Arizona State University

Southwestern Regional Water-Energy Nexus Event

Tempe, Arizona • September 8, 2016

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Tempe, Arizona – September 8, 2016

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Executive Summary

Access to water ties the people of the Southwest together in a way few issues can. The main source of water for the region is the Colorado River, which runs for 1,400 miles across seven western states in the United States and two states in northern Mexico. Unfortunately, droughts lasting five or more years are projected to persist 50 percent of the time over the next 50 years, and supply to burgeoning population centers will become an even greater challenge as demand rises—the number of people in the region is expected to double by 2060. Currently, forty million Americans and twenty-two federally recognized tribal nations depend on the river and its systems (both manmade and natural) for both water and energy.

As the Department of Energy outlined in its 2014 report, "The Water-Energy Nexus: Challenges and Opportunities," the water-energy nexus refers to the relationship between the water used to produce energy—including both electricity and fuel sources such as oil and natural gas—and the energy consumed to extract, purify, deliver, heat, cool, treat, and dispose of water (and wastewater).

Arizona State University (ASU) on September 8 hosted the Southwestern Regional Water-Energy Nexus Event to address the regional challenges associated with decreasing water access and increasing energy needs. More than eighty leaders from more than thirty institutions—including representatives from federal and regional governments, industries, academies, and American Indian tribes—met to think together about the regulatory, scientific, technological, and industrial solutions to the Southwest's greatest challenge.[1] The results are summarized according to the Meeting Agenda (Appendix 1) in the report to follow.

Discussion goals for the meeting included:

- Framing the water-energy problems and opportunities inherent to the Southwest.
- Demonstrating that finding solutions to the unique water-energy challenges associated with Department of Energy interests in the Southwest will assist in addressing a spectrum of energy challenges across the country and on a global scale.
- Exhibiting the region's (1) scientific capabilities embodied in our universities, national labs, and utilities; (2) sophisticated understanding of cross-agency federal and local regulatory systems governing the water-energy nexus; and (3) unique willingness to address these challenges due to the impact of climate change and the resulting need for advanced clean energy technology alternatives.

[1] Speakers and attendees at the September 8 event included stakeholders from six states (Arizona, California, Colorado, New Mexico, Nevada, and Utah); three tribal entities (Gila River Indian Community, Fort Mojave Indian Tribe, and the Navajo Nation); four national labs (Lawrence Livermore, Los Alamos and Sandia National Labs, and the National Renewable Energy Laboratory); two utilities (Southern Nevada Water Authority and Western Area Power Administration); seven universities (Arizona State University, New Mexico Tech, Northern Arizona University, University of California – Irvine, University of Colorado – Boulder, University of New Mexico, and Utah State University); as well as major industry leaders, such as Coca Cola and Intel, in addition to hydropower startup Natel Energy. Leaders from the U.S. Department of Energy attended, and U.S. Senator Flake (R-AZ) prepared a welcome video.

INTRODUCTION

Framing the Water-Energy Nexus in the Southwest

OPENING REMARKS

Sethuraman Panchanathan, PhD, Executive Vice President and Chief Research and Innovation Officer, ASU Office of Knowledge Enterprise Development

The Honorable Jeff Flake, U.S. Senator and Member of the Senate Committee on Energy and Natural Resources

This Southwestern Regional Water-Energy Nexus Event brings together expertise from the United States' most arid region—consisting of Arizona, California, Colorado, Nevada, New Mexico, and Utah—to discuss both how water is used to produce energy and how energy is used to extract, purify, and deliver water. The event is designed to involve local, state, and federal scientists, stakeholders, and policymakers in the question: How can regional governments, utilities, industries, and research institutions collaborate to address solutions to ongoing challenges via the water-energy nexus approach?

Many of our region's political leaders understand the critical role energy plays in our use of water. U.S. Senator Jeff Flake of Arizona joined via video to welcome the group, emphasize how essential water and energy are to southwestern life, and encourage further collaboration in this important area.

REVIEW OF PROGRAM AND OBJECTIVES

John Sabo, PhD, Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability, ASU; Professor, School of Life Sciences, College of Liberal Arts and Sciences; Affiliated Faculty; Center for Biodiversity Outcomes, Julie Ann Wrigley Global Institute of Sustainability

The single greatest threat to global sustainability is the availability of safe, clean water. Nowhere is this more acute than in the American Southwest. The extent of frequent droughts is tough to predict, leaving historical sources near exhausted, reservoirs depleted, and ultimately impacting the availability of clean energy while the "new" sources of water are wastewater and the ocean, both requiring significant energy (and funding) to make the water usable.

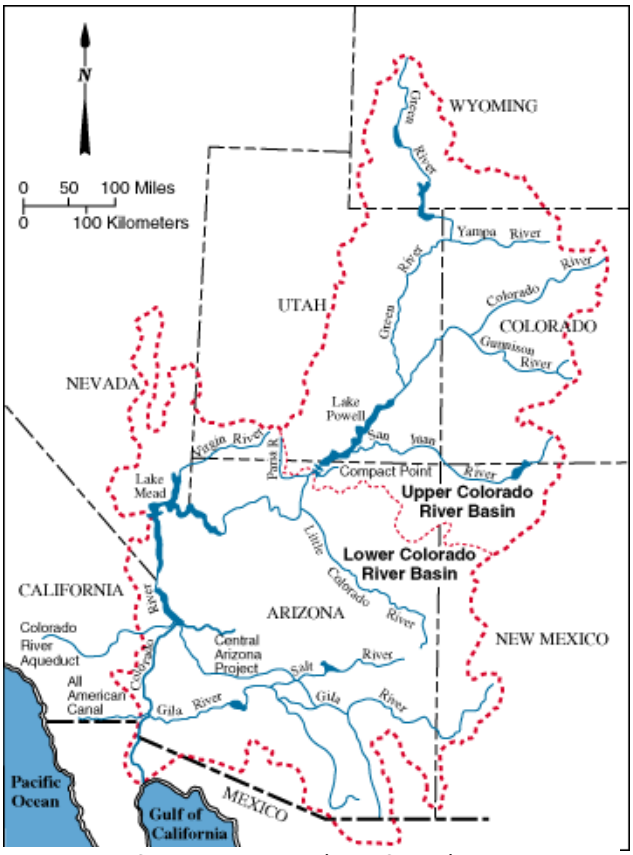

Figure 1 – Seven states in the U.S. and two in Mexico mutually depend on the Colorado River for water, uniting regional interests and necessitating collaboration between governments, utilities, industries, and institutions (Map courtesy of the U.S. Department of Interior, Bureau of Reclamation).

Collaboration between governments (local, state, federal, and tribal), utilities, industries, universities, and laboratories will be key to combating the global threat of a changing climate and developing regional solutions to challenges at the intersection of water and energy.

One example of successful collaboration is the Palo Verde Nuclear Generating Station, located west of Phoenix near Tonopah, Arizona. Owned in part by utilities in Arizona, California, and New Mexico, among others, it produces about 3.3 gigawatts of electric power and serves more than four million people, making it not just the largest nuclear power plant in the United States, but the largest nuclear facility in the world completely cooled using treated wastewater.

Our mutual dependence on a single river—the Colorado—unites our regional interests and necessitates collaboration (Figure 1). While we have made substantial progress, many opportunities for reusing, recycling, and further leveraging water and energy resources still exist. The future should be about working together to maximize and modernize existing infrastructure to make the most of these opportunities.

Many in the region are already attempting this. For instance, Natel Energy seeks to harvest low head hydropower on aqueducts and canals. Such a solution could apply broadly across the Southwest and exemplifies the interdependency of water and energy and how we can use one to optimize delivery of the other.

PANEL ONE

Southwestern Challenges and Opportunities in Water-Energy

MODERATOR

Sarah Porter, JD, Director, Kyl Center for Water Policy, Morrison Institute for Public Policy, ASU

PARTICIPANTS

Tzahi Cath, PhD, Director, AQWATEC; Chair, Mines Research Council, Colorado School of Mines

Otakuye Conroy-Ben, PhD, Assistant Professor, School of Sustainable Engineering and the Built Environment, ASU

Steve Johnson, Energy Management and Marketing Office, Western Area Power Administration (WAPA)

Colby Pellegrino, MBA, Colorado River Program Manager, Southern Nevada Water Authority

SUMMARY

It is an understatement to say Southwestern water sources are limited. Reuse and recycling is not just important, but critical to keep pace with fast-growing cities in arid and semi-arid climates. Through aggressive investments into new and existing technologies, many regional metropolitan areas have found ways to use less water while continuing to grow their economies. Some, such as Las Vegas and Phoenix, have almost maximized wastewater reuse. For instance, 95 percent of southern Nevada's wastewater is treated and returned to the Colorado River.

Among the top research areas of focus for the region should be finding a better way to store energy.

Despite these successes, water utilities still need funds to build infrastructure and implement existing technologies. Concurrently, new technologies and campaigns must be developed to keep up with demand and increase water quality.

Among the top research areas of focus for the region should be finding a better way to store energy. In part due to source variability, (sunlight, water, and wind), renewable technology options are not being fully leveraged. For example, as it currently stands, wind farms must be shut down if there is a surplus of hydropower during high runoff peaks in spring. Generated solar energy could also go to waste without a method of storing excess power. Power companies, cooperatives, and administrators should have more options

than taking these generators offline for the sole reason that there is no way to store the resulting energy.

According to this panel, disruptive technology, on the order of a “Wright brothers event,” must take place for us to fully use existing water reserves and fully leverage existing renewable technologies in order to maintain successful population centers in this arid climate. We must build into next-generation water-power systems the capability to switch between multiple sources to manage and optimize their loads.

Additional research is needed to improve modeling and forecasting of water availability. The flow of the Colorado River, for example, depends on the amount of snow in the Rocky Mountains, and current models are unable to predict spring flow even one year in advance.

Figure 2 – The Claude "Bud" Lewis Carlsbad Desalinization Plant near San Diego removes salt from 50 million gallons of seawater every day and is a prime example of implementing existing technology to find new sources of water in the arid West.

Apart from recycled wastewater, desalinized seawater and brackish groundwater are the West’s only new sources of water. Investments into new research and existing desalinization technologies are critical as coastal and desert populations continue to grow but water supplies remain the same. For instance, San Diego already gets 10 percent of its water from a desalinization plant near Carlsbad, California (Figure 2), but current desalinization costs limit spreading the technology wider in the near future—at least within the United States. It is worth noting that where the technology has been more broadly implemented, costs have been reduced. A cubic meter of desalinized water in Israel, for example, costs roughly a third of what it does in the United States.

Even with all of this research and technical advancement, there is no substitute for educating the population about making major adjustments in troubling use trends. For instance, despite the successful use and implementation of advanced technology to reclaim wastewater for municipal drinking water, the public and policymakers remain resistant to the idea of drinking clean water that may have once flowed through a sewer. People could be educated in order to be more open to the broad spectrum of options to establish more efficient public water-energy use trends.

LIGHTNING ROUND

Envisioning the Future of Water-Energy Governance

SPEAKER

Dave White, PhD, Director, Decision Center for a Desert City, Julie Ann Wrigley Global Institute of Sustainability, ASU

SUMMARY

Water and energy systems must be integrated and managed together because they are used together. For instance, Phoenix AZ's Central Arizona Project—the 336-mile aqueduct that carries water from the Colorado River to Phoenix and Tucson—is the largest user of electricity in the state. This arterial system requires more than 2.8 million megawatt hours of electricity (with most coming from the Navajo Generating Station) to deliver more than 500 billion gallons of water.[2] Governance systems must evolve to be flexible, adaptable, and to enhance coordination and collaboration between energy and water utilities and the people they serve.

A recent survey of water decision-makers in Arizona shows potential for broad support for several promising measures to govern water and energy together, including:[3]

- Upgrading canals and similar delivery systems with shade trees, walking paths, and smart mixed-use development to leverage water use in the area and reduce water loss via evaporation;
- Actively engaging scientists, stakeholders, and residents in water and energy resource decisions in order to balance cross-sector demand.

[2] Beth Kleiman, "The Water-Energy Nexus Dimension of the Central Arizona Project System Use Agreement," *Central Arizona Project*, September 14, 2016, http://www.cap-az.com/documents/education/2016-Kleiman.pdf.
[3] Dave D. White, Lauren Withycombe Keeler, Arnim Wiek, Kelli L. Larson, "Envisioning the future of water governance: A survey of central Arizona water decision makers," *Environmental Practice* 17, no. 1 (November 2014): 25–35.

PANEL TWO

De-risking the Value Chain for Early Adopters of Clean and Related Tech Innovation

MODERATOR

Robin L. Newmark, PhD, Associate Laboratory Director, Energy Analysis and Decision Support, National Renewable Energy Laboratory

PARTICIPANTS

Michael Bernier, Director of Sustainability and Environmental Affairs, Salt Lake City Area, Swire Coca-Cola

Kris Mayes, JD, Director, Utility of the Future Center, ASU; Senior Sustainability Scholar, Julie Ann Wrigley Global Institute of Sustainability, ASU

Jake Davis, PhD, Site Water Treatment and Reuse Engineer, Intel

Gia Schneider, Chairman of the Board and Chief Executive Officer, Natel Energy

SUMMARY

We are entering a new way of thinking about water and energy, a future where economic growth in the Southwest must be unyoked from water use. As a result, communities are finding ways to use less water while continuing to grow their economies. Las Vegas and Phoenix in the last decade added hundreds of thousands of residents while using the same amount of water. On the industry side, Swire Coca-Cola drastically reduced the amount of water it needs to produce a liter of Coke, so much so that it will meet its goal to be water neutral five years early. Other corporations are finding ways to follow suit.

This new thinking is replacing the old in many water-energy discussions. However, current practices—including regulated rates based on revenue requirements, operating expenses, capital investment values, asset depreciation, and a rate of return—do not encourage the development or adoption of new technologies or system-wide evolution. Even if they did, the amount of capital needed upfront to build or upgrade plants and facilities discourages change.

Fortunately for consumers (but leaving questions about how these changes will be systematically supported), the development and implementation of alternative and renewable energy sources is dooming utility monopolies. Advanced hydroelectric systems and new solar technologies may allow consumers to fully divorce themselves from their current utility company as soon as two years from now. In order to survive, existing utilities will have to become providers of next-generation products and services.

Despite this promise, the United States, and even the Southwest, (which has some of the highest concentrations of renewable energy sources in the country), is far from moving away from centralized power plants, and more investment into renewable energy research and technology is needed to complete the transition. Even with that investment, experts predict at least ten to twenty years will be required to complete the transition.[4]

To foster decentralization and conservation, a method must be developed to get accurate measures for the amount of water used to produce energy on a unit basis. In turn, this data would inform models and quantify tradeoffs between water and energy, which could then be applied to better manage resources and create incentives for improved efficiency.

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Testbeds and pilot projects where multiple stakeholders collaborated together are also necessary. For instance, micro grid projects in Brooklyn and San Diego have saved utilities millions of dollars. And Natel Energy's hydropower pilot project in rural areas across the region have worked well because (1) existing infrastructure can be used, (2) permits are comparatively easy to obtain in rural areas, and (3) rural areas feature fewer regulations that could impede testing.

Smaller projects like these can be scaled to municipalities using a testbed approach, and businesses can be encouraged to test or adopt technology developed at labs and universities through programs such as the Department of Energy's small business voucher program.

While conservation for some companies, such as Swire Coca-Cola, makes good business sense—water is the product's number-one ingredient—for others, becoming water neutral or more energy efficient is not as simple. At the end of the day, the big question for most businesses trying to consume and reuse energy and water more efficiently is: how much do these changes cost? How can we work with local and state governments to share those costs?

Universities can also assist governments and businesses by convening a forum where water and energy stakeholders (including large utilities, industry specialists, and regulators) can come together to share ideas to de-risk the adoption of new technologies and encourage conservation.

[4] See U.S. Energy Information Administration, "Electric Power Monthly with Data for June 2016," Washington, DC: U.S. Department of Energy, August 24, 2016.

PANEL THREE

Water-Energy from the Tribal Perspective

OPENING REMARKS

Jacob Moore, MBA, Assistant Vice President, Tribal Relations, Office of University Affairs, ASU

MODERATOR

Christopher Deschene, JD, Director, Office of Indian Energy Policy and Programs, U.S. Department of Energy

PARTICIPANTS

Governor Stephen Roe Lewis of the Gila River Indian Community

Chairman Timothy Williams of the Fort Mojave Indian Tribe

Bidtah N. Becker, JD, Executive Director, Natural Resources, Navajo Nation

Sam Woods, Business Development Manager, Navajo Transitional Energy Company

SUMMARY

At the heart of the water-energy nexus conversation at the Department of Energy is a clean-energy ecosystem. Water and energy are fundamental issues to tribal nations, since in their cultural worldview, "water is life." American Indian tribal lands have and will continue to play a critical role in the support of next-generation clean energy and efficient water use.

Understanding and consulting with individual tribal nations is important. Many tribal nations are already expertly working at the intersections of multi-state jurisdictions to provide water and power to both their local populations and constantly emerging cities in the southwest. Without such discussion and collaboration, national energy policy may negatively affect southwestern tribal nations and communities. For instance, restrictions on coal-fired power plants, with few alternatives discussed, has the potential to bring serious economic and environmental consequences to regional communities, especially to tribal nations in the region (Figure 3).

Figure 3 – The Navajo Generating Station in Page, Arizona, is the single-greatest source of revenue and jobs for members of the Navajo Nation. Efforts by the federal government to curtail its emissions and possibly shut down the station have been met with resistance—from the Navajo, the Central Arizona Project, and the Salt River Project—because of its importance in delivering power and water to Arizona's metropolitan areas.

In addition to the technical aspects of water delivery and power generation, for instance, water and energy policymakers must take into account the social and political context of each tribal nation rather than tribal nations en bloc. It is simple, if you know one tribal nation, you only know one tribal nation. Active and authentic consultation with tribal representatives early and often is critical to the success of clean energy investment efforts.

The Department of Energy's Office of Indian Energy plays an important role in translating between federal and local issues and is especially interested in success via regional partnerships. Next-generation water-energy utility development is a local economic development opportunity with the potential to enhance regional sustainability, create jobs, and increase workforce skill deployment across tribal lands and beyond tribal borders. Next-generation goals should include a clean energy ecosystem that leads to an energy economy in which tribal nations actively participate as critical partners in national and even global initiatives.

KEYNOTE ADDRESS

Mission Innovation and Regional Partnerships

KEYNOTE SPEAKER

The Honorable Elizabeth Sherwood-Randall, PhD, Deputy Secretary, U.S. Department of Energy

OVERVIEW OF HER REMARKS

In 2014, the U.S. Department of Energy released a report on the water-energy nexus, outlining the interdependency of energy and water systems and the future of both in the twenty-first century. The overview also highlighted challenges and opportunities of the water-energy nexus and encouraged collaboration with public and private-sector partners in developing integrated solutions to issues that cannot be ignored.

Nowhere are these issues more obvious than in the American Southwest. Climate change and a growing population could make already scarce water even more scarce; water and energy sources could become even more variable.

While the Department of Energy requested $100 million—a 240 percent increase over previous budgets—to research and develop solutions to issues related to the water-energy nexus, the Department cannot possibly do this alone. State, local, and tribal governments must participate and coordinate resources. Universities and national laboratories must work to build knowledge and expertise, and utilities and industries must work with all of the above to help get new technologies out of the Valley of Death and into the marketplace.

To help generate solutions to water-energy nexus issues and other energy goals, the Department invested $1.3 billion in ARPA-E projects and helped fund twelve clean energy projects in Arizona alone (to the sum of $40 million), funded research on solar cells and more efficient solar systems, and pushed for more advanced photovoltaic projects. In addition, the Department created loan programs to accelerate the development of clean energy and a small-business voucher program to speed time to market of new technologies.

Going forward, as the United States changes presidential administrations, research must continue to be funded at all levels. Businesses and universities must continue to advocate for funding for programs and projects to develop and adopt new technologies. Education at all levels must be supported to provide the STEM foundation essential to functioning in the twenty-first century and to working to resolve our greatest challenges moving forward—including the water-energy nexus.

PANEL FOUR

University Research Initiatives at the Water-Energy Frontier with Vice Presidents for Research

MODERATOR

Robert McGrath, PhD, Director, Renewable and Sustainable Energy Institute, University of Colorado, Boulder

PARTICIPANTS

Elizabeth Cantwell, PhD, Vice President for Research Development, ASU

Gabriel P. Lopez, PhD, Vice President for Research, University of New Mexico

Mark McLellan, PhD, Vice President for Research, Utah State University

Pramod Khargonekar, PhD, Vice Chancellor for Research, University of California, Irvine

Carlos Romero, PhD, Associate Vice President for Research and Economic Development, New Mexico Tech

SUMMARY

Existing efforts by federal agencies to fund work at the water-energy nexus are mostly traceable to the National Science Foundation's work with the Innovations at the Nexus of Food, Energy and Water Systems (INFEWS) program. This program, in addition to previous iterations at NSF, are critically important. However, support from outside of the NSF mission is much needed. It is gratifying to see the Department of Energy recognizing the important role of the water-energy nexus—specifically as it is associated with generating power and transporting water to those who need it.

New research is needed to better understand and support solutions to major challenges at the water-energy nexus. For example, developing advanced data analytics that can model human behavior in the environment requires a merging of physical and social sciences.

In addition to recommending the Department of Energy fund a major research initiative in this area, it is critical that existing programs throughout the federal government that currently fund water-energy nexus research must not be interrupted by the upcoming change in presidential administration. New funding opportunities should embody a spirit of multidisciplinary, cross-sector collaboration.

New funding opportunities should embody a spirit of multidisciplinary, cross-sector collaboration.

A regional focus to advance the science around unique geographical challenges recognized by the Department of Energy is welcome and recommended. Such a regional focus could be supported through joint workshops and research engagements. Such efforts would also further support education initiatives to connect current researchers and scientists to the next generation of producers, users, and innovators.

Finally, if we wish to infuse the business sector with environmental leaders and stakeholders, universities must tie activities with commercial interests. A public-private partnership to create a water-energy nexus testbed could bring together key players (e.g., scientists, students, social system thinkers) to help industries minimize investment risks and increase incentives to leverage opportunities at the water-energy nexus.

APPENDIX ONE

Meeting Agenda

10:00 – 10:30 AM	Framing the Water-Energy Nexus in the Southwest Welcome from **Dr. Sethuraman Panchanathan**, Executive Vice President, ASU and Review of Program and Objectives with **Dr. John Sabo**, Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability, ASU
10:30 – 11:30 AM	Southwestern Challenges and Opportunities in Water-Energy **Ms. Sarah Porter Director**, Kyl Center for Water Policy, Morrison Institute, Arizona State University, Moderator **Dr. Tzahi Cath Director**, AQWATEC; Chair, Mines Research Council, Colorado School of Mines **Dr. Otakuye Conroy-Ben**, Assistant Professor, School of Sustainable Engineering and the Built Environment, Arizona State University **Mr. Steve Johnson**, Energy Management and Marketing Office Manager, Western Area Power Administration (WAPA) **Ms. Colby Pellegrino**, Colorado River Program Manager, Southern Nevada Water Authority
11:30 – 11:45 AM	Lightning Round: Envisioning the Future of Water-Energy Governance **Dr. Dave White Director**, Decision Center for a Desert City, Julie Ann Wrigley Global Institute of Sustainability, Arizona State University
11:45 AM – 12:15 PM	Lunch Provided with a Networking Break
12:15 – 1:15 PM	De-risking the Value Chain for Early Adopters of Clean and Related Tech Innovation **Dr. Robin L. Newmark**, Associate Laboratory Director, Energy Analysis and Decision Support, National Renewable Energy Laboratory, Moderator

Mr. Michael Bernier, Director of Sustainability & Environmental Affairs, Salt Lake City Area, Swire Coca Cola
Ms. Kris Mayes Director, Utility of the Future Center, Arizona State University
Mr. Jake Davis, Site Water Treatment and Reuse Engineer, Intel
Ms. Gia Schneider, Chairman of the Board and Chief Executive Officer, Natel Energy

1:15 – 2:15 PM Water-Energy from the Tribal Perspective

Mr. Jacob Moore Assistant, Vice President, Tribal Relations, Office of University Affairs, Arizona State University, introducing
Mr. Christopher Deschene, Director, Office of Indian Energy Policy and Programs, U.S. Department of Energy, Moderator
Governor Stephen Roe Lewis, Gila River Indian Community
Chairman Timothy Williams, Fort Mojave Indian Tribe
Ms. Bidtah N. Becker, Executive Director, Natural Resources, Navajo Nation
Mr. Sam Woods, Business Development Manager, Navajo Transitional Energy Company

2:15 – 2:30 PM Coffee Break

2:30 – 3:00 PM Keynote Address: Mission Innovation and Regional Partnerships

Dr. Sethuraman Panchanathan, Executive Vice President, Arizona State University, introducing
The Honorable Dr. Elizabeth Sherwood-Randall, Deputy Secretary, U.S. Department of Energy

3:00 – 4:00 PM University Research Initiatives at the Water-Energy Frontier

Dr. Robert McGrath, Director Renewable & Sustainable Energy Institute (RASEI) University of Colorado Boulder, Moderator
Dr. Elizabeth Cantwell, Vice President for Research Development, Arizona State University

Dr. Gabriel P. López, Vice President for Research, University of New Mexico

Dr. Mark McLellan, Vice President for Research, Utah State University

Dr. Pramod Khargonekar, Vice Chancellor for Research, University of California, Irvine

Dr. Carlos R. Romero, Associate Vice President for Research and Economic Development, New Mexico Tech

4:00 – 5:00 PM Reception

APPENDIX TWO

Panelists and Speakers

Sethuraman Panchanathan, PhD, Executive Vice President and Chief Research and Innovation Officer, ASU Office of Knowledge Enterprise Development

Sethuraman "Panch" Panchanathan leads ASU's knowledge enterprise, which advances research, innovation, strategic partnerships, entrepreneurship, and global and economic development at the university. Panchanathan was the founding director of the School of Computing and Informatics and was instrumental in founding the Biomedical Informatics Department at ASU. He also served as the chair of the Computer Science and Engineering Department. He founded the Center for Cognitive Ubiquitous Computing (CUbiC) at ASU. CUbiC's flagship project iCARE (for the blind and visually impaired) won the Governor's Innovator of the Year Academia Award in November 2004.

In 2014, Panchanathan was appointed by President Barack Obama to the U.S. National Science Board (NSB). He has also been appointed by U.S. Secretary of Commerce Penny Pritzker to the National Advisory Council on Innovation and Entrepreneurship (NACIE).

Panchanathan is a fellow of the National Academy of Inventors (NAI), the Canadian Academy of Engineering, the Institute of Electrical and Electronics Engineers (IEEE), and the Society of Optical Engineering (SPIE). He is currently the Chair-Elect in the Council on Research (CoR) within the Association of Public and Land-grant Universities (APLU). Panchanathan was the editor-in-chief of the IEEE Multimedia Magazine.

His research interests are in the areas of human-centered multimedia computing, haptic user interfaces, person-centered tools and ubiquitous computing technologies for enhancing the quality of life for individuals with disabilities, machine learning for multimedia applications, medical image processing, and media processor designs. Panchanathan holds a PhD in electrical and computer engineering from the University of Ottawa; a master's of technology in electrical engineering from the Indian Institute of Technology, Madras; and bachelor's degrees in electronics and communication engineering and physics, from the Indian Institute of Science, Bangalore and the University of Madras in India, respectively.

John Sabo, PhD, Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability, ASU; Professor, School of Life Sciences, College of Liberal Arts and Sciences; Affiliated Faculty; Center for Biodiversity Outcomes, Julie Ann Wrigley Global Institute of Sustainability

John Sabo is an ecologist who studies the importance of water in determining the viability and resilience of animal and plant populations in river and riparian ecosystems. He and his research team use large-scale field experiments and the application of stable isotopes to understand how droughts and floods influence freshwater and terrestrial biodiversity. They also study how these extreme events affect food web structure. He also develops statistical techniques to measure the resilience of river food webs and the fisheries that these food webs support. Sabo collaborates broadly across disciplines, synthesizing large datasets to answer

questions about the impacts of floods and water scarcity on the interactions between humans and biodiversity. Sabo's work is being applied to problems in watershed management and freshwater sustainability to understand how water scarcity and extreme weather influence food security and biodiversity. Sabo earned his doctorate from the University of California, Berkeley.

Sarah Porter, JD, Director, Kyl Center for Water Policy, Morrison Institute for Public Policy, ASU

Sarah Porter was named inaugural director of the Kyl Center for Water Policy in January 2015. Part of Arizona State University's Morrison Institute for Public Policy, the Kyl Center promotes research, analysis, collaboration, and open dialogue to build consensus in support of sound water stewardship solutions for Arizona and the West.

Porter came to the Kyl Center from the National Audubon Society, where she served as the Arizona state director and led Audubon's Western Rivers Project, a multistate initiative to protect and restore important river habitats in the Intermountain West.

Before joining Audubon, she spent fourteen years as an attorney in private practice, specializing in commercial litigation. She serves on the University of Arizona's Water Resources Research Center's External Advisory Council, the Phoenix Parks and Recreation Board, and several other community boards. She received her undergraduate degree from Harvard University, then her law degree from Arizona State University.

Tzahi Cath, PhD, Director, AQWATEC; Associate Professor of Environmental Engineering; Chair, Mines Research Council, Colorado School of Mines

Tzahi Cath's main research field is membrane processes for wastewater treatment, desalination of saline and hypersaline brines, reclamation of impaired water for potable reuse, and energy from water and wastewater. Another field of his research focuses on lifecycle assessment and techno-economical evaluation of these processes and the development of decision support tools for selection and optimization of treatment processes. He is a principal investigator on many research projects focusing on the integration of membrane contactor processes in seawater and brackish water desalination, in domestic and industrial wastewater treatment, and in life support systems.

He holds PhD and MS degrees in Environmental Engineering from the University of Nevada, Reno and a bachelor's in Mechanical Engineering from Tel Aviv University. He is currently the director of the Advanced Water Technology Center (AQWATEC) at Colorado School of Mines, and until recently served the leader of the Advanced Engineered Systems Thrust of the Engineering Research Center ReNUWIt.

Otakuye Conroy-Ben, PhD, Assistant Professor, School of Sustainable Engineering and the Built Environment, ASU

Otakuye Conroy-Ben's research focuses on the biological effects of polluted water. Her research interests include environmental endocrine disruption, metal and antibiotic resistance in bacteria, and wastewater epidemiology. She teaches courses on environmental engineering, soil and groundwater remediation, and contaminant fate and transport. A

member of the Ogalala Lakota tribe, she is also an advisor the ASU chapter of the American Indian Science and Engineering Society (AISES).

Dr. Conroy-Ben received her bachelor's in chemistry from the University of Notre Dame, a master's in analytical chemistry from the University of Arizona, and a PhD in Environmental Engineering from the University of Arizona.

Steve Johnson, Energy Management and Marketing Office, Western Area Power Administration (WAPA)

Steve Johnson directs the twenty-four-hour energy management and marketing function and related resource planning, scheduling, and accounting activities for the Colorado River Storage Project Management Center and the Loveland Area Projects in WAPA's Rocky Mountain Region. He closely coordinates with the US Bureau of Reclamation regarding reservoir and river operations while managing energy delivery obligations and grid reliability.

Steve began his career in power system operations on the City and County of San Francisco's Hetch Hetchy hydro system in Northern California and came to WAPA as a system operator.

He has also served on the NERC BAL-002-WECC-2 standard drafting team, as a member of the operating committee and board of the Rocky Mountain Reserve Group, executive committee member of the Southwest Reserve Sharing Group, and on various WECC committees, subcommittees, working groups, and task forces. He continues to serve on the WECC Operating Committee.

He holds a North American Electric Reliability Corporation system operator certification for over fifteen years, and has been certified at the Reliability Coordinator level for the past eleven. He attended the University of California, Davis and Bismarck State College.

Colby Pellegrino, MBA, Colorado River Program Manager, Southern Nevada Water Authority

Colby Pellegrino leads and coordinates development of the SNWA's policies related to the protection of Nevada's interests and rights to Colorado River water. As a subject matter expert in hydrologic, legal, and political issues associated with the Colorado River Basin, Pellegrino serves as the agency's representative on interstate and international technical committees. She also supports the development of multi-state agreements regarding the Colorado River and negotiates on behalf of the organization. Because many of the agreements associated with the Colorado River are viewed by the broader water community as precedent-setting, Pellegrino also represents the SNWA at conferences and symposiums related to water resource management.

She is a native of Las Vegas, earning her bachelor's degree in Civil Engineering from the University of Nevada, Las Vegas and her MBA from Mississippi State University.

Dave White, PhD, Director, Decision Center for a Desert City, Julie Ann Wrigley Global Institute of Sustainability, ASU

Dave White's research focuses on developing, implementing, and evaluating institutions to link knowledge to action for sustainability. His findings have been published in dozens of

scientific journal articles and featured in popular media, including the *New York Times* and the *Wall Street Journal*.

He also holds an appointment at ASU as Senior Sustainability Scientist with the Julie Ann Wrigley Global Institute of Sustainability and is affiliated with the Consortium for Science, Policy, and Outcomes and the School of Public Affairs.

White is a recipient of the President's Medal for Social Embeddedness from ASU and the Celebrating Natural Resources Award from the University of Idaho. He received his PhD from Virginia Tech, his master's from the University of Idaho, and bachelor's from George Mason University.

Robin L. Newmark, PhD, Associate Laboratory Director, Energy Analysis and Decision Support, National Renewable Energy Laboratory

Robin Newmark has led or contributed to programs involving energy, climate, and water issues, including the interdependence of water and energy systems. She serves in an advises such diverse groups as the multinational laboratory Energy-Water Nexus consortium, the United States-China Expert Carbon Capture and Sequestration (CCS) Steering Committee, and the Scientific Advisory Committee for the Union of Concerned Scientists' Energy and Water in a Warming World Initiative. She is also a member of the editorial board for Current Sustainable/Renewable Energy Reports and a guest editor for Environmental Research Letters.

An author of over 50 papers, reports, and patents, Newmark is a fellow of both the Renewable and Sustainable Energy Institute at the University of Colorado, Boulder and the Center of Integrated Water Research at the University of California. Santa Cruz. She earned her bachelor's from the Massachusetts Institute of Technology, her master's from the University of California, Santa Cruz, and PhD from Columbia University.

Michael Bernier, Director of Sustainability and Environmental Affairs, Salt Lake City Area, Swire Coca-Cola

Michael Bernier has been the Director of Sustainability & Environmental Affairs for Swire Coca Cola since 2008. Previous to that, he was a Plant Manager for Dreyer's Grand Ice Cream and an Operations Manager for Haagen-Dazs Ice Cream. He earned a BS in Consumer Studies with a minor in Economics from the University of Utah.

Kris Mayes, JD, Director, Utility of the Future Center, ASU; Senior Sustainability Scholar, Julie Ann Wrigley Global Institute of Sustainability, ASU

Kris Mayes served on the Arizona Corporation Commission from 2003 until 2010. She helped co-author the Arizona Renewable Energy Standard, which requires that by 2025 utilities must generate 15 percent of their overall energy portfolio from renewable sources, like wind solar, biomass, biogas, geothermal and other technologies. The standard contains the most aggressive distributed generation requirement in the country, requiring utilities by 2011 to acquire 30 percent of their energy from residential or non-utility owned installations, like rooftop solar panels on someone's home or on a shopping mall. She also helped establish one of the most ambitious energy efficiency standards in the nation, requiring utilities to sell 22 percent less energy by 2020 than they would have under current forecasts.

Jake Davis, PhD, Site Water Treatment and Reuse Engineer, Intel

Jake Davis started with Intel as an intern and has since become one of the microprocessor giant's experts on treating and reusing industrial wastewater. His background is in electrochemistry and electro-membrane processes, and he also own his own firm, ELIXR, where he researches and develops new water treatment technologies. Jake holds a PhD in chemical engineering from the University of Arizona, where he also earned his bachelor's degree.

Gia Schneider, Chairman of the Board and Chief Executive Officer, Natel Energy

Gia Schneider sets strategy and company direction and defines the commercial execution plan for the hydropower-focused company. She is passionate about finding economically viable solutions to mitigate climate change, foster sustainable development and produce inexpensive renewable energy. Schneider holds a bachelor's in Chemical Engineering from MIT and has thirteen years' experience in the energy and renewable industries. She provided strategic and tactical solutions to several major energy companies as a consultant for Accenture and has significant experience in energy-related strategy development and deal valuation. Schneider also started the carbon emissions trading desk at Credit Suisse, growing it to a profitable business in its first year. Prior to Credit Suisse, she worked in the Strategy Group at Constellation, a leading power generation company.

Jacob Moore, MBA, Assistant Vice President, Tribal Relations, Office of University Affairs, ASU

Jacob Moore is responsible for the intergovernmental affairs between Arizona State University and tribal nations. Previously, Moore was managing partner for Generation Seven Strategic Partners, LLC, and also worked as an Economic Development Analyst and Special Assistant on Congressional and Legislative for the Salt River Pima-Maricopa Indian Community. Moore served as a member of the Arizona State Board of Education for eight years, where he was board president once and vice president twice.

Currently he serves on the board of directors for the Arizona Community Foundation, the ASU Morrison Institute, WestEd, the Arizona Minority Education Policy Analysis Center (AMEPAC), and Touchstone Behavioral Health. He earned a Bachelor of Science degree in Finance and an Executive MBA from the Arizona State University's W. P. Carey College of Business. Moore is an enrolled member of the Tohono O'odham Nation.

Christopher Deschene, JD, Director, Office of Indian Energy Policy and Programs, U.S. Department of Energy

Christopher Deschene has more than twenty years of management and policy experience, along with extensive tribal relationships and deep expertise in business and energy development, natural resources, and environmental policies, federal Indian law, and government affairs. Prior to his DOE appointment, he spent ten years as a partner with the Law Offices of Schaff & Clark Deschene, LLC.

His experience extends to business and energy development on tribal, state, and federal lands. He has extensive knowledge of power generation, transmission, distribution, renewable energy development, oil and gas development, utility formation, water, natural resource, energy and environmental policy development, tribal and federal administrative and regulatory permitting, energy contracting and negotiations.

Deschene previously served with the U.S. Marine Corps as an infantry and reconnaissance officer and completed his service as a major in the U.S. Marine Corps Reserve. He served with distinction and completed two tours in the Persian Gulf. While on active duty, Deschene also served as a military research engineer with Lawrence Livermore National Laboratory. He earned a BS in mechanical engineering from the U.S. Naval Academy and concurrent master's in mechanical engineering and a law degree from Arizona State University. Deschene is licensed to practice law in Arizona and the Navajo Nation.

Governor Stephen Roe Lewis of the Gila River Indian Community

Governor Stephen Roe Lewis was raised in Sacaton, *Gu-u-Ki*, on the Gila River Indian Community, and is proud to have attended school from kindergarten to eighth grade there. Governor Lewis graduated from Arizona State University with a Bachelor's of Science and pursued graduate studies at John F. Kennedy School of Government at Harvard University. He has long been an advocate for Native American issues nationally, and was selected to serve as a Board member for the National Indian Education Association (NIEA), and Delegate to the White House Conference on Indian Education. Governor Lewis has served the Community as a Gaming Commissioner for the Gila River Gaming Commission, as a member of the Board of Directors for the Gila River Telecommunications, Inc., and as a member of the Board of Directors for the Gila River Healthcare Corporation.

Governor Lewis was the first Native film curator for the Sundance Film Festival in Park City, Utah, and was an associate producer for the groundbreaking and critically acclaimed TBS six-part feature documentary, "The Native Americans." Currently he serves on the Board of Directors for the Native American Rights Fund (NARF), the Executive Board for the National Indian Gaming Association (NIGA) and the Board of Trustee for the Heard Museum of Phoenix.

Chairman Timothy Williams of the Fort Mojave Indian Tribe

Tim Williams has served as the Chairman of the Fort Mojave Indian Tribe for eight years. The tribe has lands in Arizona, California and Nevada, with tribal headquarters in the small California town of Needles. His duties as chairman are dedicated to improving the quality of life for the members of the tribe.

Williams served in the U.S. Marine Corps. He earned a BS in business administration from Northern Arizona University.

Bidtah N. Becker, JD, Executive Director, Natural Resources, Navajo Nation

Before serving in her current position, Bidtah Becker worked for the Navajo Nation Department of Justice and most recently was the Assistant Attorney General for the Natural Resources Unit. She has earned degrees from the University of New Mexico School of Law and the Georgetown University School of Foreign Service. In 2012, President Obama appointed Becker to serve as a trustee for the Institute of American Indian and Alaska Native Arts. She is also currently the Treasurer for the Navajo Studies Conference Board.

Sam Woods, Business Development Manager, Navajo Transitional Energy Company

Sam Woods is a member of the Navajo Nation and brings more than twenty-five years of engineering development, policy, and management experience for Navajo Transitional Energy Company (NTEC). Woods has extensive expertise in tribal business and energy development, project management, power and energy design and engineering, utility management, natural resources and energy policies, government relationship and affairs. Woods served as the Interim CEO and General Manager for NTEC after its acquisition of Navajo Mine in New Mexico. Woods also served as a political appointee for the Navajo Nation President and provided guidance on energy and resource policy development.

Prior to joining the Navajo Nation President's Office, Woods worked for an EPC/Design-Build firm, where he worked on numerous electric generating facilities (over 1,200 MW combined-cycle and 300 MW simple-cycle generation design/engineering experience), a paper plant expansion project, and a minerals processing plant.

Woods also served on the Navajo Green Economy Commission, the Navajo Nation Investment Committee, the Navajo Nation Energy Advisory Committee, Navajo Energy Task Force, New Mexico Green Building Council and the Institute of Electrical and Electronics Engineers ("IEEE"). Woods graduated from New Mexico State University with a BS in electrical engineering.

The Honorable Elizabeth Sherwood-Randall, PhD, Deputy Secretary, U.S. Department of Energy

Sherwood-Randall serves as the Deputy Secretary of the U.S. Department of Energy, a position she has held since 2014. She joined the Obama Administration on day one, serving from 2009 to 2013 as Special Assistant to the President and Senior Director for European Affairs at the National Security Council and from 2013 to 2014 as White House Coordinator for Defense Policy, Countering Weapons of Mass Destruction, and Arms Control.

Before joining President Obama's team, Sherwood-Randall worked at Stanford University, at Harvard University, and at the Council on Foreign Relations. In the Clinton administration, she served as Deputy Assistant Secretary of Defense for Russia, Ukraine, and Eurasia from 1994 to 1996.

She attended college at Harvard and then went on to graduate school at Oxford University, where she was among the very early ranks of female Rhodes Scholars. After finishing her education, she began her career working for then-Senator Joe Biden as his chief advisor on foreign and defense policy.

Robert McGrath, PhD, Director, Renewable and Sustainable Energy Institute, University of Colorado, Boulder

Robert McGrath was named as RASEI Director in July of 2015. In this role, he serves under a joint appointment between the University of Colorado and the National Renewable Energy Laboratory (NREL). Prior to this, McGrath served as senior vice president at the Georgia Institute of Technology and director of the Georgia Tech Research Institute (GTRI). Under McGrath's leadership, GTRI grew to have more than 2,000 employees and R&D awards in excess of $350 million. Before joining GTRI, McGrath worked in a variety of capacities with Battelle Memorial Institute. McGrath served as senior vice president for research at The Ohio State University, and as tenured professor in material science and engineering, and physics. He served as associate vice president for research and director of strategic & interdisciplinary initiatives at Penn State University, and also worked for Sandia National Laboratory in Albuquerque, New Mexico.

McGrath received his Ph. in nuclear science and engineering from the University of Michigan and earned bachelor's and master's degrees from Penn State University in engineering sciences, mathematics, and physics.

Elizabeth Cantwell, PhD, Vice President for Research Development, ASU

Elizabeth "Betsy" Cantwell is responsible for leading the creation, management and capture of large-scale, externally-funded programs and projects that advance Arizona State University's research enterprise. Cantwell came to ASU from the Lawrence Livermore National Laboratory (LLNL), where she was director for economic development. Prior to working at LLNL, she served in strategic leadership roles at the Oak Ridge National Laboratory, the Los Alamos National Laboratory in New Mexico and NASA headquarters in Washington, D.C.

Cantwell earned her PhD in mechanical engineering at the University of California, Berkeley, an MBA from the University of Pennsylvania's Wharton School of Business, and a BA in human behavior at the University of Chicago.

Gabriel P. Lopez, PhD, Vice President for Research, University of New Mexico

Gabriel López recently returned to the University of New Mexico (UNM) as vice president for Research, after serving as a professor of Biomedical Engineering and Mechanical Engineering and Materials Science at Duke University. At Duke, he was the founding director of the NSF's Research Triangle Materials Research Science and Engineering Center (RT-MRSEC). Prior to his service at Duke, López was a professor of Chemical

Engineering and Chemistry at UNM. During his initial time at UNM, he served as the founding director of the Center for Biomedical Engineering beginning in 2005, and the Biomedical Engineering Graduate Programs beginning in 2008.

López earned degrees in chemical engineering from the University of Colorado and the University of Washington (PhD).

Mark McLellan, PhD, Vice President for Research, Utah State University

Mark McLellan is currently vice president for research and dean of the School of Graduate Studies at Utah State University, Utah's land-grant and space-grant research institution. Before coming to Utah State, he was dean of research and experiment station director at the University of Florida for five years. He also served six years as director of a multi-college research center at Texas A&M University and was a tenured professor and department chair at Cornell University. At all four universities, McLellan has developed and implemented major research programs and demonstrated leadership in varied outreach and communications efforts.

McLellan received his bachelor's degree from the University of Massachusetts, Amherst and his master's and doctorate from Michigan State University, all in food science. Throughout his career, his research has focused on food processing technology for fruits and vegetables, computer systems applications and information management in the food sciences, and sensory evaluation of foods.

Pramod Khargonekar, PhD, Vice Chancellor for Research, University of California, Irvine

Pramod Khargonekar provides strategic direction for the Office of Research, which supports and enhances the creative and scholarly activities of UCI faculty. He has held faculty positions at the University of Minnesota, the University of Michigan and the University of Florida. At Michigan, Khargonekar was chair of the Department of Electrical Engineering and Computer Science and also was the Claude E. Shannon Professor of Engineering Science. At Florida, he was dean of the College of Engineering. In addition, he served as Deputy Director for technology at the U.S. Department of Energy's Advanced Research Projects Agency-Energy.

Khargonekar earned a Bachelor of Technology degree in electrical engineering at Bombay's Indian Institute of Technology and a master's in mathematics and a PhD in electrical engineering at the University of Florida.

Carlos Romero, MBA, Associate Vice President for Research and Economic Development, New Mexico Tech

Carlos Rey Romero serves as Associate Vice President for Research and Economic Development, overseeing, finances, external relations, and strategic analysis. In his position, he also serves as the Board Treasurer to the National Cave and Karst Research Institute.

Prior to joining New Mexico Tech, he was at the University of New Mexico where he served in several positions over twelve years, most recently as the AVP for Research and Compliance and Managing Director of the Institute of Policy, Evaluation and Applied Research. Before working at UNM, Romero was financial advisor and director of intergovernmental relations at the New Mexico Finance Authority, where he provided advice and expert testimony in the area of public finance, planning and infrastructure development to two governors, the New Mexico state legislature and local government leaders.

His teaching and research is focused in the areas of economics, ethics, and physics. Romero was American Chemical Society (ACS) fellow at Los Alamos National Laboratory working in the Condensed Matter and Thermal Physics Division. He received his BS in science and chemical engineering from New Mexico Institute of Mining and Technology (New Mexico Tech), an MBA from the New Mexico Highlands University, and his ABD in educational leadership from the University of New Mexico.

APPENDIX THREE

Regional Stakeholders

MUNICIPALITIES (CITIES AND TOWNS)

PHOENIX

As Arizona's capital and largest city, Phoenix boasts a population of more than 1.5 million (more than 4.5 million people live in the metro area it encompasses), making it the United States' sixth largest city and twelfth largest metropolitan area. Several high-tech industries have operations in the Salt River Valley, particularly, electronics and avionics. Phoenix and its suburbs not only deal with the extreme temperatures and weather of a desert climate, but also of an urban heat island. Despite these often blistering conditions, the city has sustained growth.

Canals built as part of the Central Arizona Project—the largest and most expensive aqueduct system ever constructed in the United States—divert water from the Colorado River to the entire region's residents, farms, and businesses.

FLAGSTAFF

Flagstaff lies 7,000 feet above sea level on the southwestern edge of the Colorado Plateau, rising from the surrounding land like an island amid a desert sea. Home to Northern Arizona University, Flagstaff is much cooler and wetter than any other city in Arizona. Residents get their water from the nearby mountains, groundwater, and treated wastewater.

TEMPE

Best known as the home of Arizona State University, Tempe is located just east of Phoenix. Its northern part is a dense urban development, made of university buildings and student housing, while its southern half consists of lower-density homes and office parks. Tempe relies on water from the Central Arizona Project.

TUCSON

Built on an alluvial plain in the Sonoran Desert, Tucson is Arizona's second largest city—with a metropolitan area just over a million people. Apart from being home to the University of Arizona, the city also has a significant military presence; many of its technology employers are tied to Department of Defense contracts.

Tucson shares the Central Arizona Project canal with Phoenix and its suburbs, from which it gets the majority of its water. It also collects groundwater and treats and recycles wastewater.

LOS ANGELES

As the nation's second largest city and metropolitan area, the Los Angeles combined statistical area is home to almost 19 million people. Much like Phoenix and Las Vegas, the

area has little to no natural water sources and relies on a series of aqueducts and canals that divert water from Sierra Nevada snowmelt, central California sources, and the Colorado River.

Even though only nine percent of Los Angeles's water comes from the Colorado River, the whole of southern California gets more than half its water from the Colorado—4.4 million acre-feet of water per year, more than fourteen times the amount used by Nevada and fifty-eight percent more than that claimed by Arizona.

IRVINE

Irvine is located in Orange County, California, and is part of the Los Angeles metropolitan area. It is known for its high-tech industry and strong concentration of higher-education institutions, the University of California, Irvine, being among them. Their water comes from a network of local wells and from aqueducts diverting water from the Colorado and other northern California sources.

SAN DIEGO

Adjacent to the Mexican border, California's southernmost city is a thriving beach-lover's paradise. Though tourism is its major industry, over 1.3 million people live and work in San Diego. The city is to the U.S. Navy and Marines what Colorado Springs is to the U.S. Air Force—a regional hub essential to the function of the nation's military. San Diego has also developed into a center for biotechnology.

Although much of their water comes from the Colorado River and other sources of northern snowpack melt, the city also gets water from a desalinization plant in nearby Carlsbad.

SANTA BARBARA

Promoted as the American Riviera, Santa Barbara's ideal Mediterranean climate means life there is centered around the ocean and nearby agriculture, including some of the nation's best beaches and wine growing regions. Almost half a million people call Santa Barbara County home and get their water from the Santa Ynez River, the nearby mountains, state aqueducts, and desalinization.

DENVER

The Mile High City is Colorado's capital and largest city. Both Denver and its suburbs have grown at unexpected rates. More than 680,000 people call the city itself home; its metropolitan area houses more than 3.4 million.

Shadowed from sufficient snow and rainfall by the Rocky Mountains, Denver is forced to collect snowmelt from rivers and streams into reservoirs located dozens of miles from the city's center. As is the case in much of the Southwest, Denver's booming population places increasing strain on the city's water sources.

COLORADO SPRINGS

Nested in the shadows and foothills of America's most famous mountain, Pikes Peak, Colorado Springs is the state's second most populous city. More than 456,000 call it home (with close to 700,000 in its metropolitan area). The city is defined by the strong presence of

the military, with six major Air Force and Army sites in the area, including the U.S. Air Force Academy.

As a high desert city, Colorado Springs experiences erratic seasonal weather (January, for example, has been as hot as 76° F and as cold as -27° F) and receives little precipitation each year and depends on water pumped from mountain springs and reservoirs.

BOULDER

Home to tech startups, venture capitalists, and the University of Colorado's flagship campus, Boulder rests right next to the Rocky Mountain foothills, approximately 5,430 feet above sea level. The city's primary water source is Boulder Creek, which receives water from Front Range snowpack.

LAS VEGAS

Las Vegas is situated in the North America's driest desert—the Mojave (the city itself averages only 4.2 inches of rain each year)—and is surrounded on all sides by mountains. Like Phoenix, Las Vegas is an urban heat island, which is compounded by the monolithic glass, concrete, and steel structures that make up its signature Strip.

The Colorado River annually supplies 300,000 acre-feet of water to the city, most of which is cleaned, recycled, and put back into the river. Through the efforts of the Southern Nevada Water Authority, Las Vegas has been a leader in advancing quality treatment methods and conservation efforts.

RENO

Located just below the eastern foothills of the Sierra Nevada Mountains, "The Biggest Little City in the World" is part of a metropolitan area with more than 420,000 people. It is home to the University of Nevada's flagship campus. Its primary water source is the Truckee River, which has its source in the high mountains to the west.

ALBUQUERQUE

New Mexico's most populous city—with over 500,000 residents—is also home to the state's flagship higher-education institution, the University of New Mexico, as well as Sandia National Laboratories. The city is situated on the Rio Grande River, a major drinking water source. The city also receives 48,000 acre-feet of Colorado River water.

SOCORRO

This small New Mexico town sits in the Rio Grande Valley at an elevation of 4,579 feet. The New Mexico Institute of Mining and Technology—New Mexico Tech—is located there. Residents obtain their water from a network of wells and thermal springs.

SALT LAKE CITY

Founded as a haven for Mormon settlers, Salt Lake City and its surrounding areas have bloomed into a significant metropolitan area, with more than 1.1 million people calling the

valley home. The city also is home to the University of Utah. Its inhabitants get their water from the Wasatch Mountains to the east and from deep wells.

LOGAN

Home of Utah State University, Logan is located to the north of the Salt Lake combined statistical area, in the shadows of the Bear River Mountains. The city receives considerably more moisture than any other on this list and receives water from a nearby spring in Logan Canyon.

TRIBAL NATIONS[5]

FORT MCDOWELL YAVAPAI NATION

The Fort McDowell Yavapai Nation is a 950-member Native American tribe that calls central Arizona's upper Sonoran Desert home. Located northeast of Phoenix within Maricopa County, the forty-square-mile reservation is bisected by the Verde River. The Nation operates the Fort McDowell Casino, the We-Ko-Pa Golf Club, and the Fort McDowell Tribal Farm.

FORT MOJAVE INDIAN TRIBE

The Fort Mojave Indian Reservation spans land that stretches along the banks of the Colorado River, covering approximately 24,000 acres in Arizona and 5,500 acres in Nevada. The Mojave Indians are *Pipi Aha Macav*, "The People by the River." Their agricultural economy is driven by crops like alfalfa, cotton, and wheat. The Colorado also provides opportunities for recreation and tourism.

GILA RIVER INDIAN COMMUNITY

The Gila River Indian Community (GRIC) traces its roots to the Hohokam—American Indians who lived and farmed along the Gila River centuries ago. Composed of two tribes, the Pima and the Maricopa, GRIC is located in south-central Arizona. The community is expanding and diversifying its economic base, and their Gila River Reservation is home to agricultural, industrial, retail, and recreational concerns.

INTER TRIBAL COUNCIL OF ARIZONA (ITCA)

The Inter Tribal Council of Arizona was established in 1952 to provide a united voice for tribal governments located within the state to address common issues and concerns. The members of ITCA are the highest-elected tribal officials—tribal chairpersons, presidents, and governors.

As a subset of the ITCA, the Tribal Leaders Water Policy Council broadens tribal leader participation in water policy and collaborates with federal, state. and regional resource management bodies. They also work within their own communities to strengthen tribal capacity through improved information and analysis on water management.

[5] This list is by no means exhaustive and includes only American Indian tribes whose representatives attended the event.

NAVAJO NATION

The Navajo Nation extends into Utah, Arizona, and New Mexico and covers over 27,000 square miles, an area larger than ten of fifty U.S. states. The Navajo economy is diverse, including recreational activities, agriculture, and arts and crafts, however, the greatest sources of revenue and largest employers are their mining and oil interests. Navajo leaders have been working to bring pipelines, water treatment, and irrigation systems to their communities.

SAN CARLOS APACHE NATION

The San Carlos Apache Indian Reservation spans Gila, Graham, and Pinal Counties in southeastern Arizona, encompassing over 1.8 million acres. San Carlos Lake is the largest body of water in Arizona, with 158 miles of shoreline. It is the center of many recreational opportunities on the reservation, including fishing.

SALT RIVER RESERVATION

The Salt River Pima-Maricopa Indian Community is a sovereign tribe located in the Phoenix metropolitan area. Bounded by the cities of Scottsdale, Tempe, Mesa and Fountain Hills, the community encompasses 52,600 acres and is comprised of members of the Pima and Maricopa tribes. Out of respect for the land, 19,000 acres are maintained as a nature preserve, with the remaining land supporting agricultural, industrial, commercial, residential, and recreational use.

ENERGY AND WATER UTILITIES

ARIZONA COMMERCE AUTHORITY (ACA)

The Arizona Commerce Authority is the state's leading economic development organization. It uses a three-pronged approach to grow and strengthen Arizona's economy—recruit, grow, create. It is overseen by a board composed of Arizona leaders in business and policy, including Arizona Governor Doug Ducey.

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY (ADEQ)

The Water Quality Division (WQD) works to safeguard Arizona's drinking water and reduce the impact of pollutants discharged to surface and ground water.

ARIZONA DEPARTMENT OF WATER RESOURCES (ADWR)

ADWR administers and enforces Arizona's groundwater code and surface water rights laws, except those related to water quality. It negotiates with external political entities to protect Arizona's Colorado River water supply and represents the state in water rights discussions with the federal government.

ARIZONA PUBLIC SERVICE (APS)

The Water Resource Management Department evaluates water supplies and usage at existing APS facilities and ensures infrastructure reliability. They also evaluate conservation opportunities and implement new technologies to increase efficiency.

ARIZONA STATE LAND DEPARTMENT

The Water Rights Section supports the department on water issues and consists of three distinct programs: Contractual Water, Water Rights and Claims Administration, and Well Registration and Administration.

CALIFORNIA PUBLIC UTILITIES COMMISSION

The California Public Utilities Commission (CPUC) works to ensure California's water utilities deliver clean, safe, and reliable water to their customers at reasonable rates. One-hundred and eight investor-owned water utilities operate under the CPUC's jurisdiction and provide water service to about 16 percent of California's residents. Approximately 95 percent of that total is served by nine large water utilities, each serving more than 10,000 connections. Annual water and wastewater revenues under the CPUC's regulation total $1.4 billion.

CENTRAL ARIZONA PROJECT (CAP)

Started in 1973, the project built a 336-mile canal that diverts Colorado River water from Lake Havasu into central and southern Arizona. Each year the nation's aqueduct system—the United States' largest—delivers over a million acre-feet of water to cities, farms, and tribal communities. While municipal portions of the project were declared substantially complete in 1994, some of those intended to bring water to tribal reservations have yet to be built, and the U.S. Department of the Interior estimates twenty years could pass before they are finished.

COLORADO WATER CONSERVATION BOARD

The Colorado Water Conservation Board represents each major water basin, Denver, and other state agencies in a joint effort to use water wisely and protect it for future generations. The board consists of fifteen members appointed by the governor to conserve, develop, protect, and manage Colorado's water.

DENVER WATER

Denver Water supplies water to the City and County of Denver and nearly 50 percent of Denver Water customers who live in the surrounding suburbs. It is responsible for the collection, storage, quality control and distribution of drinking water to nearly a quarter of Coloradans.

LOS ANGELES DEPARTMENT OF WATER AND POWER

The LADWP Water System is the largest municipally owned and operated retail water utility in the country. Its mission is to provide Los Angeles' residents with reliable, high-quality, competitively priced water in a safe and environmentally responsible manner. The Water System's ten-year Capital Improvement Program focuses on maintaining or replacing existing components of the Water System and constructing new facilities to ensure LADWP fulfills its mission.

NAVAJO TRANSITIONAL ENERGY COMPANY (NTEC)

NTEC is a wholly owned limited-liability company of the Navajo Nation that operates the Navajo Mine and supplies coal to the Four Corners Power Plant near Farmington, New

Mexico. NTEC seeks to use part of its income to develop renewable and alternative energy projects.

SALT RIVER PROJECT (SRP)

SRP is the oldest multipurpose federal reclamation project in the United States. Serving central Arizona since 1903, they deliver approximately 800,000 acre-feet of water annually to a 375-square-mile service area and manage a 13,000 square-mile watershed that includes an extensive system of reservoirs, wells, canals, and irrigation laterals.

SAN DIEGO WATER AUTHORITY

Working with Poseidon Water, the SDWA helped create the Carlsbad Desalination Project, which includes the largest seawater desalination plant in the nation and provides approximately 10 percent of the region's water supply.

SOUTHERN CALIFORNIA EDISON

SCE manages a number of programs and projects in water and water treatment that improve energy efficiency and boost water conservation. Using SCE's pump testing services, Suburban Water Systems, an investor-owned utility that serves over 300,00 people, was able to increase plant efficiency by 18 percent, lowering electric costs and reducing its carbon footprint.

SOUTHERN NEVADA WATER AUTHORITY

The Southern Nevada Water Authority (SNWA) is a cooperative, not-for-profit water utility formed in 1991 to address southern Nevada's water needs. SNWA officials manage the region's water resources and provide for Las Vegas Valley residents' and businesses' present and future water needs.

WESTERN AREA POWER AUTHORITY (WAPA)

One of four power marketing administrations in the U.S. Department of Energy, WAPA markets and transmits wholesale electricity from multiuse water projects. Hydropower resources are produced at federal dams in eleven states, with enough kilowatt-hours of electricity sold to power more than three million homes and businesses a year.

XCEL ENERGY

Xcel Energy is a utility holding company serving more than 3.3 million electric customers and 1.8 million natural gas customers across eight Western and Midwestern states, including Colorado, Michigan, Minnesota, New Mexico, North Dakota, South Dakota, Texas and Wisconsin.

REGIONAL HYDROPOWER INFRASTRUCTURE

DAVIS DAM

This Colorado River dam spans across Arizona and Nevada, with Bullhead City, Arizona on one side and Laughlin, Nevada on the other. Davis Dam was completed in 1951 and outputs approximately 255 MW (Megawatts) of electricity.

GLEN CANYON DAM

Located in northern Arizona along the Colorado River, the dam was built on the upper portion of the river in 1966 and formed what is now Lake Powell. The hydroelectric plant here provides much of the power for the Intermountain West region, with an output in the range of 1,296 MW.

HOOVER DAM

Design and construction of the United States' most iconic New Deal project bridged three American presidencies, from 1928 until 1936. Spanning the Black Canyon of the Colorado River, the massive dam impounds Lake Mead, the largest reservoir in the United States (when full). The hydroelectric generators provide power for public and private utilities in Arizona, California, and Nevada, on the order of 2,079 MW.

REGIONAL SOLAR POWER PLANTS

AGUA CALIENTE SOLAR PROJECT

This photovoltaic power station, located in Yuma County, Arizona was completed in April 2014. It uses then-film technology-based photovoltaic panels manufactured by First Solar. It has a capacity of 290 MW.

ANTELOPE VALLEY SOLAR RANCH

Located near Lancaster, California, within Antelope Valley, this photovoltaic power plant was commissioned in April 2014. Its full capacity is 150 MW.

ARLINGTON VALLEY SOLAR ENERGY PLANTS

These two photovoltaic plants are located approximately 40 miles west of Phoenix, Arizona. Operations commenced in 2013, and together, they provide 250 MW of electricity.

CRESCENT DUNES SOLAR ENERGY PROJECT

This is the first utility-scale concentrating solar power plant with a central receiver tower and advanced molten salt energy storage technology. Located near Tonopah, about 190 miles northwest of Las Vegas, the plant was synchronized to the grid in October 2015 and started providing energy. It currently is at a capacity of 125 MW.

DESERT SUNLIGHT SOLAR FARM

This photovoltaic power station, located six miles north of Desert Center, California, in the Mojave Desert, is tied with Topaz Solar Farms for the greatest installed capacity at 550 MW. It was completed in January 2015 and has power purchase agreements with both Pacific Gas & Electric (300 MW) and Southern California Edison (250 MW).

IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

This concentrated solar thermal plant opened in February 2014 and is currently considered the largest plant of its kind in the world, on 4,000 acres of land in California's Mojave Desert. It has an energy capacity of 392 MW.

MESQUITE SOLAR POWER PROJECT

A photovoltaic power plant completed in 2013 about 50 miles west of Phoenix, Arizona, the Mesquite plant has a capacity of 150 MW. It has an agreement with Pacific Gas & Electric to send all 150 MW to California.

MOJAVE SOLAR PROJECT

Located northwest of Barstow in California's Mojave Desert, this concentrated solar power plant was completed in December 2014. Electricity generation is 1005 from the sun, with no supplementation from fossil-based sources. It has a capacity of 280 MW.

NEVADA SOLAR ONE

Built in 2007 on the outskirts of Boulder City, Nevada, this concentrated solar plant uses 760 parabolic trough concentrators with over 182,000 mirrors to heat fluid in receiver tubes. This produces steam that drives turbines. The plant has a capacity of 75 MW.

SOLANA GENERATING STATION

Located near Gila Bend, Arizona, this was the first U.S. solar plant to use molten salt thermal energy storage technology. Completed in 2013 by the Spanish company Abengoa Solar, it has a total capacity of 280 MW, which is enough power to supply 70,000 homes.

SOLAR ENERGY GENERATING SYSTEMS (SEGS)

The oldest solar power plant still operating (originally built in the 1980s), it is now the second largest in the world, after the Ivanpah facility. SEGS is located in northern San Bernardino County in California and consists of nine individual solar power plants that collectively have a total capacity of 354 MW. The facility uses parabolic troughs and solar thermal technology along with natural gas to generate electricity.

TOPAZ SOLAR FARM

Completed in November 2014, this photovoltaic power station, located in San Luis Obispo County, California, has an installed capacity of 550 MW, tying it with the Desert Sunlight Solar Farm for greatest capacity.

RESEARCH LEADERS – NATIONAL LABS

LAWRENCE LIVERMORE NATIONAL LABORATORY (CALIFORNIA)

Lawrence Livermore National Laboratory's mission is to strengthen the security of the United States by developing world-class science and technology to enhance national defense, reduce the threat from global terrorism and weapons of mass destruction, and to provide vision and technical excellence on scientific issues of national importance. The laboratory's Program for Climate Modeling and Intercomparison monitors the global water cycle to gain insight into future water availability.

NATIONAL RENEWABLE ENERGY LABORATORY (COLORADO)

NREL has been a pioneer in the development of water-energy system solutions that explicitly address and optimize water-energy tradeoffs. NREL has evaluated these solutions for Department of Defense bases, islands, communities recovering from disasters, individual buildings and campuses, and large-scale water treatment and transport facilities.

LOS ALAMOS NATIONAL LABORATORY (NEW MEXICO)

The Los Alamos National Laboratory works to solve national security challenges through scientific excellence. The Critical Watersheds program analyzed the impact of disturbances on watersheds of all scales, including the Colorado River system. Preliminary results suggest that climate-driven disturbances will have an increasing impact on regional water supplies. The program, which is just over halfway done, is part of ongoing research into atmospheric phenomena and earth systems related to the nation's energy security.

SANDIA NATIONAL LAB (NEW MEXICO)

The Sandia Water Initiative seeks to increase the safety, security, and sustainability of water infrastructure through the development of advanced technologies that create new water supplies, decreasing demand through water-use efficiency, and providing decision-informing tools to the institutions responsible for balancing supply and demand.

RESEARCH LEADERS – UNIVERSITIES

ARIZONA STATE UNIVERSITY (ASU)

ASU is a top-ranked research university located in the Phoenix metropolitan area. ASU leads all public universities by enrollment and was ranked number one in innovation by *U.S. News & World Report*. ASU's Future H2O initiative is creating opportunity for change in regional, national, and global water systems by engaging faculty, students, utilities, and the private sector in developing new technologies and management concepts.

MARICOPA COUNTY COMMUNITY COLLEGE DISTRICT

One of the largest community college districts in the United States, the district encompasses ten colleges, two skill centers, and numerous education centers, all dedicated to educational excellence. They offer 954 occupational programs, thirty-one academic certificates, and nine

associate degrees and are a major provider of job training for employers in the Valley of the Sun.

NORTHERN ARIZONA UNIVERSITY (NAU)

NAU is located in Flagstaff, Arizona, and offers undergraduate, graduate, and professional degrees of high quality and societal value. The university is a high-research institution, providing practical solutions that impact our world.

UNIVERSITY OF ARIZONA (UA)

The University of Arizona is the state's land-grant university located in Tucson and is a Carnegie Very High research institution. UA engages in water research through a variety of programs. The WEST (Water & Energy Sustainable Technology) Center was opened in 2015 to bring together industry, government, and academia to develop new technologies to help communities deal with water scarcity and reuse.

STANFORD UNIVERSITY

Since its founding in 1891, Stanford has been dedicated to finding solutions to big challenges. Located between San Jose and San Francisco, Stanford is ideally situated to explore the themes of water supply and scarcity. The Water in the West program promotes effective solutions for more sustainable water management in the American West.

UNIVERSITY OF CALIFORNIA – BERKELEY (UCB)

Founded in 1868 and consistently ranked as one of the nation's leading public universities, the University of California's flagship campus is located in Berkeley, California. The Berkeley Water Center takes a comprehensive approach to water resources research and management that reflects the conditions of the twenty-first-century American West: variable and uncertain supply, increasing demand, and inadequate structural and institutional infrastructure. They seek to develop and demonstrate the application of new concepts, information and engineering technology, and computational tools that serve diverse water interests.

UNIVERSITY OF CALIFORNIA – IRVINE (UCI)

Since 1965, the University of California, Irvine has combined the strengths of a major research university with the bounty of an incomparable Southern California location. The UCI Water Energy Nexus Center (UCI WEX Center) promotes comprehensive, transdisciplinary approaches to water efficiency, energy efficiency, and greenhouse gas reduction in an urban environment with a diverse, rapidly growing population.

UNIVERSITY OF CALIFORNIA – LOS ANGELES (UCLA)

UCLA is located in Los Angeles, California. Diverse, progressive, and centered in one of the most influential cities in the world, UCLA is a truly international university that offers a world of opportunity. Its Institute of the Environment and Sustainability (IoES) uses Los Angeles and California as testbeds to find solutions to environmental issues for the broader world. Their hands-on approach immerses students in real-world problem solving. Working with eight

research centers and partnerships throughout the UCLA network, they achieve national and global reach.

UNIVERSITY OF CALIFORNIA – RIVERSIDE (UCR)

Located approximately fifty miles inland of Los Angeles, UCR is recognized as one of the most ethnically diverse public research institutions in the nation. UCR is undergoing a tremendous growth spurt, with new and remodeled facilities being commissioned on a regular basis. UCR's Water Science and Policy Center researches critical issues related to water policy, water quality, and water scarcity.

UNIVERSITY OF CALIFORNIA – SAN DIEGO (UCSD)

The University of California San Diego is a student-centered, research-focused, service-oriented public institution located in the La Jolla neighborhood of San Diego. The Center for Western Weather and Water Extremes provides state-of-the-art modeling and predictions of weather events to understand effects on water supplies and flooding.

UNIVERSITY OF CALIFORNIA – SANTA BARBARA (UCSB)

The University of California, Santa Barbara is a public research university located on the California coast. Ranked eighth among all public universities for "Best Colleges" by *U.S. News and World Report*, UCSB offers a learning and living environment like no other. UCSB's Marine Science Institute is an international leader in marine and environmental research, which has impacts that extends beyond local waters to address issues affecting oceans around the world.

UNIVERSITY OF SOUTHERN CALIFORNIA (USC)

The University of Southern California is one of the world's leading private research universities. An anchor institution in Los Angeles, a global center for arts, technology and international business, USC's diverse curriculum provides extensive opportunities for interdisciplinary study and collaboration with leading researchers in advanced learning environments. The USC Water Research Center seeks to address the severe deficiencies in characterizing, monitoring, and understanding of water scarcity in arid climates.

COLORADO SCHOOL OF MINES (CSM)

Colorado School of Mines—also known as "Mines" or "CSM"—is a public research university devoted to engineering and applied science. The curriculum and research program are built around responsible stewardship of the Earth. Mines is one of the few institutions with expertise focused on resource exploration, extraction, production, and utilization, and has a unique positioning in higher education.

The Advanced Water Technology Center (AQWATEC) was established in 2006 at the Colorado School of Mines. AQWATEC is supporting the advancement of the campus thrust areas of water and renewable energy and the NSF-funded Engineering Research Center Reinventing the Nation's Urban Water Infrastructure (ReNUWIt).

COLORADO STATE UNIVERSITY (CSU)

Located in Fort Collins, CSU is the state's land grant university and does considerable research on issues related to agriculture, forestry, veterinary medicine, and the environment. It is home to the Colorado Water Institute, whose mission is to connect all of Colorado's higher education expertise to the research and education needs of Colorado water managers and users.

UNIVERSITY OF COLORADO – BOULDER (CU-BOULDER)

Situated at the base of the Rocky Mountains, the University of Colorado, Boulder (or CU) is the flagship university of the University of Colorado system. The Center for Advanced Decision Support for Water and Environmental Systems (CADSWES) was founded in 1986 to research and develop decision support systems (DSS) used by government agencies and others to improve the management of natural resources, particularly water.

UNIVERSITY OF NEVADA – RENO (UNR)

Founded in 1874, UNR is Nevada's land-grant university and has a Carnegie Classification of High Research. Its Global Water Center seeks to solve problems of water sustainability by fostering scientific interaction and discovery and educating and training the next generation of scientists to take on emerging water issues.

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

Known as New Mexico Tech, this science and engineering-focused university is located in Socorro, New Mexico. The Hydrology program offers five undergraduate and four graduate degrees, and faculty research includes climatology, hydrogeology, geobiochemical cycling, and paleohydrology.

UNIVERSITY OF NEW MEXICO (UNM)

UNM occupies nearly 800 acres in the heart of Albuquerque, with branch campuses throughout the state. It is categorized as a Very High Research Activity university in the Carnegie Classification system. The mission of the Center for Water and the Environment is to increase the participation of underrepresented minorities (URM) in STEM professions while conducting cutting-edge research and developing technological and engineering-based solutions to problems related to water and the environment. Among its concerns are water availability and consumption in arid environments and in times of drought, as well as water problems associated with energy generation.

UTAH STATE UNIVERSITY (USU)

USU has seen substantial growth in grants and endowments in the last 25 years, transforming itself from a small regional college to a thriving research university. The Utah Water Research Laboratory (UWRL) has served as a leader in applied research of water-related challenges for 50 years, focusing on water quality, treatment, and management.

INDUSTRY

AMERICAN DG ENERGY

American DG Energy supplies low-cost energy to its customers through distributed power generating systems. They provide institutional, commercial, and small industrial facilities with clean, reliable power, cooling, heat and hot water through their On-Site Utility™ energy solutions. American DG Energy is headquartered in Waltham, Massachusetts.

GE WATER – WATER AND PROCESS TECHNOLOGIES

This division of General Electric Power and Water provides chemical and equipment solutions and services to customers to optimize and manage water resources across industries and municipalities.

INTEL CORPORATION

Intel is one of the largest semiconductor chip makers in the world. The manufacturing process that produces chips requires a great deal of purified water, which later becomes industrial wastewater. In its Chandler, Arizona facility, Intel has developed methods to clean its wastewater. Whatever portion cannot be cleaned is recycled into other uses, such as the plant's cooling towers.

NATEL ENERGY

Natel Energy is an international water and energy innovation company based in Alameda, California in the San Francisco Bay Area. Their vision is to launch hydropower systems that enable cost-effective production of low-impact, distributed baseload energy while maintaining the health of watershed ecosystems and the communities surrounding them.

POSEIDON WATER

Poseidon Water is a water project development company headquartered in Boston, Massachusetts. They identify, plan, finance, develop, own and manage large water infrastructure projects. They take a public-private partnership approach. They specialize in reverse osmosis seawater desalination facilities. They developed the Carlsbad Desalination Plant in San Diego County, the largest such plant in the nation.

SWIRE COCA-COLA

Swire is a dedicated partner of the Coca-Cola company and is the regional bottler and distributor for eleven Western states. They employ over 1,800 people in the region and have plants and distribution facilities throughout the Southwest. Because water is the number-one ingredient in every beverage they make and sell, Swire has significant interest in securing and preserving regional water sources, both now and for generations to come.

APPENDIX FOUR

Attendee List

NAME		AFFILIATION	POSITION
A.J.	Simon	Lawrence Livermore National Lab	Energy Systems Scientist
Aaron	Wilson	Idaho National Lab	Research Scientist
Ali	Douraghy	Berkeley Lab	Earth and Environmental Sciences
Amanda	Arnold	Arizona State University	Executive Director, Federal Research Relations, OKED
Andy	Wolfsberg	Los Alamos National Lab	Deputy Division Leader, Earth and Environmental Sciences
Bidtah	Becker	Navajo Nation	Executive Director, Natural Resources
Bill	Petuskey	Arizona State University	Vice President for Science, Engineering, and Technology
Britt	Crow-Miller	Arizona State University	Assistant Professor, School for the Future of Innovation in Society
Bryan	Brayboy	Arizona State University	Borderlands Professor of Indigenous Education and Justice, School of Social Transformation; Director, Center for Indian Education
Carlos	Romero	New Mexico Tech	Associate Vice President for Research and Economic Development
Carol	Burns	Los Alamos National Lab	Deputy Principal Associate Director - Science, Technology, and Engineering
Chelsea	Border	Arizona State University	Student
Christopher	Deschene	US Department of Energy	Director, Office of Indian Energy Policy and Programs
Colby	Pellegrino	Southern Nevada Water Authority	Colorado River Program Manager
Dave	White	Arizona State University	Director, Decision Center for a Desert City
David	Conrad	US Department of Energy	Deputy Director, Office of Indian Energy Policy and Programs
David	Montero	Intel	Site Infrastructure Waste Water Manager
Diane	Stearns	Northern Arizona University	Associate Vice President for Research
Mac	McKee	Utah State University	Director, Utah Water Research Laboratory
Duke	Reiter	Arizona State University	Senior Advisor to the President, Office of University Affairs
Elizabeth	Cantwell	Arizona State University	Vice President, Research Development
Elizabeth	Sherwood-Randall	US Department of Energy	Deputy Secretary

NAME		AFFILIATION	POSITION
Faye	Farmer	Arizona State University	Director, Research Development, Office of Knowledge Enterprise Development
Fernando	Reyes	Arizona State University	Project Coordinator, Knowledge Enterprise Development
Gabriel	López	University of New Mexico	Vice President for Research
Gia	Schneider	Natel Energy	CEO
Jacob	Moore	Arizona State University	Assistant Vice President of Tribal Relations
Jake	Davis	Intel	Site Water Treatment and Reuse Engineer
James	McCollough	US Department of Energy	Chief of Protocol
John	Sabo	Arizona State University	Professor, School of Life Sciences
Kaitlyn	Fitzgerald	Zero Mass Water	Business Development Analyst
Kathy	Eiler	University of California, Irvine	Director, Federal Relations
Kelly	Sanders	University of Southern California	Assistant Professor, Sonny Astani Department of Civil and Environmental Engineering
Ken	Carlson	Colorado State University	Professor, Civil and Environmental Engineering; Director, Center for Energy Water Sustainability
Kimberly	Rasar	US Department of Energy	Associate Deputy Under Secretary for Science & Energy
Kimberly	Ogden	University of Arizona	Professor, Chemical and Environmental Engineering
Kris	Mayes	Arizona State University	Director, Utility of the Future Center and the Energy Policy Innovation Council
Kristen	Pugh	University of California, Irvine	Executive Director, Federal Research Relations, Office of Research
Kristine	FireThunder	Arizona Commission of Indian Affairs	Executive Director
Laurel	Passantino	Arizona State University	Senior Project Manager, Engineering Research
Laurence	Brown	Sandia National Lab	Tribal Government Relations Manager
Lesley	Cephas	Northern Arizona University	Director, Intellectual Property and Technology Transfer
Marianne	Walck	Sandia National Lab	Vice President, Sandia California Lab; Lead, Sandia Energy and Climate Program
Marisa	Walker	Arizona Commerce Authority	Senior Vice President, Strategic Planning / Infrastructure
Mark	McLellan	Utah State University	Vice President for Research
Michael	Bernier	Swire Coca Cola	Director of Sustainability

NAME		AFFILIATION	POSITION
Mike	Hightower	Sandia National Lab	Distinguished Member of the Technical Staff, Energy Security Center
Nadya	Bliss	Arizona State University	Director, Global Security Initiative
Nancy	Sauer	Los Alamos National Lab	Associate Director, Chemistry, Life, and Earth Sciences
Netra	Chhetri	Arizona State University	Associate Professor, School of Geographical Sciences and Urban Planning and the Consortium for Science, Policy and Outcomes
Newsha	Ajami	Stanford University	Director, Urban Water Policy
Otakuye	Conroy-Ben	Arizona State University	Assistant Professor, School of Sustainable Engineering and the Built Environment
Patrick	Phelan	Arizona State University	Professor, Mechanical & Aerospace Engineering
Paul	Westerhoff	Arizona State University	Vice Provost for Academic Research Programming
Pilar	Thomas	Lewis Roca Rothgerber	Of Counsel
Pramod	Khargonekar	University of California, Irvine	Vice Chancellor for Research
Rhett	Larson	Arizona State University	Associate Professor, Sandra Day O'Connor College of Law
Richard	Middleton	Los Alamos National Lab	Research Scientist
Robert	Roessel	Salt River Project	Executive Principal
Robert	McGrath	University of Colorado-Boulder	Director, Renewable & Sustainable Energy Institute (RASEI)
Robin	Newmark	National Renewable Energy Laboratory	Associate Laboratory Director, Energy Analysis and Decision Support
Rolf	Halden	Arizona State University	Director, The Biodesign Institute, Environmental Security
Sam	Woods	Navajo Transitional Energy Company	Business Development Manager
Sarah	Porter	Arizona State University	Director, Kyl Center for Water Policy, Morrison Institute
Scott	Bugental	Arizona State University	Research Advancement Manager, Julie Ann Wrigley Global Institute of Sustainability
Sethuraman	Panchanathan	Arizona State University	Executive Vice President, ASU Knowledge Enterprise
Shari	Rogers	Arizona State University	Administrative Specialist, Office of Knowledge Enterprise Development
Sharon	Tom	Arizona State University	Communications Specialists, Office of American Indian Initiatives
Stacey	Renfrow	Coca Cola Refreshments	Safety, Environmental, and Security Manager
Stephanie	Kuzio	Sandia National Lab	Manager, Earth Systems Analysis

NAME		AFFILIATION	POSITION
Stephen Roe	Lewis	Gila River Indian Community	Governor
Steve	Bohlen	Lawrence Livermore National Lab	Global Security E-Program Manager
Steve	Johnson	Western Area Power Administration (WAPA)	Energy Management and Marketing Office Manager
Timothy	Williams	Fort Mojave Indian Tribe	Chairman
Tom	McCann	Central Arizona Project	Deputy General Manager
Travis	Lane	Inter Tribal Council of Arizona	Assistant Director
Treavor	Boyer	Arizona State University	Associate Professor, School of Sustainable Engineering and The Built Environment
Tzahi	Cath	Colorado School of Mines	Professor and AQWATEC Director; Chair, Mines Research Council
Wes	Herche	Arizona State University	Research Scientist, Foresight Initiative and Global Security Initiative

APPENDIX FIVE

Further Reading

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