of *Hydrology and Earth System Sciences* and is serving on the American Geophysical Union's Hydrology Section Outstanding Student Paper Award committee.

**Andrew VanLoocke** is an Agricultural Meteorologist in the Department of Agronomy at Iowa State University. Andy studies the impacts of land use change as well as global change on water relations in agroecosystems. His team uses a combination of micrometeorology and plant physiological measurements along with agroecosystem models to scale crop water use from the leaf, to the canopy, and to the region. Global change research topics include the impacts of increasing CO2, O3 and/or temperatures on crop water demands and water cycling. Land use change research topics include bioenergy production scenarios such as transitioning to perennial C4 grasses or biomass sorghum in the Central and Midwestern U.S. Andy is excited to participate in the WC-16 Future Challenges and Solutions at the Agriculture-Water Nexus (Part 2). (andyvanl@iastate.edu)

**WC-17 Innovative Solutions in Cities (Part 2)**

*(Jefferson Room)*

Urban water and energy systems evolved to be centralized but disconnected systems many of which are now financial and ecological liabilities. The presentations will cover how urban systems can operate as largely self-reliant, independent but interconnected systems that provide improved environmental outcomes, alternatives for capital investment, critical engagement of corporate partners and provide the interactions of the food-energy-water nexus that move towards water and energy minimums, improved resilience and sustainability as well improving environmental outcomes.

The Café presenters will outline systems that exist or are being planned for implementation to meet these challenges. They will outline the limitations, the successes and the challenges of each case study. The discussion should illuminate the issues and challenges for the FEW vision in urban systems.

Moderator: Carmel Ruffolo, Associate Vice President for Research and Innovation, Marquette University
Speakers:

- David Garman, Founding Dean, School of Freshwater Sciences, University of Wisconsin-Milwaukee
- Kristin Getter, Academic Specialist, Michigan State University*
- Deron Lovaas, Senior Policy Advisor, Urban Program, National Resources Defense Council*
- Nathan Phillips, Professor of Earth and Environment, Boston University
- James Wasley, Director of the Institute for Ecological Design and Professor, School of Architecture and Urban Planning, University of Wisconsin-Milwaukee

Dr. **Carmel Ruffolo** is the Associate Vice President for Research and Innovation at Marquette University. She has actively collaborated with sector partners to help make the Milwaukee region a national water hub. Her work on credit transfer between educational institutions has become the basis for linked water technology education regionally. Currently, she focuses on technology transfer especially of water and energy innovations. Dr. Ruffolo has been involved in economic development and entrepreneurial initiatives centered on water, water technology and workforce development. Dr. Ruffolo works closely with companies, entrepreneurs, academic institutions, government agencies and other organizations such as The Water Council and Mid-West Energy Research Consortium to address the many interest and goals of Marquette University and the region. (442-886-9250, carmel.ruffolo@marquette.edu)

**David Garman** is the Founding Dean of the School of Freshwater Sciences at the University of Wisconsin-Milwaukee. His career has covered the full range of environmental management from water resources and pollution control through to new environmental technologies, covering all aspects of measurement, management policy, and strategy analysis.

**Deron Lovaas** is Director of State/Federal Policy & Practice for the Natural Resources Defense Council's (NRDC's) Urban Solutions Program. He advocates for policies that boost efficiency of affordable housing as part of the Energy Efficiency for All project, and for investments in smart transportation and community development. He is an expert on a variety of issues and has testified many times before Congress and other policymaking institutions on topics including dependence on oil, energy efficiency, fuel economy, transportation infrastructure, roads and bridges, public works, gas taxes, aviation, buses, railroads and bicycle and pedestrian projects.

**Nathan Phillips** is Professor of Earth and Environment at Boston University. His research focuses on physiological mechanisms that regulate water, carbon, and energy exchanges between plants/ecosystems and the environment, especially in the context of environmental change. More recently, this research has been translated to studies of the ecology "in cities", and the ecology "of cities", in an interdisciplinary research program called "Urban Metabolism" supported by the National Science Foundation and Boston University's Sustainable Neighborhood Laboratory.

**James Wasley** is a Director of the Institute for Ecological Design and the former Chair of the Department of Architecture. He is the Past-President of both the Society of Building Science Educators and the Wisconsin Green Building Alliance: An Affiliate of the United States Green Building Council. He was a founding member of WGBA in 1997. Professor Wasley's current research is in the creation of ecological urban waterscapes at a variety of scales. He has been designing and building stormwater demonstration projects on the UWM campus since 2005. Since 2011 he has led the school-wide Milwaukee Inner Harbor Project, which has explored the redevelopment and ecological restoration of the 200+ acres of brownfields surrounding the Port of Milwaukee. This has in turn led to a suite of ten demonstration projects on the harbor at the UWM School of Freshwater Sciences that are moving towards implementation.

**WC-18 Best Practices in Teaching at the Nexus**

*(Lincoln Room)*

This session will focus on the current status of education about the Food-Energy-Water Nexus. It will be a great opportunity for interested participants to share experiences on the current best practices, discuss what has worked, and present problems which have been encountered. Also it will be an opportunity to discuss new ideas and examine new strategies to counter challenges in teaching the Nexus. The session will consider teaching the Nexus at different scales and focus on where we can leverage our collective capacity to build new strategies and present the complexities of the nexus to a variety of audiences. We will evaluate where the best opportunities are for partnerships with sharing resources, research collaborations, papers, grants and funding sources.

Moderator: Laura Lindenfeld, Director, Margaret Chase Smith Policy Center, University of Maine
Speakers:

- Anna Aguilera, Assistant Professor of Biology, Simmons College
- Kathleen Bell, Professor, University of Maine
- Hossein Noorian, Professor, Department of Business Management, Wentworth Institute of Technology
- Henderson Pritchard, Associate Professor, Wentworth Institute of Technology
- Gayle Zydlewski, Associate Professor, School of Marine Sciences, University of Maine

**Laura Lindenfeld**'s work draws inspiration from the idea that we can make better, more informed decisions about how we shape our collective future. As a researcher of communication, her work focuses on how we can advance meaningful, productive interactions with communities, stakeholders, and decision makers by advancing linkages between knowledge and action. The Smith Policy Center is a nonpartisan, independent research unit which serves as the state's premier resource for applied public policy research. It informs public policy processes and societal decision-making through timely research and applied public policy activities focused on critical issues facing Maine and the nation. Much of her work has focused on environmental communication, especially in the area of sustainable food systems. (207-949-3679; laura.a.lindenfeld@maine.edu)

**Anna Aguilera** is an Assistant Professor in the Biology Department at Simmons College, where she teaches courses in Environmental Science and Ecology. In recent years she has designed and taught courses that explore modern agriculture and its alternatives. Her research is primarily focused on ecosystem effects of invasive species and she has recently expanded her work to include agricultural species. (617-521-2666;aguilera@simmons.edu)

Professor **Kathleen Bell** employs economics to address environmental, public health, and economic development issues. Dr. Bell studies the attitudes and behaviors of individuals and organizations to improve management of land and water resources. She has advanced novel interdisciplinary coursework and training to facilitate scientific innovations and improve the alignment of research with societal needs. Dr. Bell has served as a leader on several large interdisciplinary research programs. Her economics expertise, interdisciplinary research experience, connections to stakeholders, and leadership skills have greatly benefited these programs. Kathleen's current focus is innovations at the food-energy-water nexus in coastal systems. (207-581-3156; kpbell@maine.edu)

**Hossein Noorian** is a professor at the Department of Business Management at Wentworth Institute of Technology. His areas of teaching are accounting and financial management. He has been involved with the NCSE in the last 9 years and actively utilizing the conference findings in his courses. Prof. Noorian was granted the "2104 Excellence in Teaching Award" by the International Assembly for Collegiate Business Education (IACBE). IACBE is one of the leading national accrediting agencies which recognizes the business programs in the United States and other selected countries in the world. Prof. Noorian is the recipient of many teaching awards; among them the "Gold Leopard Award" by the Wentworth

Alumni Association and the President's Award for Excellence in Teaching; the "Grant Johnson Award". (617-989-4376; noorianh@wit.edu)

**Henderson Pritchard**'s work is primarily in sustainable materials, as well as sustainable resources, such as water, energy and food. He works with sustainable building materials, strategies for resilient building construction and land use planning. For the past few years, Pritchard has been involved with interdisciplinary teaching about the topics of food, water and resources and sustainability in the face of shifting climate. He is also interested in working with a variety of teaching strategies for presenting Food, Water, Energy topics to interdisciplinary students. (617-989-4180; pritchardh@wit.edu)

**Gayle Zydlewski** studies conservation of marine resources, focusing on fish populations. She approaches this work from an interdisciplinary perspective, recognizing the need for input from natural and social sciences to reach conservation goals that balance human need for food, energy and water. She believes the points of intersection among coastal FEW systems, institutions, and disciplines, can be used to link fundamental scientific knowledge to evidence-based decisions. Such linkages need to be incorporated in graduate training so the next generation can solve the developing problems of this nexus. Gayle works with others to involve key stakeholders in the center of research to infuse real-world experience in graduate education to move beyond the challenge of conventional disciplinary graduate programs. (207-581-4365; gayle.zydlewski@maine.edu)

## WC-19 Integrating Food, Energy and Water Planning for Sustainable Development

*(Arlington & Fairfax Rooms)*

The goal of the symposium is to advance awareness and the ability of development agencies to develop, prioritize, and implement holistic resource security initiatives to promote sustainable development. The first step towards building a sustainable society is to evaluate the state of resources across the water-food-energy-health spectrum, identify and evaluate sustainability goals encompassing these societal fundamentals, and devise metrics for evaluating progress towards, or modification of, these sustainability goals. These interrelated questions of social, economic, environmental, and other sustainability goals will be discussed in terms of systems analysis. We will focus on tropical West Africa, considering how climate forecasts can be applied to developing safe and resilient water resources, reliable energy supplies and predictions of disease outbreaks.

Moderator: Jenni Evans, Professor of Meteorology and Associate, Pennsylvania State Institutes of Energy and the Environment, The Pennsylvania State University
Speakers:

- Ana Barros, James L. Meriam Professor of Civil and Environmental, Pratt School of Engineering, and Professor of Earth and Ocean Sciences, Nicholas School of the Environment, Duke University
- Morgan Bazilian, Lead Energy Specialist, The World Bank
- Jeffrey Brownson, Co-Director, 2iE-PSU Centre for Collaborative Engagement in West Africa, and Lead Faculty, Renewable Energy & Sustainability Systems (RESS) Solar Option Program, The Pennsylvania State University
- Mark Howells, Professor, Energy Systems Analysis, KTH Royal Institute of Technology, Sweden
- Gregory Jenkins, Professor, Department of Meteorology, The Pennsylvania State University
- Andrew Morse, Professor of Climate Impacts, University of Liverpool
- Henry Willis, Senior Policy Researcher, RAND Corporation

Beginning from the physics driving long-lived precipitation systems, **Jenni Evans** seeks to understand the impact of changes in the underlying climate on water resources. She is known for her work on weather and climate in the global tropics, including tropical cyclones and convective weather systems (rainfall lasting a day or so). The majority of the rainfall in tropical Africa comes from these storms, so

understanding how climate changes will impact them is critical to planning for future societal investments. This work has led her to consider the health impacts of climate variability in the Caribbean and to look for other challenges at the interface of society and science. (814-865-3240; jle7@psu.edu)

**Ana Barros**'s interests are at the intersection of climate, hydrology, ecology, and energy with a focus on the spatial and temporal variability of surface and groundwater, nonlinear interactions among soil moisture, blue and green water resources and associated landscape productivity, and the development of science-based adaptive strategies for resource management linking water, food, and energy networks. Ana is especially interested in understanding and quantifying variability in regions of complex topography and physiography, and along dynamic hydroclimatic boundaries and vegetation transitions using observations and models. (919-660-5539; barros@duke.edu)

**Morgan Bazilian** has over two decades of experience in the energy sector. Dr. Bazilian is a member of the World Economic Forum's Global Advisory Council on Energy, is Visiting Professor at KTH in Sweden, and a Research Associate at Cambridge. Previously he worked for the U.S NREL, in the United Nations, and for the Irish Government (mbazilian@worldbank.org)

**Jeffrey Brownson** researches the evolving interdisciplinary themes of photovoltaics, community solar, energy economics, and sustainability. Solar photovoltaics are the bellwether for new opportunities in integrative solar energy goods and services. This world café presents energy for Africa in transformation, evolving from combustible fuels to a new wave of renewable energy affecting the global food-energy-water nexus. Energy impacts in water, ecosystems services, food systems, and social systems demonstrate how a "solar ecology" framework will contribute to a new wave of coupled discoveries and social change influencing the food-energy-water nexus by 2100. (814-867-4227; solarpower@psu.edu)

**Mark Howells**' research covers energy systems analysis, methodological development, and modelling of energy systems in global and regional perspectives with the aim to develop decision support systems for decision makers. Before joining KTH, he worked at the Planning and Economic Studies section (PESS) in the International Atomic Energy Agency (IAEA) in Vienna. There, he worked with the application of energy systems analysis to answer questions relating to social, economic, environmental and other strategic goals.

**Greg Jenkins'**s background is in atmospheric modeling and observations with an emphasis on West Africa. He is known for his work on understanding the processes associated with weather, climate, and natural sources of tropospheric ozone associated with West Africa. He has been actively been working to increase the observational and human capacity in the atmospheric sciences in West Africa. In this presentation, Greg will discuss the current and future weather/climate risk associated with different sources of water in West Africa and how active monitoring and forecast systems should be developed to protect West African populations.

**Andrew Morse** works on the impacts of climate variability and climate change on human and animal health. He is best known for his work on the impacts of climate variability at seasonal scales on health through integrating health impacts models, especially dynamic malaria models, with ensemble prediction systems. He has been active in transferring these skills across other disciplines and impact areas, including working with businesses. He also works on longer climate change impacts on disease using outputs from a range of global climate models using probabilistic approaches to bound the uncertainties in projections. (+44 151 794 2879; A.P.Morse@liv.ac.uk)

**Henry Willis**' research applies decision analytic tools and risk analysis to help decision makers choose among competing resource management strategies or policy options. He has used this approach to address the technical, economic, institutional, and social components of problems related to economic development, environmental policy, and disaster management. An example of his recent research is developing the Pardee RAND Food-Energy-Water Index for global resource security. Henry earned a PhD studying risk analysis and management and worked for several years as an environmental engineer.

**WC-20 Soil: The Invisible Link Between Food, Water, and Everything Else**
*(Washington Room B)*

Healthy soil plays a crucial role within the food-energy-water nexus, as essential to the water supply as it is to food production. For example, of the total global annual precipitation falling on land, 61 percent becomes green water (water stored in soils and available for plants), while 39 percent goes to rivers, lakes, and aquifers. Presentations in this section will explore the importance of healthy soil for addressing climate change and preserving our water supply. We will then hear about regenerative agricultural practices from the farm perspective, followed by policy options to improve soil security for generations to come.

Moderator: Allison Aubrey, Correspondent, National Public Radio News
Speakers:

- Lara Bryant, Soil Health Fellow, Natural Resources Defense Council
- Jonathan Cobb, Farmer, Texas
- Diana Donlon, Director, Cool Foods Campaign, Center for Food Safety
- Heather Gall, Assistant Professor, Department of Agricultural and Biological Engineering, Pennsylvania State University
- Henry Lin, Professor of Hydropedology/Soil Hydrology, Pennsylvania State University
- Christine Morgan, Professor, Texas A&M University

**Allison Aubrey** is a correspondent for NPR News. Aubrey is a 2013 James Beard Foundation Awards nominee for her broadcast radio coverage of food and nutrition. And, along with her colleagues on The Salt, inner of a 2012 James Beard Award for best food blog. Her stories can be heard on *Morning Edition* and *All Things Considered.* She's also host of the NPR video series *Tiny Desk Kitchen.* Through her reporting Aubrey can focus on her curiosities about food and culture. She has investigated the nutritional, and taste, differences between grass fed and corn feed beef. Aubrey looked into the hype behind the claims of antioxidants in berries and the claim that honey is a cure-all for allergies.

**Lara Bryant** is a Soil Health Fellow at the Natural Resources Defense Council. Growing up in rural East Tennessee, Bryant learned the importance of sustainable agriculture. Later she studied soil science and then worked for years as an environmental chemist, analyzing soil for public safety. When she realized that people are the most effective tool for change, she made a career change and for the past several years has worked for non-profits in Washington, DC as an advocate for sustainable agriculture and soil health. For NRDC, Bryant advocates for public policy that recognizes the importance of soil as the foundation of a resilient future with plentiful food, sustainable energy, and clean, safe water for all. (202-717-8236; lbryant@nrdc.org)

**Jonathan Cobb** is a soil rancher and is passionate about regenerating the soil and providing healthy nutrient-dense food for his family and community. After seven years of row crop farming 2,500 acres with his father, Jonathan nearly left the farm. It was an introduction to soil health that gave hope and led him to stay and change the paradigm. Jonathan and his sister started Green Fields Farm in 2013 and currently provide grass-fed & finished beef and pastured eggs from their family farm in central Texas. He also works with Green Cover Seed to provide custom cover crop mixes as a tool to help others regenerate the life in their soils.

**Diana Donlon** is the Center for Food Safety's (CFS's) Food and Climate Campaign Director where she leads Soil Solutions—a program communicating the critical importance of rebuilding soil health for food security, fresh water availability, and climate stability. Before coming to work for CFS, Diana worked for a variety of family foundations supporting youth and sustainable agriculture programs and was one of the founders of Roots of Change, a state-wide collaborative transitioning California's food system. As a

program executive at the Goldman Environmental Prize, she helped elevate the critical causes of environmental activist around the world.

**Heather Gall** is an Assistant Professor in the Department of Agricultural and Biological Engineering at Pennsylvania State University. She studies the effects of agricultural management practices on water quality, with an emphasis on the fate, transport, and impacts of emerging contaminants (ECs). Heather is interested in understanding how, when, and why soils act as either a sink or source ECs, and how legacy agricultural activities influence the trajectory of landscape responses to changes in management practices. (814-863-1817; heg12@psu.edu)

**Henry Lin** received his PhD in Soil Science from Texas A&M University. His research and teaching program focuses on the development of hydropedology as an intertwined branch of soil science and hydrology that embraces integrated studies of the landscape-soil-water-ecosystem relationship across scales. He is a Fellow of the Soil Science Society of America and of the Agronomy Society of America. He has published over 190 papers and edited ten special issues of various scientific journals. He is interested in the holistic understanding of the food-energy-water nexus as it relates to soil health, green water, environmental quality, ecosystem sustainability, and the Earth's Critical Zone. (814-865-6726; henrylin@psu.edu)

**Christine Morgan** is a Professor at Texas A&M University. Soil security requires maintenance and improvement of the soil resource to produce food, fiber, and fresh water, to contribute to sustainable energy production, adapt to climate changes, and to maintain biodiversity, human health, and function in ecosystems. Achieving soil security involves scientific, economic, industry and political engagement to effectively and credibly inform policy frameworks and implement appropriate actions. Soil security has a number of dimensions that interact with environmental, social, and economic components. A soil security framework can be defined using five dimensions, which include capability, condition, capital, connectivity and codification. (979-845-3603; cmorgan@ag.tamu.edu)

**WC-21 Food, Energy and Water in the Corn Belt**
*(Prince William Room)*

The purpose of this session is to explore the complex relationships among food, energy, and water in the Corn Belt and discuss opportunities to optimize societal benefits while minimizing negative consequences. It reports on major new findings of the USDA-funded "Climate and Corn-based Cropping Systems CAP (CSCAP or 'Corn Cap')," a transdisciplinary partnership among 11 institutions creating new science and educational opportunities. The CSCAP seeks to increase the resilience and adaptability of Midwest agriculture to more volatile weather patterns by identifying farmer practices and policies that increase sustainability while meeting crop demand. The team's vision is to create a region-wide coordinated functional network to develop science-based knowledge that addresses climate mitigation and adaptation, informs policy development, and guides on-farm, watershed level, and public decision-making in corn-based systems.

Moderator: David Blockstein, Senior Scientist, National Council for Science and the Environment
Speakers:

- Robert Anex, Professor, Biological Systems Engineering, University of Wisconsin–Madison
- J. Gordon Arbuckle, Associate Professor, Iowa State University
- Rattan Lal, Director, Carbon Management and Sequestration Center, The Ohio State University
- Kristi Lekies, Associate Professor and Extension Specialist, The Ohio State University
- Dennis Todey, Extension State Climatologist, South Dakota State University
- Lois Wright Morton, Professor of Sociology, Iowa State University

Dr. **David Blockstein** is a member of the education team of the USDA-funded "Climate and Corn-based Cropping Systems CAP (CSCAP or 'Corn Cap')," which is a transdisciplinary partnership among 11 institutions creating new science and educational opportunities. He is the Executive Secretary of the Council of Energy Research and Education Leaders (CEREL) and Advisor to the Association for Environmental Studies and Sciences (AESS). (202-207-0004; David@NCSEonline.org)

**Robert Anex** is a Professor of Biological Systems Engineering at the University of Wisconsin-Madison. Dr. Anex's research is focused on developing and assessing systems for producing energy, fuels and products from biorenewable resources. For example, Dr. Anex's research group is studying economic and environmental feasibility of biorenewable chemicals being developed in the Engineering Research Center for Biorenewable Chemicals (CBiRC), nutrient recovery and cycling in biofuel systems, and impacts of biomass production on the hydrologic cycle. Dr. Anex's research combines process development in the laboratory with large-scale model-based assessment of agricultural-industrial systems. Key tools used to evaluate the economic efficiency and environmental sustainability of biobased products are Life Cycle Assessment (LCA) and Techno-economic Analysis (TEA). Dr. Anex and his students have been working understand the interdependencies among agricultural and industrial systems with the goals of ensuring food, water and energy security for an ever-growing population.

**J. Gordon Arbuckle** is an associate professor and extension sociologist at Iowa State University. He centers his research and extension efforts on increasing the resilience and adaptive capacity of agricultural systems. He has expertise in survey research, with a primary focus on farmer decision-making, especially as it pertains to soil and water quality. He is lead social scientist for the Climate Change, Mitigation, and Adaptation in Corn-Based Cropping Systems (CSCAP) project, a USDA National Institute of Food and Agriculture (NIFA)-funded effort to develop and promote more resilient agricultural systems in the U.S. Corn Belt. He is also Director of the Iowa Farm and Rural Life Poll, an annual panel survey of Iowa farmers. (515-294-1497; arbuckle@iastate.edu),

**Rattan Lal** is the Director of the Carbon Management and Sequestration Center at The Ohio State University. The center studies soil carbon sequestration, soil and water conservation and management, soil structure improvement through conservation agriculture, mulch farming, cover cropping and integrated nutrient management. He also focuses on soils of the tropics in relation to food and nutritional security, and adaptation and mitigation of climate change. (614-292-9069; lal.1@osu.edu)

**Kristi Lekies** is Associate Professor and Extension Specialist in the School of Environment and Natural Resources at The Ohio State University. With a background in human development, her work focuses on human-nature interactions across the life span, including individuals' experiences in natural settings, school and community gardens, and environmental education and outdoor recreation programs. Over the past five years, she has served as evaluator for the courses, climate camps, and other educational activities developed for teachers and graduate students as part of the USDA Corn-Based Cropping Systems project.

**Dennis Todey** is an Extension State Climatologist at the South Dakota State University. He has a PhD and BS from Iowa State University and an MS from South Dakota School of Mines and Technology, all in Meteorology. His research focuses on gathering data from different observation networks and comparing the data from them for consistency and comparability; understanding climate effects on yield trends in the Midwest; relationships of Pacific sea-surface temperatures and changes on Midwest climate and agriculture; natural and human-induced changes in the water balance at the atmosphere-land surface interface; and South Dakota climate trends.

**Lois Wright Morton** received her PhD in Development Sociology at Cornell University. She is currently a Professor of Sociology in the College of Agriculture and Life Sciences at Iowa State University. Dr. Morton directs the USDA-National Institute of Food and Agriculture (NIFA) Climate & Corn-based

Cropping System Coordinated Agricultural Project (CSCAP), a $20 million research-extension-education transdisciplinary project involving 140 scientists from ten land grant universities and the USDA Agricultural Research Service in the nine-state upper Midwest region. Dr. Morton's areas of research include civic structure; social relations and human dimensions of natural resource management; performance-based agricultural environmental management in local watersheds; and impacts of long term weather change on agricultural land use management, rural communities, and rural quality of life. (515-294-2843; lwmorton@iastate.edu)

**WC-22 Aquaponic and Hydroponic Systems in Controlled Environments**

*(Potomac Rooms I, II)*

This session will address the potential of hydroponic and aquaponic (aquaculture with hydroponics in a closed loop) systems within controlled environments (CEs) to sustainably meet demands for food production with limited resources. In conventional agriculture, food productivity is limited by the input of energy, water, nutrients, and labor, and modulated by local climate. In contrast, with CE, optimal crop potential is realized through efficient production methods, resource recycling and reuse, and effective control of the plant's aerial and root-zone environments. In addition, the effects of climate variability in CE are reduced or eliminated by utilizing controlled structures to offer nutritious, safe, secure, and predictable products. Aquaponic and hydroponic food production systems that utilize organic, inorganic, and/or recycled natural resources for plant fertilization will be presented.

Moderator: William "Bill" Cooper, Director, Environmental Engineering Program, National Science Foundation
Speakers:

- Rachel Brennan, Associate Professor of Environmental Engineering, Pennsylvania State University
- Gene Giacomelli, Director, Controlled Environment Agriculture Center, University of Arizona
- Michael Mageau, Assistant Professor, Environment and Sustainability, University of Minnesota, Duluth
- David Specca, Assistant Director of Controlled Environment Agriculture and Bioenergy, Rutgers University

**Bill Cooper** directs the NSF program that funds projects looking at the environmental engineering implications of energy and resource consumption; the availability of high quality water supplies; and the fate and transport of contaminants of emerging concern in air, water, and soils. Prior to joining NSF in 2013, Bill was a Professor and Director of the Urban Water Research Center at the University of California, Irvine.

**Rachel Brennan,** PhD, PE, is an Associate Professor of Environmental Engineering at Penn State University and a Senior Consultant with Golder Associates. Her area of expertise is in the research, development, and application of sustainable technologies for the treatment of a variety of water contaminants, including chlorinated solvents, hydrocarbons, explosives, pharmaceuticals, pesticides, and acid mine drainage. Her current research efforts focus on ecological wastewater treatment, enhanced nutrient removal, and the beneficial reuse of aquatic plant biomass for the production of sustainable fertilizers, feedstocks, and biofuels. She currently serves as Director of Penn State's Advanced Ecological Engineering Systems Lab (Eco-MachineTM) and is the Faculty Advisor to the Penn State chapter of Engineers Without Borders. (814-865-9428; rbrennan@engr.psu.edu)

Dr **Gene Giacomelli**, Director of the Controlled Environment Agriculture Center at the University of Arizona, Tucson, is a professor in the Agricultural/Biosystems Engineering Department. He focuses on research, design, development, and applications of controlled environment plant production systems

(greenhouse/growth chamber), with emphases on: crop production, nutrient delivery, environmental control, mechanization, and labor. He continues NASA studies on bioregenerative life support food systems. With Sadler Machine Co., he designed and implemented an automated food growth chamber at the NSF South Pole Station in Antarctica. Other efforts include educating students in engineering and science; outreach for application through Cooperative Extension; and collaborating with businesses for economic development. (520-626-9566; giacomel@ag.arizona.edu)

**Michael Mageau** received a MS Degree in Environmental Biology from the University of Minnesota Duluth (UMD) and a PhD in Environmental Science with a certificate in Ecological Economics and Sustainable Development from the University of Maryland. He is currently an Assistant Professor of Environment and Sustainability at UMD. Michael directs the Environment and Sustainability (ES) undergraduate degree program and the Center for Sustainable Community Development (CSCD). Michael's research and teaching interests are aimed at sustainable community development with a focus on renewable energy systems and sustainable food systems. In the past five years, he has developed and directed Victus Farms, a 9,000 square foot controlled environment agriculture (CEA) production facility aimed at creating an economically viable model for year-round, sustainable food production in cold climates. (218-726-6133; mmageau@d.umn.edu)

**David Specca**'s work focuses on sustainable greenhouse practices including hydroponics, aquaponics, and clean energy technologies such as anaerobic digestion, biofuels, and combined heat and power (CHP). He serves as the Assistant Director for Controlled Environment Agriculture and Bioenergy at the Rutgers University EcoComplex and also owns and manages a u-pick fruit and vegetable farm. His experience in both the research and commercial aspects of the food-energy-water nexus gives him a unique perspective for the integration of systems that are technically sound and economically feasible. He has a BS in Horticulture and an MS in Plant Science from Rutgers University and serves as the Agricultural Representative on the New Jersey Water Supply Advisory Council. (609-499-3600; specca@aesop.rutgers.edu)

## **Workshops** (Wednesday 2:00 p.m. – 5:00 p.m.)

### W-1 Managing Water Resources at the River Basin Scale
*(Potomac Rooms III, IV)*

This workshop will identify scientific and policy challenges in understanding how humans interact with food-energy-water systems as well as identify practical challenges to integrating human behavior and hydroclimatic models at the river basin scale. Experts will discuss the challenges of sustaining water supplies with changes in land use, climate and population. A facilitated discussion will review what actions are needed to improve climate adaptation knowledge transfer among societies and forward technical and institutional innovation to sustain, improve, or transition agriculture, urban development, environmental protection, and energy production and consumption in snow-fed arid lands. Outcomes will include: (1) a network of scholars active in research and policy development for communities living in snow-fed river basins; (2) the identification of common climate adaptation challenges; and (3) a collaborative report and journal article.

Moderators: Maureen McCarthy, Great Basin Program Director, University of Nevada, Reno and Dustin Garrick, Assistant Professor and Philomathia Chair of Water Policy, McMaster University, Food, Energy, Environment, Water ($FE^2W$) Network
Speakers:

- Michael Dettinger, Research Hydrologist, U.S. Geological Survey
- Derek Kauneckis, Associate Professor, Voinovich School of Leadership and Public Affairs, Ohio University
- Claudia Ringler, Deputy Division Director, National Resource Theme, International Food Policy Research Institute
- Loretta Singletary, Adjunct Professor, University of Nevada, Reno

**Maureen McCarthy**, as Great Basin Program Director at the University of Nevada, Reno (UNR), coordinates transdisciplinary research and outreach programs with scientists, water and natural resource managers, and tribal communities in the Great Basin and American Southwest. She serves as Director of the Great Basin Cooperative Ecosystem Studies Unit and Chair of the Great Basin Landscape Conservation Cooperative Steering Committee. Dr. McCarthy is also Executive Director of the Tahoe Science Consortium, where she coordinates applied research and science-based decision-making in support of environmental management in the Lake Tahoe Basin. (775-784-8262; mimccarthy@unr.edu)

**Dustin Evan Garrick** specializes in water allocation policy and river basin governance in water stressed regions of Western North America and Southeast Australia. He holds grants from the Canadian and Australian Research Councils to investigate adaptation to climate extremes and water allocation reform in North America and Australia. He has a special interest in interdisciplinary and science-practitioner networks that connect science and policymaking. He currently serves on the management committee of the Food, Energy, Environment and Water ($FE^2W$) Network. He recently served on the Global Water Partnership/OECD task force on Water Security and Sustainable Growth and is active on a number of international and comparative water policy projects.

Dr. **Michael Dettinger** is a research hydrologist for the U.S. Geological Survey, Branch of Western Regional Research, and a research associate at Scripps Institution of Oceanography, who researchs the hydrology, climate, and water resources of the West, focusing on regional surface water and groundwater resources, hydroclimatic variability, and climate-change impacts.

**Derek Kauneckis** is an associate professor at Ohio University's Voinovich School of Leadership and Public Affairs, where he teaches in the Environmental Studies Program. He received a Ph.D. in Public Policy from Indiana University at Bloomington. Dr. Kauneckis' research focuses on governance and

institutional design as applied to environmental and science/technology policy. His current work focuses on climate change adaptation and local governance, the resilience of socio-ecological systems, policy innovation and the science/policy interface. He is currently studying the climate resilience of western river systems, local government climate change policies and the emergence of local and regional green business programs.

**Claudia Ringler** leads the Natural Resource Theme at the International Food Policy Research Institute (IFPRI) with a focus on policy analyses for enhanced resource use efficiency across water, land, and energy for more sustainable food production systems. Dr. Ringler is also a flagship co-lead of the CGIAR Research Program on Water, Land and Ecosystems on Managing Resource Variability and Competing Uses, which has ongoing nexus research in various developing country river basins. Claudia is also chairing the Food, Energy, Environment and Water network ($FE^2W$), which uses a risk-based approach to the nexus focusing on identifying solutions in six large river basins. Finally, Dr. Ringler is involved with the Sustainable Water Future's program (under Future Earth) on the Nexus. (202-862-5600; c.ringler@cgiar.org)

**Loretta Singletary** is an Adjunct Professor at the University of Nevada, Reno. Her areas of study are climate change, GIS and spatial analysis, global change, interdisciplinary modeling, international work, and water resources in developing countries.

### W-2 The Roadmap to Reduce Food Waste: A Focus on Scalable, Transformative Innovation
*(Tidewater Room)*

This workshop will explore how existing practices and solutions can be implemented to dramatically reduce the 40 percent of all food which is wasted in the United States and globally. We will discuss the barriers that must be overcome in order to scale solutions such as consumer behavior and perceptions, infrastructure, logistics, and policy frameworks. ReFED, a new initiative to collaboratively develop a roadmap for reducing food waste in the United States, is actively looking at the opportunities through an economic lens. This workshop will use the recent learnings of ReFED as a starting point.

Moderator: Sarah Vared, Associate, MissionPoint Partners and ReFED
Speakers:

- David Barber, President and Co-owner, Blue Hill Farms
- JoAnne Berkenkamp, Senior Advocate, Food & Agriculture Program, Natural Resources Defense Council
- Emily Broad Leib, Assistant Clinical Professor of Law, Harvard Law School
- Ron Gonen, Co-founder and CEO, Closed Loop Fund*
- William Sarni, Enterprise Water Strategy Consulting Leader, Deloitte Consulting LLP

**Sarah Vared** is an Associate at MissionPoint Partners, an impact investment firm, where she focuses on investments and philanthropic advising related to food and agriculture, water, efficiency, and resiliency. Most recently, Sarah has been leading ReFED—a cross-sector, collaborative effort to develop a roadmap to reduce food waste in the United States. Previously, Sarah worked for the Pacific Gas and Electric Company and Navitas Partners, where her work included the development of innovative programs to reduce energy consumption through analytics, automation, and Smart Grid applications. Sarah has an MBA from the Presidio Graduate School and a BA from the University of California, Santa Barbara. (svared@mppgrp.com).

**David Barber** is the President and Co-owner of Blue Hill, a working farm, restaurant, product, and consulting company supporting agriculture that positively contributes to the world's food system. The 138-acre farm in Great Barrington, Massachusetts has been in the Barber family for three generations. The Blue Hill restaurant has locations in Greenwich Village and Pocantico Hills, New York and is a leader in the movement to promote ecologically produced food. David is also a founding partner and board member of the Stone Barns Center for Food and Agriculture in Westchester County, New York. (david@bluehillfarm.com)

**JoAnne Berkenkamp** focuses on improving the efficiency of our food system at the national level, particularly through food waste prevention and food recovery. JoAnne has nearly two decades of experience in the food systems arena, including regional food systems development, consumer education, policy advocacy, institutional food procurement, and food supply chain research and development. Her work on food waste has been featured by *National Public Radio*, *Huffington Post*, TODAY.com/*CNBC News*, *CNET News*/*CBS Interactive* and the *San Francisco Chronicle*, among others. JoAnne holds a Master's degree in Public Policy from Harvard University. (612-618-3419; jberkenkamp@nrdc.org)

**Emily Broad Leib** is Deputy Director of the Center for Health Law and Policy Innovation, where she co-founded and directs the Center's Food Law and Policy Clinic, the first law school clinic in the nation devoted to providing legal and policy solutions to address the health, economic, and environmental challenges facing the food system. Broad Leib teaches courses on food law and focuses her scholarship and practice on increasing access to healthy foods, reducing the waste of healthy and wholesome foods, and reducing barriers to market entry for small-scale and sustainable food producers. (617-390-2590; ebroad@law.harvard.edu)

**Ron Gonen** is the Co-founder and CEO of the Closed Loop Fund. The Closed Loop Fund was formed by a group of the world's largest manufacturers, consumer goods companies, and retailers to invest in municipal recycling infrastructure, materials science, and sustainable packaging. Prior to the Closed Loop Fund, Ron was the Deputy Commissioner of Sanitation, Recycling, and Sustainability for in the Bloomberg Administration in New York City. In 2013, the Natural Resources Defense Council (NRDC) and Earth Day New York named Ron as the Public Official of the Year in New York City. Ron has been an Adjunct Professor at Columbia Business School since 2010. In 2012, he was the recipient of the Social Enterprise Teaching Award for Excellence in Teaching. From 2004 to 2010, Ron served as the Co-founder and CEO of RecycleBank. Ron received an MBA from Columbia Business School.

**William Sarni** leads Deloitte's Enterprise Water Strategy practice. For more than three decades he has been providing environmental and sustainability services to private and public-sector enterprises. Will is also an internationally recognized thought leader in developing and implementing corporate-wide water stewardship and sustainability strategies. (303-294-4217; wsarni@deloitte.com)

## **Symposia D** (Thursday 9:50 a.m. – 11:20 a.m.)

### S-D1 How Telling Stories About Our Work Can Help Us Do It Better

*(Conference Theater)*

The food-energy-water nexus is subject to catastrophe: flood, drought, loss of power, failure of crops. Our system-by-system reductionist approach is also subject to failure as these systems are not just complicated, but complex. Rather than waiting until catastrophe to react, this session focuses on the use of storytelling as a way to motivate action and change. Drawing on different perspectives — communication and the media; game theory, role playing, and simulation; and facilitation and conflict management—this session explores how storytelling can break through this complexity. Speakers will also engage the audience on how they might be able to use storytelling and stories in their own work.

Moderator: Lara Fowler, Senior Lecturer, Pennsylvania State Law and Research Fellow, Pennsylvania State Institutes of Energy and the Environment

Speakers

- Beth Karlin, Research Director, Norman Lear Center, University of Southern California
- Liz Neeley, Executive Director, Story Collider
- Thomas Seager, Associate Professor, School of Sustainable Engineering and the Built Environment, Ira A. Fulton Schools of Engineering; Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability; Lincoln Fellow of Ethics and Sustainability, Schools of Sustainable Engineering and the Built Environment, Arizona State University

**Lara Fowler** is a mediator/attorney focused on environmental issues, including all things water. Prior to joining Penn State in 2012, she worked on public policy issues for the Oregon Water Resources Department, attended the University of Washington School of Law, and practiced with a law firm in Seattle. She now holds a joint appointment as a Senior Lecturer at Penn State Law and a Research Fellow with the Penn State Institutes of Energy and the Environment where she is researching how water and conflict play out in a region that includes Marcellus Shale development, the Chesapeake Bay, and flood prone rivers. (814-865-4806, lbf10@psu.edu Twitter: @fowler_lara)

**Beth Karlin**'s current projects include investigating climate communication, documentary film, digital activism, and science engagement. In addition to her role at the Lear Center, Dr. Karlin works with government, private, and non-profit organizations on strategy, implementation, and evaluation of behavioral programs, and lectures regularly on Transformational Media and the Psychology of Sustainability. Prior to joining the Lear Center, Beth previously founded and directed the Transformational Media Lab with the Center for Unconventional Security Affairs at the University of California, Irvine and spent a decade working in K-12 education as a teacher, counselor, curriculum developer and school administrator. (bethkarlin@gmail.com)

**Liz Neeley** leads an organization focusing on true, personal stories of science told live on stage. Her team includes producers, actors, comedians, teachers and PhD researchers. Story Collider blends the best ideas from the arts with the strongest research on communication. Over the past ten years, Beth has specialized in environmental science, journalism, and social media. In her workshops, coaching, speaking, and writing, she is always searching for the best ways of spreading ideas through influential networks and delights in good data, beautiful ideas, and gorgeous design. (LizNeeley@StoryCollider.org Twitter: @LizNeeley)

**Thomas Seager** leads a project funded by the National Science Foundation that applies game theory to develop new strategies for teaching ethical reasoning skills relevant to sustainability to science and engineering graduate students. This project interprets sustainability primarily as an ethical concept, and places students in noncooperative game situations that confront the salient problems of sustainability,

such as intergenerational equity and weak vs. strong formulations of the sustainability concept. Dr. Seager also conducts research related to environmental decision analysis, and the life-cycle environmental impacts of alternative energy technologies. (Thomas.Seager@asu.edu; Twitter: @seagertp)

## S-D2 Public Opinion and Nexus Policy

*(Roosevelt Room)*

This symposium will present analyses from a recently completed national public opinion survey dedicated to food-energy-water nexus issues conducted under the auspices of the Institute for Science, Technology and Public Policy at Texas A&M University. Presentations will report on: the extent to which, and ways in which, the general U.S. public seems to understand connections between water and energy, water and food, and energy and food; factors that explain why some people have greater awareness of these elements of the nexus; implications of nexus awareness for public policy support to address nexus issues; and factors explaining political support for policies that affect different nodes of the nexus.

Moderator: Kent E. Portney, Professor, Bush School of Government and Public Service, Texas A&M University
Speakers:

- Justin Bullock, Assistant Professor, Department of Service and Administration, Bush School of Government and Public Service, Texas A&M University
- Bryce Hannibal, Post-doctoral Fellow, Institute for Science, Technology and Public Policy, Texas A&M University
- Manuel Teodoro, Associate Professor, Department of Political Science, Texas A&M University

Commentators:

- G. Tracy Mehan, Executive Director, Government Affairs, American Water Works Association
- Paul Lussier, Director, Science Communications With Impact Network at Yale; Founder, President and Executive Producer, Me2U Media, Inc.

**Kent E. Portney** joined the faculty of the Bush School of Government and Public Service at Texas A&M University, where he is professor in Department of Public Service and Administration. He also serves as a Senior Fellow in the Institute for Science, Technology and Public Policy. Prior to joining the Bush School he was professor of political science at Tufts University, where he was director of the Water and Research Program at the Center for International Environment and Resource Policy (CIERP) at Tufts' Fletcher School of Law and Diplomacy and co-founder of the Tufts Water Diplomacy doctoral program.

**Justin Bullock** is an assistant professor in the Public Service and Administration department and a research fellow in the Institute for Science, Technology and Public Policy. Bullock earned his PhD in public administration and policy with a specialization in public management and public policy from the University of Georgia in 2014. He is co-author of *How (Not) to Solve the Problem: An Evaluation of Scholarly Responses to Common Source Bias* and *Attitudes about Hard Work: A Global Perspective on the Beliefs of Government Employees*."

**Bryce Hannibal** is a Post-Doctoral Fellow at the Institute for Science, Technology and Public Policy at the Bush School of Government and Public Service, Texas A&M University. His academic interests include economic sociology, environmental sociology, social policy, social networks and network analysis. He received his PhD and MS degrees in sociology from Texas A&M University and his BS from Brigham Young University-Idaho. His current research projects include dynamic social network analysis, network influences of environmental knowledge, coupled human-natural systems, the energy-food-water nexus, and formation of environmental policy.

**Manuel "Manny" Teodoro** is Associate Professor of Political Science at Texas A&M University. He studies U.S. environmental policy, examining the ways in which local management and political institutions condition the implementation of federal environmental regulations. He also pursues a line of applied policy research on urban infrastructure and utility finance, working with utility industry leaders on management and policy issues. In 2013 he completed the first comprehensive study of American water utility CEOs and has begun to develop new theory and applications based on data from that study.

**G. Tracy Mehan, III** is Executive Director of Government Affairs for the American Water Works Association (AWWA). He was an independent consultant and served as Interim President of the U.S. Water Alliance and Source Water Protection Coordinator for the U.S. Endowment for Forestry and Communities. He was Principal with The Cadmus Group, Inc., an environmental consulting firm, with offices in Arlington, Virginia from April 2004 to July 2014. On May 13, 2014, Mehan was appointed to a two-year term to the U.S. Environmental Protection Agency's Environmental Financial Advisory Board. Mehan served as Assistant Administrator for Water at the U.S. Environmental Protection Agency from 2001 to 2003.

**Paul Lussier** leads a business/education collaborative of experts in media, science, technology and communications which provides the business and public policy sectors with science-based research for development and piloting of new information ecosystems, media planning solutions and brand messaging, with specific emphasis on sustainability and earth science communications. Me2U Media leverages all available platforms, technologies and entertainment genres, in all formats: print, digital, broadcast and live events. Lussier is also the Founder and Director of the Science Communications with Impact Network (SCWIN) for the development, piloting and deployment of coalition-building public communication strategies, public policy, and business sector engagement with planetary science, which counts among its partnerships government ministries and science institutions worldwide. (paul.lussier@yale.edu)

## S-D3 Ecosystem Services for Nexus Solutions

*(Potomac Rooms V, VI)*

The water-energy-food nexus is an important, but as of yet insufficiently explored, entry point to improving ecosystem services for people and the environment. The session seeks to explore how the nexus approach can help to secure the sustainable provision and equitable distribution of ecosystem services in various agricultural landscapes across the globe. It aims to examine how increased resource use efficiency through solutions in the water, energy, and food sectors ensure that ecosystem services will continue to generate services for future generations and particularly for the poor.

Moderator: Nathanial Matthews, Global Research Coordinator, CGIAR Program on Water, Land and Ecosystems and International Water Management Institute
Speakers:

- Andrew Bell, Assistant Professor of Environmental Studies, New York University*
- Anthony Janetos, Director, Frederick S. Pardee Center for the Study of the Longer-Range Future and Professor, Earth and Environment, Boston University
- Tracy Rouleau, Deputy Chief Economist, Office of Program Planning and Integration, National Oceanic and Atmospheric Administration
- Wei Zhang, Research Fellow, International Food Policy Research Institute

**Nathanial Matthews** is the Global Research Coordinator of the CGIAR Program on Water, Land and Ecosystems (WLE). In his role with WLE, Nate manages teams and projects across WLE's four focal regions (West Africa, East Africa, the Ganges, and the Greater Mekong), working with over 175 partners to develop scalable solutions for reducing poverty, improving food security, and maintaining healthy ecosystems. A political and environmental scientist by training, Dr. Matthews has 14 years professional

experience across business, education, research, and consulting that spans over 20 countries. In addition to his role with WLE, Nate is a Senior Visiting Fellow at King's College London, a Visiting Fellow at the University of East Anglia Water Security Centre, and a Fellow of the Royal Geographic Society. (+44 77489665; n.matthews@cgiar.org; Twitter: @Nate_Matthews_)

**Andrew Reid Bell** is Assistant Professor of Environmental Studies at New York University. Prior to joining NYU he was Research Fellow at the International Food Policy Research Institute (IFPRI) in Washington, DC, and Earth Institute Fellow at Columbia University. His work employs modeling tools and economic/behavioral experiments to examine resource behavior in rural contexts; current project areas include Malawi, Pakistan, Bangladesh, Cambodia, and Vietnam. (212-998-8899, andrew.reid.bell@nyu.edu)

Prof. **Anthony Janetos** joined Boston University in May 2013 as Director of the Frederick S. Pardee Center for the Study of the Longer-Range Future and Professor of Earth and Environment. Previously, Prof. Janetos served as Director of the Joint Global Change Research Institute at the University of Maryland, where for six years he oversaw an interdisciplinary team of natural scientists, engineers and social scientists committed to understanding the problems of global climate change and their potential solutions.

**Tracy Rouleau** is NOAA's Deputy Chief Economist in the Office of Program Planning and Integration, which is the nexus for coordinating, empowering, and catalyzing the integration of Social Science across NOAA. Her work focuses on NOAA-wide priorities including advancing the integration of ecosystem services into management and policy; improving and maintaining the rigor of NOAA's high-profile economic data; transitioning research on risk communication and behavior to application; improving coordination and collaboration on socioeconomic datasets and initiatives at the interagency level; and measuring and communicating the value of NOAA's products and services.

**Wei Zhang** is a research fellow in the Environment and Production Technology Division. Her research focuses on valuing and modeling ecosystem services for policy-relevant analysis and understanding socioeconomic and behavioral factors in ecosystem services and natural resource management, which often requires cross-boundary coordination, with implications for sustainable agricultural development and poverty reduction. Wei earned a PhD in Agricultural, Food, and Resource Economics at Michigan State University. She has a Master's degree in Community Development and Applied Economics from the University of Vermont and a BA degree in International Economics from Renmin University in China. (202-862-5626; w.zhang@cgiar.org)

## S-D4 Confluence of Government, Industry and Academic Research Activities

*(Washington Room B)*

The confluence of demands and needs posed by the food and energy sectors requires efficient water use and water reuse technologies through innovative, integrated, and interdisciplinary approaches to address the challenges of food and energy production. Sound management plans and policies by governments and businesses to protect scarce, vital freshwater resources are required. Research innovations created by scientists and engineers are also required to mitigate water pollution and pathogen threats to global water sustainability. This session will examine how government, industry, and academic research sectors can promote deeper interconnections and engagement in meaningful dialogue on mitigating critical risk drivers, including competition for water, lessening regulation pressures, aging/inadequate infrastructure, water pollution, and climate variability.

Moderators: Patricia Sobecky, Professor and Associate Provost, University of Alabama; Melanie Beazley, Assistant Professor, University of Central Florida; and Carl A. Pinkert, Vice President for Research and Economic Development, University of Alabama

Speakers:

- Bennett Bearden, Director, Water Policy and Law Institute, University of Alabama
- Peter Colohan, Senior Advisor to the Chief Scientist, National Oceanic and Atmospheric Administration
- Ching-Hua Huang, Professor, School of Civil and Environmental Engineering , Georgia Institute of Technology
- Greg Koch, Senior Director, Global Water Stewardship, The Coca-Cola Company

Dr. **Patricia Sobecky**'s work focuses on applying innovative approaches from the broad fields of molecular biology, engineering, and environmental microbiology to help solve societal challenges posed by man-made and natural contaminant risks to soil and water quality in terrestrial, freshwater, and marine systems. She has authored 60 scientific publications, served as chief scientist for oceanographic cruises in the Gulf of Mexico, and is an editor for the international journal FEMS Microbiology Ecology. She has received grant funding from the DOE, NSF, the Office of Naval Research (ONR), and industry. She is currently funded by The Gulf of Mexico Research Initiative to assess impact, recovery, and restoration efforts following the 2010 Deepwater Horizon oil spill in the northern Gulf of Mexico. (205-348-4890; psobecky@ua.edu)

Dr. **Melanie Beazley** is an early career scientist in a tenure-earning Assistant Professor position in the Department of Chemistry at the University of Central Florida. She earned her PhD in Geochemistry at the Georgia Institute of Technology and held postdoctoral fellowships in microbiology at the University of Oklahoma and the University of Alabama. Her research centers on the fate and transport of contaminants in natural environments including soils, sediments, groundwater, and surface waters. She has over 10 years of experience in contaminant bioremediation, including heavy metals, radionuclides, and hydrocarbons. Dr. Beazley has participated in research projects coordinated among multiple universities and government laboratories. (407-823-2171; melanie.beazley@ucf.edu)

Dr. **Carl A. Pinkert** joined the University of Alabama (UA) in 2013 and serves as Vice President for Research and Economic Development and as a tenured Professor of Biological Sciences. He provides leadership and oversees university-wide research enhancement and compliance activities, development of research infrastructure, and oversight of technology transfer and economic development activities. He earned his PhD from the University of Georgia and was a postdoctoral fellow at the University of Pennsylvania. His research revolved around animal modeling and transgenesis primarily targeting human developmental and metabolic diseases. He served as an editor of Transgenic Research and on editorial boards of five others. He was elected a Fellow of the American Association for the Advancement of Science (AAAS) in 2011. (205-348-4566; cap@ua.edu)

Dr. **Bennett Bearden**'s legal, political, and negotiating experiences have placed him squarely in the center of one of Alabama's most important natural resources issues: water policy. Dr. Bearden is the founding director of the Water Policy and Law Institute at the University of Alabama and former chair of the Alabama Water Agencies Working Group (AWAWG), the Governor's state water policy task force. He also serves as Special Counsel on Water Law and Policy to the Governor of Alabama. Dr. Bearden holds a doctorate (JSD degree, legal education's counterpart to the PhD) in water law and policy from McGeorge School of Law, University of the Pacific. Dr. Bearden's current research involves policy analysis of the Alabama Irrigation Initiative in the Food-Energy-Water Nexus. (205-247-3683; bbearden@ua.edu)

**Peter Colohan** assists NOAA leadership on issues relating to water and drought and in the management and oversight of NOAA's research portfolio. From 2010 to 2014, Peter served as Assistant Director for Environmental Information and Senior Policy Analyst at the White House Office of Science and

Technology Policy. He also served as the White House chair of the United States Group on Earth Observations and led the development of the National Plan for Civil Earth Observations. He created the Climate Data and Tools Working Group of the President's Climate Resilience and Preparedness Council, and chaired a steering group on water science and technology initiatives under the Committee on Environment Natural Resources and Sustainability. Colohan facilitated the establishment of the Group on Earth Observations (GEO), an intergovernmental body involving over 90 governments, five United Nations agencies, and more than 50 international organizations, and served as the body's Executive Officer from 2003 to 2007. (202-482-6101; Peter.Colohan@noaa.gov)

Dr. **Ching-Hua Huang** has more than 20 years of research and teaching experience on water quality engineering and environmental chemistry. She has directed federal, state, and industry research projects focusing on drinking water safety, wastewater treatment and reuse, environmental fate and mitigation of emerging contaminants, advanced water treatment process development, waste remediation, and resource recovery. Dr. Huang's water research spans from municipal water systems, to storm water and to water for food processing. She has published more than 90 peer-reviewed publications, book chapters, and conference proceedings and is a frequent invited speaker at international conferences and universities. The research by Dr. Huang and her students has received honors from the American Chemical Society and the Society of Environmental Toxicology and Chemistry. (404-894-7694; ching-hua.huang@ce.gatech.edu)

**Greg Koch** has nearly 30 years of experience and is a globally recognized leader in water resource management. He leads Coca-Cola's global water stewardship program across some 1,000 facilities and numerous agricultural supply regions focusing on: efficiency and wastewater management; watershed protection and climate change adaptation; community water initiatives; and water policy engagement. Nexus analyses and modeling is part of business risk assessment and mitigation efforts, as well as a central theme in water policy engagement and reform efforts. (404-676-7698; gkoch@coca-cola.com)

## S-D5 Systems-Based Modeling of FEW Nexus in Megacities

*(Lincoln Room)*

This session will explore research advances for food-energy-water (FEW) systems protection, in particular the integration and interdependency of heterogeneous data and internet of things signals, uncertainties, climate risks, for systems-based modeling, verification at the pilot scale, and analysis of the impact of urbanization and anthropogenic disruptions on FEW systems in cities. The session will also address challenges and complexity in the protection and interactions of FEW resources utilizing mathematical and GIS techniques, big data analytics, decision support tools, and "infrastructure ecology" methodologies.

Moderator: Nada Marie Anid, Dean, School of Engineering and Computing Sciences, New York Institute of Technology
Speakers:

- Noël Bakhtian, Energy-Water Nexus Lead, Office of International Affairs, U.S. Department of Energy
- Vatsal Bhatt, Senior Energy Policy Advisor, Brookhaven National Lab and Eco Partnership Program
- Ziqian (Cecilia) Dong, Assistant Professor of Electrical and Computer Engineering, New York Institute of Technology
- Joshua Sperling, Research Fellow, National Center for Atmospheric Research, University of Colorado

Dr. **Nada Anid** is the first female dean of the New York Institute of Technology's (NYIT's) School of Engineering and Computing Sciences, overseeing 80 faculty and 3,500 students. She embraces forward-thinking and applications-oriented strategic partnerships with the public and private sector, including an Entrepreneurship & Technology Innovation Center with labs in IT & Cyber Security, Bioengineering & Health, and Energy & Green Technologies. She is committed to educating a new generation of engineers ready to address challenges identified by the National Academy of Engineering, and an active proponent of K-12 STEM education, encouraging girls to experience the thrill of discovery and design. She earned a PhD in environmental engineering from the University of Michigan, and BS and MS degrees in chemical engineering from the Royal Institute of Technology (KTH Stockholm). (516-686-7931; nanid@nyit.edu)

Dr. **Noël Bakhtian** leads coordination and strategy efforts on Energy-Water Nexus activities for the Department of Energy's (DOE) Office of International Affairs. In this role, she manages the U.S. interagency working group on the international water-energy nexus (IWEN) and supports bilateral and multilateral DOE nexus engagements including the new $50M U.S.-China Clean Energy Research Center energy-water track, the proposed International Energy Agency global nexus network, and various others. She concurrently serves as a Senior Fellow in the White House Office of Science and Technology Policy (OSTP). (noel.bakhtian@hq.doe.gov)

**Ziqian (Cecilia) Dong** is an Assistant Professor of Electrical and Computer Engineering at New York Institute of Technology. She is the recipient of Hashimoto Prize and Hashimoto Fellowship. She serves as the PI for the NYIT Research Experience of Undergraduates Site funded by NSF focusing on securing mobile devices and wireless communication networks. Her research combines sensor technologies and communication networks for automatic sensor data collection and data analysis in various applications of cyber physical systems with focus on implementing low cost sensors (air, water quality sensors) through wireless network to facilitate automatic fine-grained data collection to improve the understanding of the dynamics of FEW resources. The problems her research addresses are how to ensure reliability of measurement data, how to recover missing data with limited measurement data and how to visualize and interpret the collected sensing data to correlate with environmental events to improve the understanding of FEW nexus. (646-273-6129; ziqian.dong@nyit.edu)

**Joshua Sperling** is a Research Fellow in the Urban Futures program at the National Center for Atmospheric Research (NCAR) in Colorado. He is a former Fulbright Scholar, NSF PIRE Fellow, and holds a PhD from the interdisciplinary Sustainable Urban Infrastructure program at the University of Colorado Denver. His research combines engineering, planning, and policy approaches to the nexus of FEW-related infrastructure systems, environmental change, and health in cities. Recent NSF-funded research has focused on developing low-carbon, healthy, and resilient cities in the U.S., China, and India and on 'Sustainable Cities: People, Infrastructures and the Energy-Water-Climate Nexus'. He has also had invitations to the UN World Water Organization, World Energy Forum, and UNDP Equator Prize; worked professionally at the global firm ARUP; and contributed as a lead author to the Second Assessment Report on Cities and Climate Change. (240-997-9245; joshuabsperling@gmail.com)

### S-D6 Feeding 9, 10, 11 Billion Sustainably (Part 2)

*(Potomac Rooms I, II)*

This session begins with an overview presentation on scenarios of world demand for crops through 2050 with and without anticipated climate change. Results are drawn from a recent multi-model study of world food demand organized by the Agricultural Model Intercomparison and Improvement Project (AgMIP). Economic responses to climate change include changes in cropland area, crop yield, international trade, crop consumption, and prices. A second presentation will discuss the challenges of animal protein production and the research priorities needed to address them. Other topics for this

session include competition for land between food crops and energy crops, sustainability of livestock production, economics of the U.S. food system, and the potential for organic production systems.

Opening Remarks: Ron Sands, Senior Economist, Economic Research Service, U.S. Department of Agriculture
Moderator: Birgit Meade, Economist, U.S. Department of Agriculture
Speakers:

- Carolyn Dimitri, Associate Professor of Food Studies, Department of Nutrition, Food Studies and Public Health, New York University
- Robin Schoen, Director, Board on Agriculture and Natural Resources (BANR), The National Academies of Sciences, Engineering and Medicine
- Steve Slater, Vice President of Research and Development, Midwestern BioAg

Closing Remarks: Jerry Miller, Director of Science and Technology for Sustainability Program, The National Academies of Sciences, Engineering and Medicine

**Ron Sands** joined the USDA's Economic Research Service (ERS) in 2009 as a Senior Economist. Dr. Sands' primary activity is the development of the Future Agricultural Resources Model (FARM), a global computable-general-equilibrium model used to simulate agricultural adaptation to climate change and options for reducing net greenhouse gas emissions in agricultural, forestry, and energy systems. Prior to joining ERS, Dr. Sands had nearly 22 years of service with the Pacific Northwest National Laboratory. He currently serves as co-chair of the Interagency Group on Integrative Modeling, an interagency working group of the U.S. Global Change Research Program.

**Birgit Meade** is an economist with the USDA's Economic Research Service (ERS). Dr. Meade's research focus is on trade agreement analysis, global food security, and international food demand issues. She has been a lead author of annual International Food Security Assessment reports, a flagship publication of ERS, for more than 20 years. As co-author of reports and articles presenting food demand elasticities, she currently works with researchers at the University of Florida and the World Bank to provide updated estimates based on a unique World Bank data set for 2011 which covers 180 countries. These elasticities are valuable inputs in models around the world.

**Carolyn Dimitri** is an Associate Professor of Food Studies in the Department of Nutrition, Food Studies and Public Health at New York University. Her teaching and research focuses on the U.S. food system, including the organic food system. She is currently working on a book examining the economics of the U.S. food system. Prior to joining the NYU faculty, Dr. Dimitri worked as a research economist at the Economic Research Service of the U.S. Department of Agriculture. She is an Associate Editor of the journal Renewable Agriculture and Food Systems, a member of the scientific board of the Organic Center, and a member of the executive board of the Organic Farming Research Foundation.

Since 2005, **Robin Schoen** has led BANR 's portfolio of work which currently includes studies on workforce needs in food and agriculture, genetically engineered crops, brucellosis in the greater Yellowstone area, occupational health and injury surveillance, and nutrient requirements of beef cattle. In her 25-year career at the Academies', she has led a diversity of activities, including a Howard Hughes Medical Institute grant that sent US experts and their equipment to Mexico and South America to teach advanced molecular biology courses to young investigators, and a study on the responsibilities of authorship: sharing publication-related data and materials. (202-334-2236, rschoen@nas.edu)

Dr. **Steve Slater**, Vice President of Research and Development, joined Midwestern BioAg in 2014. He is a geneticist/biochemist with over 20 years of experience in biotechnology and agricultural research. He has particular expertise in genetics and genomics of bacteria and plants. Most recently he was scientific programs manager at Great Lakes Bioenergy Research Center at the University of Wisconsin–Madison. From 2004 to 2008, Dr. Slater was an associate professor at Arizona State University. Prior to his work

in academia, he spent nearly 10 years at Monsanto Co. as a senior scientist. He received his Ph.D. in Molecular Microbiology from Case Western Reserve University and was an NIH Postdoctoral Fellow at Harvard University.

**Jerry Miller** was appointed Director of the Science and Technology for Sustainability (STS) Program at the National Academies of Sciences, Engineering, and Medicine in February 2015. Previously, Dr. Miller served as President of Science for Decisions, a consulting practice which he founded to ensure that solid science is available to inform policy and management decisions that impact natural resources and the livelihoods that depend upon them. From 2009 until 2013, Dr. Miller served as Assistant Director for Ocean Sciences at the White House Office of Science and Technology Policy (OSTP).

### S-D7 Fish, the Forgotten Food Source, in Food-Water-Energy Nexus

*(Washington Room A)*

Freshwater is a shared resource. Many sectors rely upon water and increasingly, the limited availability of water leads to tough decisions. While inland fish, fisheries, and aquaculture play important roles in providing food and economic security, human well-being, and cultural attachment, they are often not accounted for when decisions about when other economically and socially important sectors, such as hydropower and agriculture are made. This session will examine how fish embody the food-energy-water nexus and will discuss recommendations for integrated water management. Sustainable management of multi-use waterways requires informed choices emphasizing the services that will provide sustainable benefits for humans while maintaining well-functioning ecological systems. Identifying, assessing, and evaluating tradeoffs between inland fisheries and other freshwater resource users will be crucial for making informed decisions.

Moderators: Abigail Lynch, Research Fisheries Biologist, U.S. Geological Survey and T. Douglas Beard, Director, National Climate Change and Wildlife Center, U.S. Geological Survey
Speakers:

- Fred Binkowski, Senior Scientist and Director, Great Lakes Aquaculture Center, University of Wisconsin–Milwaukee
- Babtist "Paul" Lumley, Executive Director, Columbia River Inter-Tribal Fish Commission (CRITFC)
- Roger Martini, Senior Fisheries Policy Analyst, Organization for Economic Co-operation and Development (OCED)

**Abigail Lynch** is a research fisheries biologist with the U.S. Geological Survey National Climate Change and Wildlife Science Center. She is working on a number of large-scale projects examining the impacts of climate change on fish using remotely-sensed data to model and estimate changing dynamics. She served as a conference organizer and facilitator for the drivers and synergies theme at the Global Inland Fisheries Conference held at the Food and Agriculture Organization of the United Nations headquarters in Rome, Italy. (703-648-4097; ajlynch@usgs.gov)

**T. Douglas Beard** is the Chief of the U.S. Geological Survey National Climate Change and Wildlife Science Center and oversees the eight regional Department of Interior Climate Science Centers which collaborate with universities and other partners to provide unbiased scientific data and tools that contribute to an understanding of the widespread impacts of climate change on fish, wildlife, ecosystems, and people. Doug is also the President of the World Council of Fisheries Societies. (703-648-4215; dbeard@usgs.gov)

**Fred Binkowski**'s professional interests over the last 30 years include Great Lakes fisheries biology with a research focus on early life stage biology, behavior, reproduction, and nutrition. Presently, his research and outreach effort is being directed at aquaculture in the areas of recirculating system technology, broodstock development, out-of-cycle spawning and Intensive Aquaculture Technology.

Recent focus has been to examine the application of some of these elements in the area of urban aquaculture with the primary focus being on aquaponics, or "fin fish and plant culture." Urban aquaculture and aquaponics represent a catalyst for establishing new businesses and creating jobs in Wisconsin. (414-382-1723; sturgeon@uwm.edu)

**Babtist "Paul" Lumley**, a citizen of the Yakama Nation, has an extensive history working with Northwest Tribes on salmon issues, particularly in the Columbia River Basin. He spent 17 years with the Columbia River Inter-Tribal Fish Commission (CRITFC) working on biological issues relating to U.S. v. Oregon and the Pacific Northwest Electric Power Planning and Conservation Act. Mr. Lumley has a wide-ranging background on issues that directly impact American Indians, Alaska Natives, and Native Hawaiians. Mr. Lumley has worked directly with tribal governments, tribal consortia, virtually all federal agencies impacting Indian Country, and Native American national and regional organizations throughout his professional career. (503-731-1295)

**Roger Martini** is the Senior Fisheries Policy Analyst for the Organization for Economic Co-operation and Development (OECD), which collects data and carries out analysis on policies in fisheries and aquaculture, with the objective of identifying policies that can bring sustainable growth to the sector and effectively achieve government objectives. Roger focuses in particular on determining the impact of fisheries support programmes and how these interact with management systems. The OECD has also emphasised recently work on policy coherence for development in fisheries in the context of Africa and Southeast Asia, where dependency on fisheries and aquaculture for food and jobs is particularly acute. (roger.martini@oecd.org)

## S-D8 Integrating Water and Energy Efficiency

*(Kennedy Room)*

Texas and California are in the midst of multi-year droughts, yet both rely heavily on electricity sources that require copious amounts of water and contribute to this prolonged drought—namely natural gas, coal, and nuclear. Using these two states as case studies, this panel will explore the inextricable link between energy and water, the need to harness data and technology to spark behavioral changes in Texans and Californians, as well as better coordination between the two sectors. Citing specific pilot and demonstration projects in Texas, California, and elsewhere, the panel will help audiences understand how people, businesses, and government can adopt and adapt to the new technology landscape to increase energy and water efficiency.

Moderator: Kate Zerrenner, Manager, Energy-Water Initiatives, Environmental Defense Fund
Speakers:

- Subodh Nayar, Market Development, WaterSmart Software
- Edward Spang, Assistant Professor, Food Science and Technology and Center for Water-Energy Efficiency, University of California-Davis
- Kimberly Stoker, Director, Environmental & Sustainability, Generation & Strategy Group, CPS Energy

**Kate Zerrenner** leads the Environmental Defense Fund's (EDF's) multi-year campaign to influence and enact state and national energy and water efficiency policy, including breaking down financial, regulatory, and behavioral barriers. Her expertise includes a sound understanding of technologies and policies affecting traditional energy generation, energy efficiency business models, and the energy-water nexus. She collaborates with key stakeholders and legislative sponsors on the passage of clean energy and energy-water legislation, including drafting legislative language and providing oral and written testimony. She serves on the City of Austin Integrated Water Resource Planning Community Task Force and the Advisory Board of the Smart Cities Council. (512-691 3423; kzerrenner@edf.org)

**Subodh Nayar** works for WaterSmart Software, which uses mobile and online tools to help water utilities educate and engage their customers to save water and money. WaterSmart offers a turnkey, cloud-based analytics and engagement platform that makes it easy to improve water-use efficiency by 5 percent in as little as 12 months. Subodh has broad energy and water industry expertise around best practice for the delivery and use of water or energy. He has been widely published in industry, technology, and business press on topics such as the energy-water nexus, the business case for intelligent smart grid deployment, the role of time-of-use (TOU) pricing in peak load shaving and successful utility use of communication technologies in smart metering and distribution grid operation. (703-596-4150; subodh@nayars.com)

Dr. **Edward Spang** is an Assistant Professor of Food Science and Technology at the University of California, Davis. His research focuses on characterizing and optimizing the efficiency of linked water, energy, and food resource systems. He is particularly interested in applying methodologies to measure and monitor these systems and their interrelationships in high-resolution and across multiple scales. He also seeks to understand the influence of markets, innovation, and policy on the integrated food-energy-water nexus. His recent publications explore mapping energy flows through water infrastructure, enhancing the conservation signal and stability of water rates, and estimating global water consumption for energy production. Dr. Spang also serves as Associate Director of the Center for Water-Energy Efficiency at UC Davis. (esspang@ucdavis.edu)

**Kim R. Stoker** is the Environmental & Sustainability Director in the Generation & Strategy Group at CPS Energy, which directs and provides leadership for utility-wide environmental strategy, compliance programs, water supply planning, environmental policy, sustainability initiatives, and the development of corporate environmental metrics. CPS Energy is the largest municipally owned electric and gas utility in the U.S., serving the nation's seventh-largest city, San Antonio, with a diversified generation portfolio including residential and commercial energy efficiency and demand response. Ms. Stoker represents the interests of CPS Energy on several regional air, water and sustainability planning stakeholder committees. She is a Registered Environmental Manager and a Professional Geologist in Texas. (210-353-2929; krstoker@cpsenergy.com)

## S-D9 Sustainability Education at the Food-Energy-Water Nexus: Ongoing Research

*(Potomac Rooms III, IV)*

The symposium will present the state of the art in competencies and professional skill development for sustainability. Emphasis will be placed on the Wiek *et al.* (2011) key sustainability competencies framework and how these competencies can be operationalized in higher education curricula; the National Council for Science and Environment study on sustainability degree program learning outcomes (NCSE); the development by the International Society for Sustainability Professionals (ISSP) of a professional sustainability certification; and the latest research on implementing interdisciplinary research and teaching in higher education. The symposium also serves to introduce attendees to the following workshop on the same topic. The overarching goal of both the workshop and the symposium is to provide an opportunity to inform advances in sustainability education at the food-energy-water nexus.

Moderator: Seaton Tarrant, Alumni Fellow, Department of Political Science, University of Florida
Speakers:

- Maureen Hart, Executive Director, International Society of Sustainability Professionals
- Deana Pennington, Research Associate Professor, University of Texas, El Paso
- Shirley Vincent, Director, Center for Environmental Education Research, National Council for Science and the Environment
- Arnim Wiek, Associate Professor, School of Sustainability, Arizona State University

**Seaton Tarrant** is an award winning teacher in the Sustainability Studies program at the University of Florida. He is in the process of completing a dissertation on the development of sustainability education in the American Higher Education system, and its relation to emergent forms of citizenship and professional development. His research seeks to integrate educational, community development, and ecological goals for sustainable democratic societies. His curricula development work centers on experiential, community-based project learning. He works as a consultant on faculty and curriculum development for sustainability education, and performs content analysis of syllabi for cohesive program development and best practices research. HIs passion is working with students. He also works across multiple communities, developing local food systems at the county planning, public school, and community garden levels. He is the live-in care taker for the 600 acre Tuscawilla Preserve, and his home doubles as the headquarters of Tuscawilla Learning Center, which provides environmental education to children ages 3 – 8, and hosts adult environmental education and permaculture workshops.

**Maureen Hart** is the Executive Director of the International Society of Sustainability Professionals (ISSP). ISSP is the world's leading professional association of sustainability professionals. As a professional association, ISSP improves the skills of sustainability practitioners through education, knowledge sharing and research, empowering professionals to make sustainability standard practice in organizations and communities around the globe. Maureen is an internationally known expert on sustainability indicators and the author of the Guide to Sustainable Community Indicators on measuring sustainability. Both the guide and the related web site are being used world-wide by organizations and communities working on understanding and measuring progress toward sustainability. She also created the on-line version of S-CORE, the sustainability assessment tool that is part of the suite of sustainability tools that ISSP offers its members. Prior to becoming the ED of ISSP, Maureen was the President and founder of Sustainable Measures, a for-profit consulting firm working with businesses, government agencies, and nonprofits on measuring and reporting on sustainable development activities.

**Deana Pennington** is Research Associate Professor at the University of Texas at El Paso, associated with the Cyber-ShARE Center of Excellence, and Associate Professor of Geological Sciences. Pennington specializes in interdisciplinary knowledge exchange processes and synthesis science; geospatial, integrated modeling and analysis of change in human/environmental systems; and data science: data management, analysis and visualization, especially for exploratory geospatial analytics.

**Shirley Vincent** is the Director of the Center for Environmental Education Research at the National Council for Science and the Environment. Dr. Vincent leads the education research program and the related academic consulting program. The research program conducts landmark longitudinal studies of U.S. interdisciplinary environmental, sustainability, and energy (IESE) education and research programs. She is the author of a number of reports and scholarly articles on interdisciplinary environmental and sustainability education, and is a frequent speaker on environmental and sustainability education topics. (918-629-5143; sgvincent@ncseonline.org)

Dr. **Arnim Wiek** is an Associate Professor in the School of Sustainability at Arizona State University. His group conducts research on competencies in sustainability, curriculum design, as well as project-based and solution-oriented learning. He currently co-leads a multi-year comparative study on “Educating Future Change Agents”. He is a member of the editorial board of the *International Journal of Sustainability in Higher Education*. He holds a Ph.D. from the Swiss Federal Institute of Technology Zurich and had research and teaching engagements at the University of British Columbia, Vancouver, the University of Tokyo, and Leuphana University of Lüneburg, Germany.

**S-D10 Transforming Food and Agricultural Policy**
*(Prince William)*

Since 2011, AGree has engaged more than 2,000 of the best minds in food and agriculture to develop consensus recommendations that will drive positive change. Areas of focus include research, immigration reform, next generation leadership, food and nutrition, local food, international development, working landscapes, and risk management. This session will focus on how AGree is working with diverse partners to elevate food and agriculture as a national priority; engage producers and the supply chain to implement cooperative conservation projects in Minnesota watersheds; integrate federal data to better inform decision-making; link food and nutrition initiatives to health; and support local food enterprises that deliver important economic development and food access benefits in communities across the country. Hear from AGree leadership about work in 2016 and beyond.

Moderator: Heather Lair, Senior Mediator, Meridian Institute
Speakers:

- Daniel Glickman, Co-Chair, AGree and former U.S. Secretary of Agriculture
- Kathleen Merrigan, Co-Chair, AGree; Executive Director of Sustainability, George Washington University; and former U.S. Deputy Secretary of Agriculture
- Jim Moseley, Co-Chair, AGree and former U.S. Deputy Secretary of Agriculture

**Heather Lair** serves as Chief of Staff to the AGree Initiative which is housed at Meridian. Heather supported the development of recommendations across AGree's eight initiatives and manages the team that is implementing specific projects and AGree's platform as a trusted convener on diverse issues facing food and agriculture. Other recent Meridian work has focused on African agriculture and food systems as well as community and regional resilience. Prior to joining Meridian, Heather worked at the University of Maryland's Office of Sustainability as a facilitator of campus partnerships, where she focused on climate and energy-efficiency strategies. She holds an MBA and an MS in Natural Resource Policy from the University of Michigan. (202-674-5034; hlair@merid.org)

**Daniel Glickman** is a Senior Fellow at the Bipartisan Policy Center, Executive Director of the Aspen Institute Congressional Program, and Chairman of the Board of the Foundation for Food and Agriculture Research (FFAR), among other senior leadership roles. Dan is a tireless advocate for rethinking food and agriculture policy, particularly the role of the U.S. research enterprise in solving tough challenges facing the food and agriculture system—climate change, drought, water quality, pests, nutrition, etc. He is also passionate about the global food security implications of U.S. foreign assistance and frequently testifies before Congress. Dan represented Kansas' 4th Congressional District for 18 years and served as a member of the U.S. House Agriculture Committee. (202-390-3994; pat.walton@aspeninst.org)

**Kathleen Merrigan** created and led the Know Your Farmer, Know Your Food Initiative at USDA to support local food systems and was a key architect of First Lady Michelle Obama's "Let's Move!" campaign. Before joining USDA, Kathleen held a variety of agriculture policy positions, including faculty member at the Friedman School of Nutrition Science and Policy at Tufts University, Administrator of the USDA Agricultural Marketing Service, and senior staff on the U.S. Senate Committee on Agriculture, Nutrition and Forestry, where she wrote the law establishing national standards for organic food. Kathleen's leadership with AGree has focused on research, nutrition, and local food. (202-994-0500; kmerrigan@gwu.edu)

**Jim Moseley** has played key roles in developing public policy regarding agriculture, the environment, and natural resources conservation at the state and national levels. For example, in 1997 Jim served as Chairman and lead negotiator of the industry team for the National Pork Producers Council's National Pork Dialogue. The dialogue was a nationwide effort to improve the environmental performance of pork operations. Jim's leadership with AGree has focused on productivity, profitability, and environmental outcomes. He has been instrumental in developing AGree's model for producer-led cooperative conservation at the watershed level to improve water quality, soil health, and profitability that is currently being piloted in Minnesota. (765-714-6404; jmose74@earthlink.net)

## **Day 3 Afternoon Sessions** (Thursday 2:30 p.m. – 5:30 p.m.)

### S-E1 A Systems Approach to Understanding the Energetics of Global Agriculture
*(Washington Room B)*

The objective of this symposium is to conceptualize the global agricultural system as a planetary energy transfer system and to account for energy pathways through the system with a focus on redirecting available energy output to food resources for human consumption. Over a half century of data regarding global agricultural output suggests that total output greatly exceeds human demand for food energy, but energy losses within the system dominate to create global food insecurity. Addressing food loss terms within the global agricultural system may be a more manageable strategy to increase the availability of agricultural production for human consumption, particularly when faced with presumed losses of agricultural production related to land conversion, climate change, and biological limits of intensified food production.

Moderators and Speakers:

- Stephen K. Boss, Director, Environmental Dynamics Program, University of Arkansas
- Quinn Montana, Doctoral Candidate, Environmental Dynamics, University of Arkansas

**Stephen K. Boss** is Professor of Environmental Dynamics and Sustainability in the Department of Geosciences at the University of Arkansas. He served as director of the interdisciplinary doctoral program in Environmental Dynamics from 2002-2015 and was the primary architect of sustainability curricula at the University of Arkansas. He served dual duty at Director of Sustainability Academic Programs and the Environmental Dynamics Program from 2010-2015. His current research interests are investigating allocation of non-renewable natural resource s, systems dynamics of global agriculture, and development of metrics of natural resource consumption to document progress toward or retreat from sustainability at global scales. (479-575-7134, sboss@uark.edu)

**Quinn Montana** is a PhD student in the Environmental Dynamics program at the University of Arkansas. Her research has centered on food policy and climate concerns. A longtime board member of the local chapter of Slow Food USA, she was one of 250 chosen to represent the U.S. at the International Slow Food Conference in Turin, Italy in 2012. Formerly Co-Chair of Fayetteville's Green Economy Group, and one of the founding members of the community Climate Change Book Forum, she is currently spearheading an initiative to ban plastic bags in the city of Fayetteville, AR. She is also the author of the book *Workship Your Food*, an exposition on the ills of our food system.

### S-E2 Towards a Food-Energy-Water-Nexus Data and Data Science Community
*(Kennedy Room)*

Data and data science are crucial in addressing the food-energy-water (FEW) nexus for understanding problems, connections, and impacts as well as for monitoring Earth resources for timely detection and management of risks (e.g., hot-spots of resource choke-points). Challenges include fragmented data with diverse collection protocols, representations, monitoring frameworks, and analysis tools with little coordination among producers and consumers. This symposium will review draft report from a recent NSF workshop on data science for the FEW nexus and continue discussions towards building a FEW nexus data community via a panel discussion, which will explore experiences of other data communities (e.g., climate, astronomy) and assess new opportunities (e.g., NSF big data spokes) to increase use and sharing of available data and to help automate data life-cycle.

Moderator: Shashi Shekhar, McKnight Distinguished University Professor, University of Minnesota
Speakers:

- Chaitanya Baru, Senior Advisor for Data Science, National Science Foundation
- Lawrence Buja, Director, Climate Science and Applications Program, National Center for Atmospheric Research
- Bradley Doorn, Program Manager, Earth Science Division, National Aeronautics and Space Administration
- Vipin Kumar, Regents Professor, University of Minnesota
- Alex Szalay, Alumni Centennial Professor, Johns Hopkins University
- Ranga Raju Vatsavai, Associate Professor, North Carolina State University

**Shashi Shekhar,** a McKnight Distinguished University Professor at the University of Minnesota, is a leading scholar in Geographic Information Systems (GIS). He co-edited an Encyclopedia of GIS and co-authored a Spatial Databases textbook. He received the IEEE-CS Technical Achievement Award, the UCGIS Education Award and was elected a Fellow of the IEEE and the AAAS. Shashi is a co-Editor-in-Chief of Geo-Informatica journal (Springer) and has served on the Computing Community Consortium Council, National Academies' committees (Mapping Sciences, GEOINT Workforce). He co-organized the "From GPS and Virtual Globes to Spatial Computing 2020" workshop to catalyze community research visions. (612-624-8307, shekhar@cs.umn.edu)

**Chaitan Baru** coordinates the Big Data research program and Data Science activities in the CISE Directorate at NSF. He co-chairs the federal inter-agency Big Data Senior Steering Group, consisting of 18 federal R&D agencies. He is on assignment from his position as Distinguished Scientist and Associate Director of Data Initiatives at the San Diego Supercomputer Center at UC San Diego, where he is also Director of the Center for Large-scale Data Systems Research. He has served in leadership roles in a number of national and international-scale "data cyberinfrastructure" initiatives, including the OpenTopography project and Tropical Ecology, Assessment and Monitoring network. (703-292-4547, cbaru@nsf.gov)

**Lawrence Buja** directs the Climate Science and Applications Program at the National Center for Atmospheric Research. USDA's new "Climate Change, Global Food Security, and the U.S. Food System" report shows climate change risks extending across every element of the global food system critical for food security, including processing, storage, transportation, trade, and consumption, with important implications for the U.S. The food-energy-water community will need to extend the federated big data approaches that transformed the climate science community over the last decade to address the much harder problem of integrating diverse, interdisciplinary data assets to identify effective adaptation and mitigation intervention points. Most recently he was Principal Investigator on USDA's Global Food Security report for the U.S. National Climate Assessment. (303-497-1330; southern@ucar.edu)

Dr. **Bradley Doorn** is the Program Manager for Water Resources in the Applied Science Program of the Earth Science Division of NASA. He also serves as the Applied Sciences Program Lead on three satellite missions, among various interagency and international leadership duties. Previously, Dr. Doorn was the Remote Sensing Coordinator and Division Director of the International Production Assessment Division of the Foreign Agricultural Service, USDA. He also spent nearly 10 years on active duty as a Topographic Engineer in the U.S. Army. Dr. Doorn received his doctorate and master's degrees from The Ohio State University in Geodetic Science and Surveying and his bachelor's degree in Geological Engineering from South Dakota School of Mines and Technology. (202-358-2187; bradley.doorn@nasa.gov)

**Vipin Kumar**'s current research interests include data mining, high-performance computing, and their applications in Climate/Ecosystems and Biomedical domains. Professor Kumar is the Lead PI of a 5-year, $10 Million project, "Understanding Climate Change - A Data Driven Approach", funded by the NSF's Expeditions in Computing program that is aimed at pushing the boundaries of computer science research. He has authored over 300 research articles, and has coedited or coauthored 11 books

including widely used text books ``Introduction to Parallel Computing'' and ``Introduction to Data Mining'', both published by Addison Wesley. Currently, Kumar serves on the steering committees of the SIAM International Conference on Data Mining and the IEEE International Conference on Data Mining. (kumar@cs.umn.edu)

**Alexander Szalay** is the Director of the Institute for Data Intensive Science. He is a cosmologist, working on the statistical measures of the spatial distribution of galaxies and galaxy formation. He is a Corresponding Member of the Hungarian Academy of Sciences, and a Fellow of the American Academy of Arts and Sciences. In 2015 he received the Sidney Fernbach Award of the IEEE Computer Society, in 2004 he received an Alexander Von Humboldt Award in Physical Sciences, and in 2007 the Microsoft Jim Gray Award. In 2008 he became Doctor Honoris Causa of the Eotvos University, Budapest. (410-516-7217, szalay@jhu.edu)

**Raju Vatsavai** is a Chancellor's Faculty Excellence Program Cluster Associate Professor in Geospatial Analytics in the Computer Science department at NCSU. He works at the intersection of spatial and temporal big data management, analytics, and high performance computing with applications in the national security, geospatial intelligence, natural resources, climate change, location-based services, and human terrain mapping. As the Associate Director of the Center for Geospatial Analytics, Raju plays a leadership role in the center's strategic vision for spatial computing research. Before joining NCSU, Raju was the Lead Data Scientist for the Computational Sciences and Engineering Division at the Oak Ridge National Laboratory. Raju has more than 25 years of research and development experience in large-scale spatiotemporal data management and geographic knowledge discovery. (rrvatsav@ncsu.edu)

## S-E3 Perspectives on Integrated Nexus Assessment

*(Roosevelt Room)*

Sectoral interdependencies among resources influence each other through complex feedbacks. Through trade and foreign investment, globalization may help to mitigate resource shortages and accelerate technological transfer. Often, however, global trade flows instead 'export' shortages or negative externalities to structurally weaker regions. An integrated ('nexus') approach to resource management is thus necessary in order to systematically integrate the explicit consideration—and economic internalization—of dependencies among specific, domestic preconditions with their global effects across resources. Natural resources—including water, (fertile) land or fossil resources—are limited and geographically unevenly distributed. This uneven distribution increasingly confronts the growing demand for 'socially useable resources,' for which demand intensity is also unevenly distributedglobally. In this session, the challenges and requirements of integrated approaches to nexus assessment shall be discussed.

Moderator: Sandra Venghaus, Institute for Energy and Climate Research - Systems Analysis and Technology Evaluation (IEK-STE), Forschungszentrum Jülich
Speakers:

- Kenneth Strzepek, Adjunct Professor of Public Policy, John F. Kennedy School of Government, Harvard University
- Holger Schlör, Senior Scientist, Institute for Energy and Climate Research - Systems Analysis and Technology Evaluation (IEK-STE), Forschungszentrum Jülich
- Deepak Sharma, Professor and Director, Center for Energy Policy, Faculty of Engineering and Information Technology, University of Technology, Sydney
- Jürgen-Fr. Hake, Professor and Head, Institute of Energy and Climate Research - Systems Analysis and Technology Evaluation, Forschungszentrum Jülich

**Sandra Venghaus** received her undergraduate degree in Environmental Science and Public Policy from Harvard University and completed her PhD in Economics in Hannover, Germany. She currently works at the Forschungszentrum Jülich in the Institute for Energy and Climate Research - Systems Analysis and Technology Evaluation (IEK-STE) with a research focus on the assessment of the nexus among energy, water, food and land. Before moving to Jülich she lead a research project on the social impacts of biofuels at the Potsdam Institute for climate impact research. (+49 2461 61 6541, s.venghaus@fz-juelich.de)

**Kenneth Strzepek** has spent 30 years as a researcher and practitioner at the nexus of engineering, environmental and economics systems, primarily related to water resource planning and management, river basin planning, and modeling of agricultural, environmental, and water resources systems. His work includes applications of operations research, engineering economics, micro-economics and environmental economics to a broad range applications: from project scale to national and global investment policy studies. He has worked for a range of national governments as well as the United Nations, the World Bank, the USAID. (617-715-5187, strzepek@mit.edu)

**Holger Schlör** studied economics at the University of Heidelberg and completed his PhD in Economics in Berlin. He received a scholarship from the German Marshall Fund and the Alfried Krupp von Bohlen und Halbach-Foundation. He has conducted research at several scientific institutions and the German Parliament. He currently works at Forschungszentrum Jülich in the Institute of Energy and Climate Research – Systems Analysis and Technology Evaluation (IEK-STE). His research focuses on sustainable development, economics, and energy systems analysis. (+49 2161 61 6971, h.schloer@fz-juelich.de)

**Deepak Sharma** has professional interests in infrastructure policy themes - in national and global contexts. Such themes include energy and water market reforms; infrastructure regulation and governance; energy-water-economy-climate change interface; environmental policy analysis; institutional economics and political economy. He is currently co-ordinating a major research project focusing on Energy-Food-Water Security challenge in a global context. The general tenor his work is multidisciplinary and policy oriented - underpinned by a recognition of the significance of global cultural, political and geo-strategic contexts. (+61 2 9514 2422, Deepak.Sharma@uts.edu.au)

**Jürgen-Fr. Hake** has received degrees in Mathematics/Physics from Bielefeld University and is now the head of the Institute for Energy and Climate Research - Systems Analysis and Technology Evaluation (IEK-STE) at the Forschungszentrum Jülich in Germany. He is also Professor for Energy Policy and Energy Economy at the Aachen University of Applied Sciences and lecturer at the University of Bonn. (+49 2461 61 6363, j.-f.hake@fz-juelich.de)

## S-E4 The Status of Low Cost Energy Technologies to Treat Saline Water for Freshwater Uses

*(Prince William Room)*

During the 20th century, the global population increased 300 percent while demand for freshwater increased 600 percent. The world's water consumption rate is doubling every 20 years, outpacing population growth by a factor of two. By 2025, global water demand will exceed supply by 50 percent due to persistent regional droughts and water will strongly compete with energy as an internationally limited resource and affect future economic development and prosperity. Agriculture, a critical component of the US economy is the major user of ground and surface water in the US accounting for approximately 80 percent of the Nation's consumptive water use and more than 90 percent in many Western States. These water shortages have promoted development of less costly treatment saline water sources.

Moderator and Speakers:

- Michael Champ, Retired, Texas A&M University
- Sven Schlumpberger, PhD Graduate Student, Massachusetts Institute of Technology

- Jeffrey Jacobs, Director, Water Science and Technology Board, National Academies of Sciences, Engineering, and Medicine

**WC-23 Opportunities and Challenges for Integrated Food-Energy Systems**
*(Conference Theater)*

This world café brings together practitioners, researchers, and other stakeholders of diverse agri-food systems that involve local co-production of food and energy. As a result, it provides a rare opportunity for sharing and synthesizing knowledge across integrated food-energy systems (IFES), ranging from landfill methane recapture powering greenhouses, to agri-voltaics, to manure-based biogas systems. The discussion will build off our recent survey of types of IFES that diversify farm products and close waste-resource loops. We will address knowledge gaps, scale issues, and policy mismatches that affect the potential of IFES to improve farm resilience and to reduce environmental impacts of local food production, as well as challenges of constructing, operating, and governing an IFES.

Moderators: Michael Gerst, Sherman Fairchild Distinguished Professor of Sustainability Science, University of Maryland and Anne Kapuscinski, Sherman Fairchild Distinguished Professor of Sustainability Science, Dartmouth College
Speakers:

- Michael Gerst, Sherman Fairchild Distinguished Professor of Sustainability Science, University of Maryland
- Anne Kapuscinski, Sherman Fairchild Distinguished Professor of Sustainability Science, Environmental Studies Program, Dartmouth College
- Don McCormick, Founder and CEO, Keene Energy and Agriculture Project
- Michael Raker, Consultant, Agricultural Energy Consultants LLC
- Ryan Shelby, Senior Energy Engineering Advisor, Office of Energy and Infrastructure, U.S. Agency for International Development

**Michael Gerst** is a research faculty at the Earth System Science Interdisciplinary Center at the University of Maryland. His expertise is in decision and systems analysis of problems that involve the intersection of the environment, technology, and society. In addition to the study of the resilience and environmental impact of integrated food-energy systems, his research portfolio has included elements of cost-benefit analysis of climate policy, the development of new scenario techniques for planning under uncertainty, guiding co-production efforts of global change indicators, and testing of visualization design efficacy. He received his PhD from Yale University in industrial ecology and techno-economic systems analysis. (mgerst@umd.edu)

**Anne R. Kapuscinski** is the Sherman Fairchild Distinguished Professor of Sustainability Science in the Environmental Studies Program at Dartmouth College. She is Chair of the Board of Directors of the Union of Concerned Scientists and Editor-in-Chief of *Sustainability Transitions*, a domain of the open-access journal, *Elementa: Science of the Anthropocene*. She leads an interdisciplinary team in researching how integrated food-energy systems (IFES) address the food-energy-water nexus in the face of climate change. One project studies 50 dairy farms to quantify effects of anaerobic digesters on closing nutrient, energy, and water loops and on long-term financial resilience. Another project develops microalgae feeds for aquaculture, the world's fastest growing food sector, and assesses their life-cycle environmental benefits. (603-646-2668, anne.kapuscinski@dartmouth.edu)

**Don McCormick** is the founder of the Local Farms Project (LFP), designer of the Keene Energy & Agriculture Project, and a leader in sustainable food production in New England for over 15 years. Don and his team created the LFP brand at Carbon Harvest Energy, where Don engineered the successful

operations, production and marketing of a state-of-the-art integrated growing facility in Brattleboro VT. Don has a unique capacity for analyzing local resources and needs, and engineering integrated food and energy systems to provide real solutions to issues of local food and energy security, impacts of climate change, water management, and significant reduction of carbon emissions. Prior to founding Carbon Harvest, Don owned a sustainable aquaponics greenhouse business in Westport NY and served as Executive Director of the Intervale Center in Burlington, VT. (603-852-4025, don.m@localfarmsproject.com)

**Michael Raker** is actively engaged in state and federal farm and energy policy on issues including the Vermont Standard Offer Program, net-metering, project permitting, and USDA grant programs. For more than two decades Mike has been helping Vermont farms improve their electrical energy efficiency and produce renewable energy via anaerobic digestion of farm wastes. For most of these years he has been a self-employed consultant providing services to farmers via Vermont's electric and efficiency utilities. For ten years Mike was the sole staff person for the Green Mountain Power Renewable Development Fund. In this capacity he provided technical assistance to all of the Vermont digester projects. Mike has a bachelor's degree in Botany from the University of Massachusetts. (802-454-0123, mmraker@aol.com)

**Ryan Shelby** is a senior energy engineering advisor within the United States Agency for International Development (USAID), where he works on the design and implementation of decentralized energy projects (<1 MW to 10 MW) in Sub-Saharan Africa and other emerging regions. Within the USAID, Dr. Shelby serves as the Program Manager for the Powering Agriculture: An Energy Grand Challenge for Development (PAEGC) initiative, which seeks to accelerate the development and deployment of clean energy solutions for increasing agriculture productivity in developing countries. Dr. Shelby completed his PhD at the University of California, Berkeley in Mechanical Engineering. (rshelby@usaid.gov)

## W-3 Strenghtening American Food System Resilience

*(Lincoln Room)*

The security of the American food supply—the ability to withstand shocks or stresses that could lead to shortfalls—is of genuine concern. Changes in the food system and the environment have created risks that are no longer hypothetical. The 27 articles in the Symposium on American Food Resilience (free article downloads at www.foodresilience.org) explore the vulnerability and resilience of food production and distribution and show how research and community action can bring about improvements. The first half of the workshop will present key symposium results with a focus on solutions and illustrations from case studies. In the second half, participants will examine the resilience issue in terms of their own interests, using facilitated strategic planning to organize concrete ideas about "Where do we go from here?"

Moderators: Gerald Marten, Leader, EcoTipping Points Project and Nurcan Atalan-Helicke, Assistant Professor, Environmental Studies Program, Skidmore College
Speakers:

- Rebecca Dunning, Social and Economic Research and Evaluation, Center for Environmental Farming Systems, North Carolina State University
- Laura Lengnick, Lead Scientist, Cultivating Resilience, Asheville, NC
- Michelle Miller, Associate Director of Outreach, Center for Integrated Agricultural Systems, University of Wisconsin
- Jeremy Solin, Wisconsin ThinkWater Coordinator, University of Wisconsin–Extension

**Gerald Marten** is a systems ecologist with research experience extending from ecosystems to human-environment interaction, working in institutions focusing on environmental policy. His main project in recent years is EcoTipping Points, featuring environmental success stories from around the world and

the lessons they offer for turning environmental decline to restoration. Recently, Gerry edited a collection of 27 articles on American Food Resilience about food system vulnerabilities to shocks and stresses that could disrupt food supply—and what can be done to improve food security. (808-551-3685; gerry@ecotippingpoints.org)

**Nurcan Atalan Helicke** is a social scientist with professional experience in rural and participatory development in Turkey and research interests in conservation of agricultural biodiversity, and Islam and genetically engineered food. She has worked with small farmers in Turkey since 2001, and recently started working with farmer groups in northeast United States, on conserving farmer livelihoods and regional varieties. She has worked with Gerry Marten as the co-editor of the special issue on American Food Resilience. (518-580-8372, natalanh@skidmore.edu)

**Rebecca Dunning** is a project manager and researcher at the Center for Environmental Farming Systems (CEFS) at North Carolina State University and specializes in the social and economic aspects of food systems and food supply chains. She leads the CEFS Building Local Food Value Chains strategic working group, which seeks to strengthen the economic viability of small- and mid-scale food producers through research activities and engagement with business entities across the food value chain. She manages the North Carolina Growing Together project (NCGT), a five-year (2013 to 2017) USDA-National Institute of Food and Agriculture (NIFA) funded initiative to link small- and mid-scale producers of produce, meat, dairy, and seafood into grocery and food service supply chains. (rebecca_dunning@ncsu.edu)

**Laura Lengnick** is an award-winning soil scientist who has explored agricultural sustainability for more than 30 years as a researcher, policymaker, educator, and farmer. Laura led the sustainable agriculture program at Warren Wilson College for more than a decade, and contributed to the 3rd National Climate Assessment as a lead author of the USDA report *Climate Change and U.S. Agriculture: Effects and Adaptation*. Laura left the college in 2014 to launch Cultivating Resilience, LLC, a firm offering ecosystem-based resilience planning services. Her new book, *Resilient Agriculture: Cultivating Food Systems for a Changing Climate* (New Society Publishers 2015), examines climate change, resilience, and the future of food through the adaptation stories of 25 award-winning sustainable producers across the U.S. (828-423-6189; laura@cultivatingresilience.com)

**Michelle Miller** is Associate Director at the Center for Integrated Agricultural Systems, the sustainable agriculture research center at the University of Wisconsin. She is a practicing economic anthropologist engaged in participatory research with practitioners. She holds degrees in landscape architecture (emphasis: regional planning and restorative ecology), and on sustainable development (emphasis: agriculture and food). In the 1990s, Michelle worked for the World Wildlife Fund on agricultural pollution prevention. For the last 15 years she has worked with fruit growers to assist them in their efforts to reduce pesticide risk and build regional markets. Current projects focus on agriculture of the middle and regional food economies, food freight transportation for cities, labor and land tenure, resiliency, and climate change. (608-262-7135; mmmille6@wisc.edu)

**Jeremy Solin** has worked in the environmental and sustainability education field for the past 15 years. Currently, he is the Wisconsin coordinator of ThinkWater, a national campaign supported by USDA to help people think and care deeply about water. His work in food systems includes co-founding Central Rivers Farmshed, an organization working to build a local food economy in central Wisconsin, and conducting dissertation research that explored the motivations, activities and outcomes of those involved in community food systems in Wisconsin. Jeremy has a bachelor's degree in water resources (UW-Stevens Point), a master's degree in environmental education (University of Minnesota, Duluth) and a doctorate degree in sustainability education (Prescott College). (jeremy.solin@ces.uwex.edu)

**W-4 Sustainability Education at the Food-Water-Energy Nexus**
*(Washington Room A)*

The workshop means to build capacity in leaders of all government levels, non-governmental organizations, and higher education institutions for sustainability education at the food-energy-water nexus. The workshop allows participants to explore how to align sustainability-oriented professional and citizen tasks with competencies, courses, pedagogies, and assessments. We share first-hand experiences with program and course development, alumni feedback, and insights from the latest International Society for Sustainability Professionals (ISSP) report and National Council on Science and Environment (NCSE) reports. The workshop starts with a series of real-world professional case studies, and works from these to identify needed competencies and to design curricula and courses. The workshop conveners are leaders in sustainability education, from teaching and research to professional development.

Facilitators:
- Maureen Hart, Executive Director, International Society of Sustainability Professionals
- Seaton Tarrant, Alumni Fellow, Department of Political Science, University of Florida
- Shirley Vincent, Director, Center for Environmental Education Research, National Council for Science and the Environment
- Arnim Wiek, Associate Professor, School of Sustainability, Arizona State University

For biographies, see S-D9.

**W-5 How to get Faculty who have Expertise on Different Aspects of Food-Energy-Water to Overcome Barriers (Intellectual, Cultural, Institutional, Disciplinary) to Collaboration**
*(Potomac Rooms I, II)*

This workshop will enable faculty from the natural sciences, social sciences, and humanities with expertise in aspects of food-energy-water (FEW) to share examples of challenges and successes in developing collaboration. There is great interest among the scientific community in the FEW nexus, but most researchers only look at one system or the interplay between two. Few scientists are exploring the three systems as an interacting system of systems. One of the biggest gaps is between h umanities and the sciences. Humanities faculty are instrumental in focusing on “sustainability” as a theme to weave together themes such as energy and the environment, and health and wellness. The workshop will result in a summary document that presents examples of collaborations and recommendations for those who want to work on this trilemma.

Speakers/Facilitators:
- David Blockstein, Senior Scientist, National Council for Science and the Environment
- Richard Moore, Senior Fellow, National Council For Science and the Environment, Emeritus; Professor, School of Environment and Natural Resources, The Ohio State University
- Serpil Guran, Director, Rutgers EcoComplex; Associate Professor of Plant Biology and Pathology, Rutgers University

Dr. **David Blockstein** is a member of the education team of the USDA-funded "Climate and Corn-based Cropping Systems CAP (CSCAP or ‘Corn Cap’)," which is a transdisciplinary partnership among 11 institutions creating new science and educational opportunities. He is the Executive Secretary of the Council of Energy Research and Education Leaders (CEREL) and Advisor to the Association for Environmental Studies and Sciences (AESS). (202-207-0004; David@NCSEonline.org)

**Richard Moore** has been on the executive committee for the Council of Environmental Deans and Directors since 2012. At The Ohio State University (OSU) he served as executive director of the Environmental Sciences Network from 2011 to 2015. He designed and helped implement the first water quality trading project in Ohio that has been running since 2007 and is expanding to cover a quarter of the State of Ohio. As an anthropologist bridging the natural and social sciences, he is the leader for the Sugar Creek water quality project which teamed farmers and researchers to improve the local water quality. He was active in the Kuwait Climate Conference and is presently a PI on the USDA grant "Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems". (330-202-3538; moore.11@osu.edu)

**Serpil Guran**'s responsibilities include management of the EcoComplex operations, programs, business incubator and facilities, as well as providing vision and leadership in establishing the EcoComplex as a clean energy innovation center for the commercialization of clean energy and environmental technologies. Dr. Guran specializes in research, development and assessment of sustainable clean energy; biofuels recycling technologies; and life cycle analysis of clean energy production systems, such as food waste to low carbon energy and assessment of biomass energy potentials to quantify carbon and water savings. She teaches Sustainability and Bioenergy Technologies classes at Rutgers University. (609-499-3600 ext. 4225; guran@aesop.rutgers.edu)

## W-6 The Food-Energy-Water Nexus in Asia and Its Global Importance

*(Potomac Rooms V, VI)*

The food-energy-water (FEW) nexus is of critical significance to Asia, as two-thirds of world's population is living in this region and it accounts for nearly 60 percent and 30 percent of global water and energy consumption, respectively. It remains a pressing challenge to ensure food, water, and energy security to sustain Asian development. This workshop focuses on this critical region and serves as a model case to advance our understanding and assessment of the FEW nexus for feeding an increasing population and meeting human's demands for water and energy, while maintaining environmental sustainability. It may serve as a platform that "breaks down barriers between fields" to build common ground and explore linkages among resources, technology, and economy in the FEW nexus for Asia and the world.

Moderator: Hanqin Tian, Solon and Martha Dixon Professor and Director, International Center for Climate and Global Change Research, Auburn University
Speakers:

- Chaoqun Lu, Assistant Professor, Department of Ecology, Evolution, and Organismal Biology, Iowa State University
- Yonglong Lu, Professor, Chinese Academy of Sciences and President, Scientific Committee on Problems of the Environment (SCOPE)
- Dennis Ojima, Professor, Department of Ecosystem Science and Sustainability; Senior Research Scientist, Natural Resource Ecology Laboratory, Colorado State University; and Director, North Central Climate Science Center, Colorado State University
- Shufen Pan, Director and Assistant Research Professor, Auburn University
- Wei Ren, Assistant Professor, College of Agriculture, Food, and Environment, University of Kentucky
- Ge Sun, Senior Research Hydrologist, U.S. Forest Service
- Qinxue Wang, Special Senior Researcher, National Institute for Environmental Studies, Japan
- Hongyuan Yu, Director of Institute for Comparative Politics and Public Policy, Shanghai Institute for International Studies

Dr. **Hanqin Tian**'s research program aims at developing and applying an integrated systems approach to the understanding, quantification, and prediction of how multiple environmental stresses affect the ability of Earth's ecosystems to provide people with essential goods and services including food, energy, clear air, and freshwater across the world, particularly in the Asian region. He was the president of the Ecological Society of America's Asian Ecology Section and a recipient of the Global Change Science Prize recognizing his breakthrough achievement in understanding carbon cycle-ecosystem-climate interactions. He has provided scientific leadership and expertise to many national and international organizations. (334-844-1059; tianhan@auburn.edu)

Dr. **Chaoqun Lu** is a quantitative ecosystem ecologist. Her research uses a systems approach that incorporates process-based land ecosystem modeling, data-model assimilation, and geospatial analysis, to investigate how climate change, land use and land management practices have affected ecosystem production, crop yield, evapotranspiration, and water yield in the coupled human-natural system. Her current research focuses on the role of nitrogen cycle in FEW nexus through crop production, N2O emission and nitrogen yield from soil to runoffs, and modification of climate extremes to FEW nexus (e.g., climate impacts on grassland productivity, water yield and its implication to livestock production in the Mongolian Plateau). Dr. Lu contributes to regional assessment and quantification of natural and human controls over food-energy-water nexus. (515-294-7443, clu@iastate.edu)

Dr. **Yonglong Lu** is an elected Fellow of The World Academy of Sciences (TWAS); the former President of the Scientific Committee on Problems of the Environment (SCOPE); Science Advisor of International Union for Conservation of Nature (IUCN); a member of the United Nations Environment Programme (UNEP) International Resource Panel; and Vice President of the Ecological Society of China. He has worked on the impacts of water and soil pollution as well as food safety, publishing more than 250 papers in peer-reviewed journals including *Science*, *Nature*, and *Science Advances* and authoring or co-authoring 16 books. He is the founding Editor-in-Chief of *Ecosystem Health and Sustainability* and the Associate Editor of *Science Advances*. He has obtained various awards and honors including the 2nd Prize of the National Award for Advancement of Science and Technology, the National Outstanding Young and Middle-aged Scientist, and the SCOPE Distinguished Achievement Award. (yllu@rcees.ac.cn)

**Dennis Ojima**'s research area involves the application of social ecological system approaches to climate and land use changes on ecosystems, carbon accounting, food security, and adaptation and mitigation strategies to climate change. He is an Aldo Leopold Leadership Fellow since 1999, has served on the National Research Council Board on Environmental Change and Society and the Board of International Science Organizations, and acted as a co-convener of the Great Plains Regional Assessment for the U.S. National Climate Assessment from 2013 to 2014. (970-491-1976; dennis.ojima@colostate.edu)

Dr. **Shufen (Susan) Pan** has an interdisciplinary educational background with a Ph.D. in ecology, a M.S. degree in economics, and undergraduate training in literature, with more than a decade of work experience in applying environmental sensing (particularly remote sensing), Geographic Information Systems (GIS) and ecological modeling to the research of environmental and climate change. Dr. Pan primary research interest is to use emerging technologies in environmental sensing, GIS, and computer simulation as tools for investigating the impacts of land use, urbanization, and climate change on ecosystem productivity, water resources, food security, and human health. In the past 20 years, She developed and applied these emerging technologies to the understanding and quantification of how multiple global changes in climate, land use/land cover (LU/LC), and atmospheric chemistry have affected carbon and nitrogen cycles, greenhouse gas emissions, and hydrological processes in a range of ecosystems across the globe including boreal and temperate forests in North America and East Asia, tropical forests in the Amazon Basin and Southeast Asia, savannas in Africa, grasslands in United States and Mongolia, urban and croplands in China and United States and at a spectrum of spatial scales that range from watershed to regional to continental to global.

Dr. **Wei Ren** is an ecosystem ecologist with a background in ecology and agricultural meteorology. Her research focuses on the human-climate-ecosystem interactions in the context of global change, with specific interests in agricultural ecosystems at multiple spatiotemporal scales. Dr. Ren uses an integrated systems approach, which incorporates numerical modeling, RS/GIS, and field observations and measurements. Her current research topics include: (1) regional assessment of food production and the dynamics of carbon, water, and nutrients in response to multiple environmental factors; and (2) climate-smart agricultural practices to enhance food production and water/nutrient use efficiency while reducing water pollution and greenhouse gas emissions. (859-257-1953; wei.ren@uky.edu)

Dr. **Ge Sun** has conducted hydrological research on various ecosystems, from Florida's cypress swamps in the humid southeastern U.S. to northern China's Loess Plateau and Mongolian drylands. He served as a leading hydrology expert for the U.S. Forest Service International Program's Mission in Mexico, Africa, and Asia. His research focuses on regional and national assessments of climate change and vegetation management impacts on forest ecosystem functions and sustainability. Dr. Sun's research contributes to understanding the interactions among water supply, agricultural water resource management, energy development, and climate adaptation at a broad scale. (919-624-0590; gesun@fs.fed.us)

Dr. **Qinxue Wang** has been working on developing systems for the observation and evaluation of regional water and material cycles in East Asia. He was worked on number of key research projects, including "Land Use for Global Environmental Conservation (LUGEC)" and "Asia-Pacific Environmental Innovation Strategy Project (APEIS)." He presided over the project "Establishment of Network for Early Detection of the Global Warming Impact," sponsored by Ministry of Environment of Japan. He is now leading a policy contribution-oriented research project entitled "Vulnerability Assessment and Adaptation Strategies for Permafrost Regions in Mongolia," supported by the Environment Research and Technology Development Fund of Japan. (+81-29-850-2128); wangqx@nies.go.jp)

**Hongyuan Yu** is the author of numerous publications, including most recently *Global Warming and China's Environmental Diplomacy* (Nova Science Publishers, 2008). Prof. Yu is exploring the connections between water, energy, food production, and the hard and soft dimensions of their impact on international security and cooperation for China and international community. Prof. Yu works on the food-energy-water nexus caused by climate change and the consequences faced by China and its neighboring countries, and describes China and its neighboring countries' domestic and international responses to the nexus crisis. (yuhongyuan@siis.org.cn)

### W-7 Implementing an Ecologically Sustainable Food Production System to Address the Food-Energy-Water Nexus

*(Potomac Rooms III, IV)*

An efficient ecologically sustainable method of food production has been developed, tested, and implemented in 151 countries to successfully feed hundreds of thousands of families in climates from the hurricane-drenched tropics to the arid regions of Kenya. From 45 years of data, this method will be contrasted with other agricultural methods and practices in terms of yield per area, calories produced per gallon of water applied, and embodied energy to flesh out what merits the designation as a feasible "sustainable" system for feeding billions while addressing the challenges at the food-energy-water nexus. We will engage the participants in considering the role, constraints, and opportunities of a biologically intensive agriculture as a nexus solution.

Facilitators:

- Gene Bazan, Co-founder, Neo-Terra
- Matt Drewno, Garden Manager, Ecology Action
- John Jeavons, Executive Director, Ecology Action
- Steve Moore, Faculty and Director of Agroecology, Elon University

- Tania Slawecki, Research Associate, Neo-Terra and Pennsylvania State University

**Gene Bazan's** projects include organizing a community to obtain funding to construct a zero-discharge ecological wastewater treatment system; using Bucky Fuller Tensegrity domes with ecological wastewater treatment systems to create portable housing; and helping to start the Center for Sustainability at Penn State. With his wife, Dr. Tania Slawecki, he formed Neo-Terra in 2005, dedicated to living lightly on the earth. His degrees are in electrical engineering, economics, and city and regional planning. He has lived and worked in Yugoslavia, Turkey, and Ghana. He gives talks, tours, and workshops on organic food production in Central PA. (neoterraexpts@aol.com)

**Matt Drewno** is certified in permaculture, the restoration of oak-savanna ecologies, and biointensive food production. After a Bachelor's of Architecture from Iowa State University, he founded RhythmicWater Ecological Design, a permaculture design business in the midwestern states. He has been working with Ecology Action since 2010, training individuals and communities in the principles of biologically intensive food production. His experience includes organic farm-scale food production, the design and implementation of food forests, residential-scale food production and community gardens. He serves on the board of Ecology Action and manages the Green Belt Mini-Farm, a research, education and demonstration mini-farm in Mendocino, California. (847-404-2586; rhythmicwater@hotmail.com)

**John Jeavons** is a leader in the field of biologically intensive agriculture. He holds a BA in Political Science from Yale University and worked as a systems analyst in business, government, and university settings before joining Ecology Action in 1972. He has authored and edited books and publications on or related to the GROW BIOINTENSIVE® Sustainable Mini-Farming System and is currently dedicated to encouraging the creation of centers around the globe that implement this climate-resilient, rapid soil-building, resource-conserving "local on a global scale" farming. This system enables people everywhere to grow a complete and balanced diet, significant income, and soil fertility using very little land. (707-459-0150; johnjeavons@mac.com)

**Steve Moore** teaches and directs the AgroEcology and Peace Corps Prep Program at Elon University in Elon, NC. He was the Small Farm Unit Manager and Agriculture Energy Specialist at the Center for Environmental Farming Systems at North Carolina State University. With the National Cooperative Extension team, he helped to develop E-extension educational information on sustainable energy production and utilization in agriculture. He is an associate editor of the peer-reviewed journal *Renewable Agriculture and Food Systems*. Steve and family have farmed organically for over 30 years; he has also been a pioneer, researcher, and advocate for solar greenhouses and high tunnel production for over 25 years. Steve is design certified in permaculture and has done extensive consulting for such groups as USAID. (336-278-6271; smoore24@elon.edu)

**Tania Slawecki** is a physicist and materials scientist as well as the former director of Penn State's Center for Sustainability, who taught courses in Sustainable Living, Green Design, Living Machines, and Integrative Medicine, and received a grant to build an ecological wastewater treatment system on campus. With her husband, Dr. Gene Bazan, they formed Neo-Terra to conduct experiments in healthy living and share their findings with the public. They present talks at the Pennsylvania Association for Sustainable Agriculture and other venues that include a detailed energy analysis of agricultural methods, how to apply sustainability metrics to food-growing, and data from their own food-growing experiences. (814-234-0836; tms9@psu.edu)

# Exhibition

Tuesday Hours – 9:00 a.m. to 5:00 p.m.
Wednesday Hours – 8:00 a.m. to 8:30 p.m.
Thursday Hours – 8:00 a.m. to 2:00 p.m.

***Ballroom Level***

1 U.S. Geological Survey

2 Center for Disease Control, NCEH/ATSDR

3 United Nations Environment Program, STAP/GEF

4 Johns Hopkins University

5 University of Phoenix

6 Midwestern BioAg

7 U.S. Forest Service

8 U.S. Department of Agriculture

9 American Meteorological Society

10 Tetra Tech – U.S. Agency for International Development

11 American Society of Agricultural and Biological Engineers

12 NASA Hyperwall

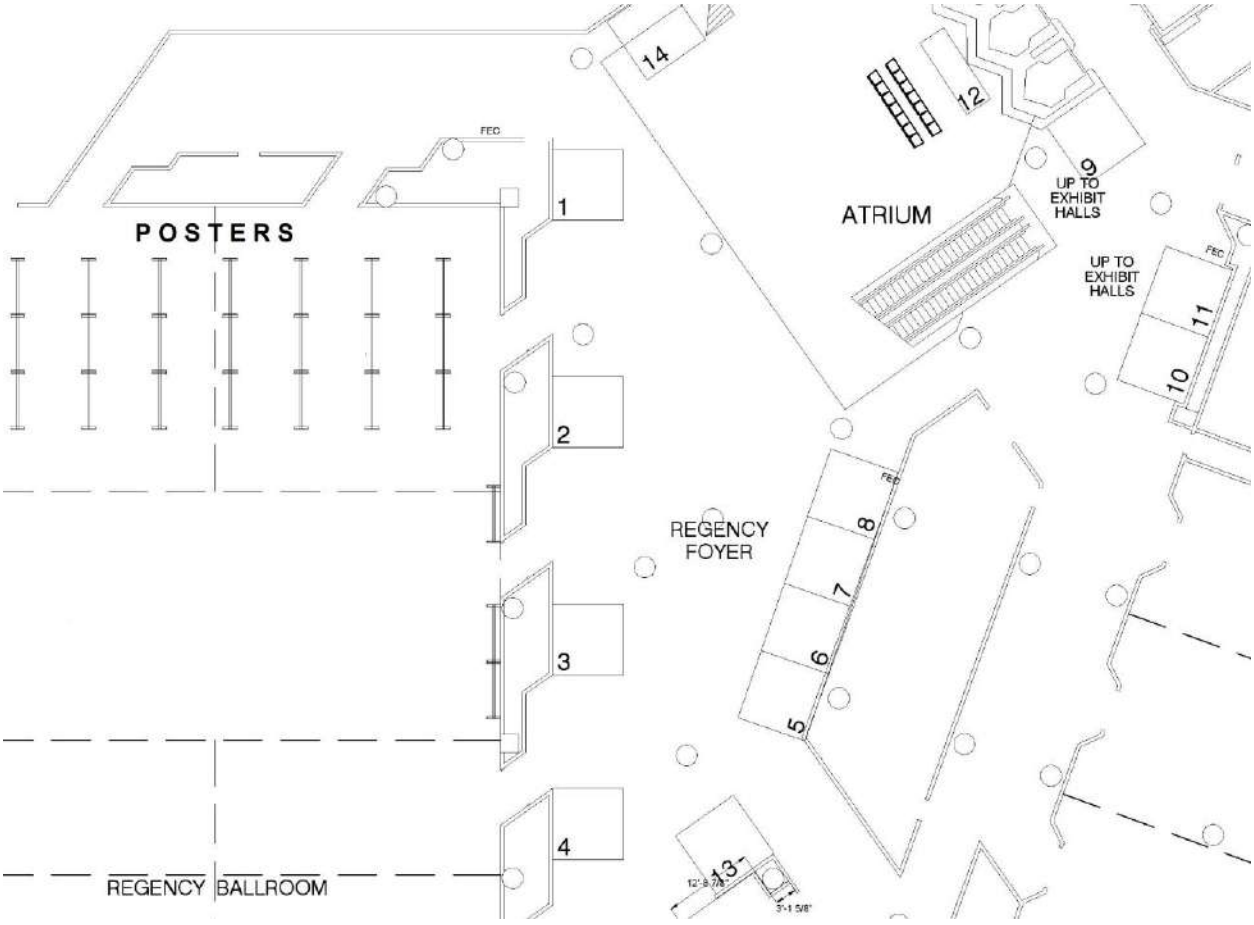
13 Bard Institute

14 Networking Hub

***Registration area on Independence Level***

15 Environmentors

16 National Council for Science and the Environment/ Information Booth



# Poster Session

*Note: Posters will be up for the duration of the conference from Tuesday through Thursday in the Regency Ballroom Foyer and in the Regency Ballroom. Please see map on previous page.*

1. **Polluting Water with a Veritable Source of Energy: The Situation in the Urban City of Lagos-Nigeria**
   Ajayi Timothy Oluwagbenga, Ajayi Grace Jadesola, Olomieja Ayodele, Ajayi Jacob Babasola
   *Ogun State Institute of Technology, Federal University of Agriculture*

2. **Novel Cost-Effect Solution for Potable Water in All Environments**
   John Abraham, Brian Purdue
   *University of St. Thomas*

3. **Monitoring and Evaluation of the Water Quality of Taal Lake, Talisay, Batangas, Phillipines**
   Felipe Martinez, Imelda Galera
   *De La Salle University Dasmarinas*

4. **Electric Power Generation and Availability of Water: Adaption Strategies Design**
   Rosa Elida Rivera, Fabio Manzini, Jorge Islas, Roberto Best
   *Institute for Renewable Energy*

5. **Coastal Biodiversity Conservation in Lake Worth Lagoon, Palm Beach County, Florida: A Collaborative Project Between Education and Community Stakeholders**
   Thomas Chesnes, Shawn McCall
   *Palm Beach Atlantic University*

6. **The Wonders of Hybrid Poplar – Environmental Uses and Alternative Markets**
   Nora Haider, Patricia Towsend, Marina Heppenstall
   *Washington State University*

7. **The Tribal Lands Collaboratory: Building Partnerships and Developing Tools to Support Local Tribal Community Response to Climate Change**
   Brian Wee, Katie Jones, AL Kuslikis, Alyssa Rosemartin, Preston Hardison
   *Neon Inc., American Indian Higher Education Consortium, US National Phenology Network, Office of Treaty Rights of the Tulalip Tribe*

8. **Growing Energy with Hybrid Poplars by Land Applying Aquaculture Effluents**
   Shawn Dayson, Allison Culbreth, Deniss Hazel, Harry Daniels, Elizabeth Guthrie Nicols
   *North Carolina State University,*

9. **Techno-Economic Viability of Desalination for Use in Agriculture**
   Paul Welle, Meagan Mauter
   *Carnegie Mellon University*

10. **Grow, Eat, Learn: Fostering Science Literacy through Food, Energy, and Water**
    Cory Forbes, Jenny Dauer, Joseph Dauer, Jennifer Melander, Tiffany Heng- Moss, Kathleen Lodl
    *University of Nebraska*

11. **Low Temperature Catalytic Thermoconversion of Biomass to Address FEW (Food-Energy-Water) Needs**
    Mohit Nahata, Johannes Schwank
    *University of Michigan*

12. **A Modeling Framework for Water-Energy-Food Nexus and Applications in the Major River Basins of China**
    Qiuhong Tang, Zhongwei Huang, Xingcai Liu, Yuanyuan Yin, Zhe Li, Huijuan Cui, Xuejun Zhang
    *Chinese Academy of Sciences*

13. **Challenges and Solutions on Overcoming Social Stigma: A Sustainable Outlook on Potable Reuse**
    Adit Patel
    *University of South Florida*

14. **Mexico in the Face of Human Rights to Water**
    Maria Tania Garcia Lopez
    *Georgetown University*

15. **Spatially Explicit Modeling of Particulate Nutrient Flux in Global Rivers**
    Sagy Cohen, Albert Ketter, Emilio Mayorga, John Harrison
    *University of Alabama*

16. **EPA Net Zero Partnerships Initiative: Promoting Sustainable and Resilient Communities through Net Zero Water, Energy, and Waste Strategies**
    Ardra Morgan, Kate Helmick
    *Environmental Protection Agency*

17. **Know Watts Cooking - The Physics of Energy Efficient Cooking University Course**
    Carla Ramsdell
    *Appalachian State University*

18. **Florida A&M University (FAMU), NOAA - Environmental Cooperative Science Center (ECSC), Statistical Modeling for Salinity Responses of Oyster Beds within Apalachicola Bay, Florida**
    "Duke" Duc N. Le, Dr. Wenrui Huang, Dr. Elijah Johnson
    *Florida A&M University*

19. **Cultivate a Conversation: Quantifying the Intersecting Viewpoints of our Food and Agriculture System**
    Alissa Welker
    *Villanova University*

20. **Jackson State University NOAA-Environmental Cooperative Science Center, Geochemical Characteristics of Water Quality, Dissolved Strontium, and Phosphorus in Estuarine Waters of Grand Bay National Estuarine Research Reserve**
    Jacqueline Q. McComb, Dr. Fengxiang Han, Professor Christian S. Rogers, Dr. Paul B. Tchounwou
    *Jackson State University*

21. **A Systematic Review Relating Changes in Crop-Selection to Water Pricing**
    Karolina Deuth, Christine King
    *Johns Hopkins University*

22. **REFRESCH - Researching Fresh Solutions to the Energy / Water / Food Challenge in Resource Constrained Environments: Pilot Projects in a Gabonese Rural Community**
    Joseph Trumpey
    *University of Michigan*

23. **Quantifying the Impacts of Droughts and Heat Waves on the Electricity Sector of the American West**
    Julio E. Herrera-Estrada, Justin Sheffield
    *Princeton University*

24. **Plant or Plug: Should the United States Be Promoting Policy to Encourage Internal Combustion Vehicles to Run on Biofuels or Battery Electric Vehicles?**
    Taylor Sloane
    *Johns Hopkins University*

25. **A Living Lab at Penn State: Using the Campus Environment for Hands-on, Immersive Education about Sustainable Food, Energy, and Water Systems**
    Steve Maruszewski, Alex Novak, Kelly Harris
    *Pennsylvania State University*

26. **Water Energy and Food Interdependencies in Texas**
    Bridget Scanlon, Michael Young, Robert Reedy, J. P. Nicot
    *University of Texas*

27. **"Triple Value" System Dynamics Modeling to Help Stakeholders Engage with Food-Energy-Water Problems**
    Nadav Tanners, Robert Black, Maura Flight, Eric Ruder, Andrea Bassi, Joseph Fiskel, Gary Foley, Marilyn Brink, Johanna Hunter
    *Industrial Economics Inc., Knowledge SRL, Ohio State University, Environmental Protection Agency*

28. **Rainfall Seasonality Effects on Coastal Zone Water Resources: the South West Florida Gulf Coastal Zone**
    Magaret Gitau
    *Purdue University*

29. **Exploring the Local Ecological Knowledge of Surfers in Maine and New Hampshire**
    Sophia Scott, Dr. Shannon Rogers
    *Plymouth State University*

30. **Understanding the Water/Energy/Land Nexus in Texas: Turning Data into Information**
    Michael Young, Bridget Scanlon, J.P. Nicot
    *University of Texas*

31. **At the Nexus of Food and Water: Fish for a Food Secure Future**
    Stephanie Ichien, Hilary Egna
    *Oregon State University*

32. **Our Changing Climate: Incorporating the Effects of Climate Change on Agriculture into the Classroom**
    James Brey, Chad Kauffman, Ira Geer, Robert Weinback, Elizabeth Mills, Kira Nugnes, Abigail Stimach
    *American Meteorlogical Society, Californis University of Pennsylvania, The College at Brockport*

33. **45 Years of Feeding People with Low Water and Energy Inputs: Performance Measures from Applications in 151 Countries**
    John Jeavons, Steven Moore, Matt Drewno
    *Pennsylvania State University, Elon University, Ecology Action*

34. **The Israeli Forum for Sustainable Nutrition – Promoting Food Security and Environmental Health For All**
    Hagit Ulanoskyh
    *The Israeli Forum of Sustainable Nutrition*

35. **Understanding the Influence of Climate Change on Municipal Water Supply Systems**
    Weiwei Mo, Haiyang Wang
    *University of New Hampshire*

36. **Nitrogen-Food-Water-Climate Nexus in Midwestern United States: Nitrogen Yield and Nitrous Oxide Emission Due to Crop Production**
    Chaoqun Lu, Hanqin Tian, Jia Yang, Bowen Zhang, Rongting Xu, Susan Pan
    *Iowa State University, Auburn University*

37. **A Global Integrated Framework to Assess, Attribute, and Reduce Future Risks to Our Food-Water-Energy Systems**
    Adam Schlosser, Niven Winchester, Erwin Monier, Sergey Paltsev, Ron Prinn, John Reily
    *Massachusetts Institute of Technology*

38. **Future Challenges at the Agriculture-Water Nexus in Mississippi River Basin**
    Wei Ren, Haqin Tian, Bo Tao, Steven Lohrenz
    *University of Kentucky*

39. **A Regional Approach to Energy and Water Nexus in Central and South Asia**
    Mohammad Saleh
    *University of Hartford*

40. **Mid Infrared Dual Frequency Comb Spectrometer for the Detection of Methane in Ambient Air**
    Hans Shuessler, Alexander Kolomenskii
    *Texas A&M University*

41. **Investment in Voluntary Family Planning Will Improve Food Security and Help Stabilize Climate**
    Joseph Speidel, Sarah Raifman, Kirsten Thompson
    *University of California, San Francisco*

42. **Sensitive Spectroscopy of Crude Oil and Well Gas**
    Hans Schuessler, Feng Zhu, James Strohaber, Alexander Kolomenskii, Mahmood Amani, Yakup Boran
    *Texas A&M University, Florida A&M University*

43. **Addressing the Nexus of Food, Energy, and Water through the Implementation of Biogas Plants in Conjunction with Wastewater Treatment Plants as a Sustainable Alternative to Waste Management in Kathmandu Valley, Nepal**
    Caitlin Eastman
    *University of Idaho*

44. **Value versus Accuracy: Application of Seasonal Forecasts to a Hydro-Economic Optimization Model for the Sudanese Blue Nile**
    Saleh Satti, Ben Zaitchik, Sualeh Siddiqui, Hamada Badr, Shrad Shukla, Christa Peters-Lidard
    *Johns Hopkins University, University Of California, National Aeronautics and Space Administration*

45. **Exploring the "Nexus Risk Trilemma" of Supply, Equity and Environmental Protection in the Severn River Basin, United Kingdom**
    Edna Hayes, Jenna Brown, Aleksandra Michalec, Jo Barnes, Chad Staddon
    *University of the West of England*

46. **Toward the Nexus Equation: A Conceptual and Mathematical Framework for Energy-Water-Food Nexus Analysis**
    Chad Higgins, Majdi Abou Najm
    *Oregon State University, American University of Beirut*

47. **Health in All Policies: A Comprehensive Approach to Improve Health at the Local Level**
    Bridget Kerner, Sandra Whitehead
    *National Association of County and City Health Officials*

48. **Off-grid Wind Power Systems for the Developing World**
    John Abraham, Brian Plourde
    *University of St. Thomas*

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