Divining Rod

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Page 3 Brackish water supplies important

Page 5 Geothermal energy discussed at water conference

Page 6 Water conference highlights desalination-energy connection

New Water New Energy

56th Annual New Mexico Water Conference focuses on renewable energy to reclaim brackish groundwater

by Will Keener

Participants in the 56th Annual New Mexico Water Conference came away with a broader view of energy and water problems after their December meeting in Alamogordo, NM. In addition to presentations and posters about projects within the state, the conference convened experts from several continents, bringing attention to the important linkages between renewable energy sources and desalination of brackish groundwater.

At the conclusion of the meeting, sponsored by the Water Resources Research Institute and the U.S. Bureau of Reclamation, a series of expert group presentations led to the identification of two critical research projects at the national and international level:

• Design of a high-yield photovoltaic and solar thermal system that produces sufficient power to support advanced treatment of brackish water. Such a system, conference participants agreed, could serve the water and energy needs of remote and rural communities.

International experts on desalination and renewable energy representing Europe, Australia, the Middle East, Northern Africa, Canada, and Singapore addressed participants at the annual New Mexico water conference. These researchers lead state-of-the-art projects around the world and described how New Mexico might benefit from their experience. Guillermo Zaragoza, left, of ProDes, (Promotion of Renewable Energy for Water Production through Desalination) presented a training session and review of the European program.

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• Pursue a better understanding of the impacts of trace contaminants on the desalination process. Aquifers with high salinity often contain contaminants, such as arsenic, chromium, or radioactivity, in trace amounts. The project would look at treatments, costs, funding sources for research, and related elements.

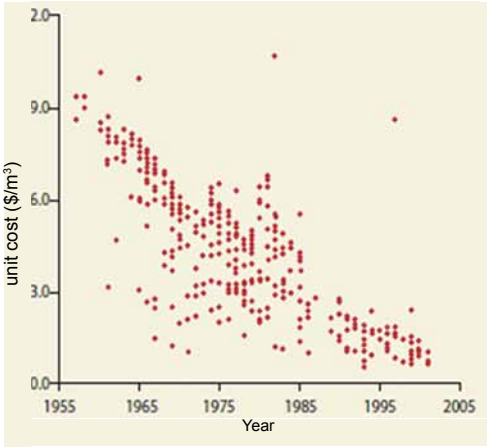
These two ideas, selected as most deserving of further research, were among dozens of suggestions from the expert panel members, who carried on discussions in smaller groups before returning to present their ideas to the entire conference. Discussion groups focused on solar, geothermal, wind, and other renewable energy sources, water resources, infrastructure needs, and environmental impacts.

The effort will bring researchers closer to providing people in remote locations reliable access to subsurface water resources now unavailable, said Sam Fernald, WRRI director. "We want these results to be widely disseminated," said Kevin Price, Advanced Water Treatment Research Coordinator for the Bureau of Reclamation. "We want to get the word out that these are great ideas, so others will want to join in." Both leaders termed the meeting a success.

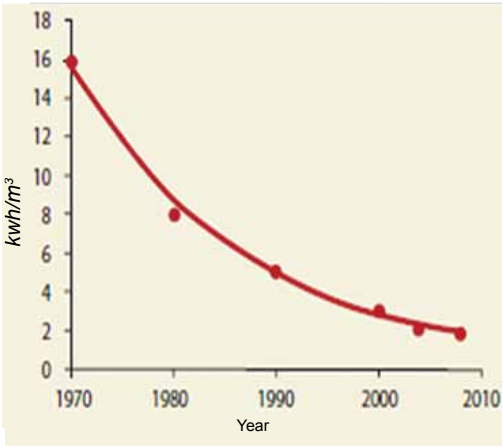
Experts from Europe, the Middle East, Africa, and Australia started the two-day meeting at the Sgt. Willie Estrada Memorial Civic Center by presenting an overview of their recent projects. Europe and Asia are currently considered by many the global leaders in desalination technology.

Guillermo Zaragoza, a researcher in Spain's ProDes (Promotion of Renewable Energy for Water Production through Desalination) project to promote the use of renewable energy for desalination, reviewed several key European projects underway and called for increased international cooperation. The world population has increased from 5.5 billion to 7 billion since 2007, Zaragoza said. "This is an increase of more than the total population of the U.S." The equivalent of 20 natural lakes per year are disappearing in China as that nation uses up its non-renewable water resources. An estimated 3.6 million people a year are dying from

Desal cost (multi-stage flash evaporation); source: Zhou and Tol (2005)



Energy use by reverse osmosis; source: Adapted from Elimelech and Phillip (2011)



These graphs show encouraging downward trends for costs of desalination and energy requirements for reverse osmosis treatment technology.

water-borne disease. “We have a lot of work to do,” Zaragoza said.

ProDes has established a roadmap and involved regulatory experts, investors, scientists and other key players in an effort to develop a renewable energy powered desalination system, he said. Barriers to success have included a tendency for desalination projects to focus on large systems impractical in small remote communities, lack of funding sources and general marketing information for investors, and poor understanding of the critical energy-water linkage.

Zaragoza praised the conferees’ goal of an integrated renewable energy-desalination system, noting that a key barrier has been that systems tend to be combinations of components developed independently rather than cooperatively between the energy and water sectors. “We are working in two different worlds and we need both industries—water developers and energy providers—to feel responsible for this,” he said.

Bekele Debele, working in the Middle East and North Africa Region for World Bank, estimated that nearly 3.7 billion gallons (14 million cubic meters) of water are desalinated in the Gulf area each day. This accounts for 46 percent of the desalination occurring in the world, he said. Saudi Arabia, the world’s leader in desalination, uses more than 1.5 million barrels of oil each day for desalination and that number is expected to reach 8 million barrels by 2030. As a result, the oil rich nation is looking to power all of its seawater desalination plants with renewable energy by 2019, Debele said.

Brackish water supplies important at home and abroad

An estimated 30 percent of the rural Navajos in Arizona are hauling water, tribal officials estimate. The numbers are increasing as the tribe faces extreme drought conditions.

New Mexico and the Southwest U.S. are providing plenty of opportunities for research on treatment of brackish groundwater that can be applied around the globe. Welcoming participants at WRRI’s 56th Annual New Mexico Water Conference, Alamogordo Mayor Ron Griggs underlined the importance of the group’s task to communities like his. “Making groundwater available, treatable, deliverable, and affordable is extremely important,” he said.

Mike Hamman, manager of the Bureau of Reclamation’s Albuquerque Area Office, said the Southwest U.S. is a prime candidate to benefit from brackish subsurface water supplies presently deemed unusable. Climate change forecasting models suggest the region is facing a 10 to 15 percent reduction in surface waters over the next few decades. He outlined a situation where population is growing, surface water allocations for agriculture are shrinking, and water resources are over-appropriated.

In Arizona, Reclamation officials have used a “roadmap” planning document developed with the help of Sandia National Laboratories to forge research partnerships for developing brackish water supplies with renewable energy resources. In a state where 13 tribes occupy large land areas, costs for water for rural residents can be four or five times the cost for those connected to a water system. “Some of the state’s lowest wage earners are paying the highest prices for water,” notes Kevin Black, a native affairs specialist.

Black and Mitch Haws, both from Reclamation’s Phoenix Area Office, are part of a team that is building a demonstration project at a remote site in northern Arizona. The team will test a membrane distillation system powered by photovoltaic array this spring and summer at a livestock well with an adjacent 24,000-gallon water tank, Haws said. Because there is no power grid in the area, the team explored a number of renewable options. Working with the University of Arizona, the investigators determined that a co-generating system—making use of both electrical power and heat generated—are the best solution for the site.

The team expects to operate the system over the summer with findings being applied to other possible desalination projects. “The system represents the kind of distributive technology needed to produce water in areas where no power grid exists,” said Black. - Will Keener

Energy and water tied in complex ways

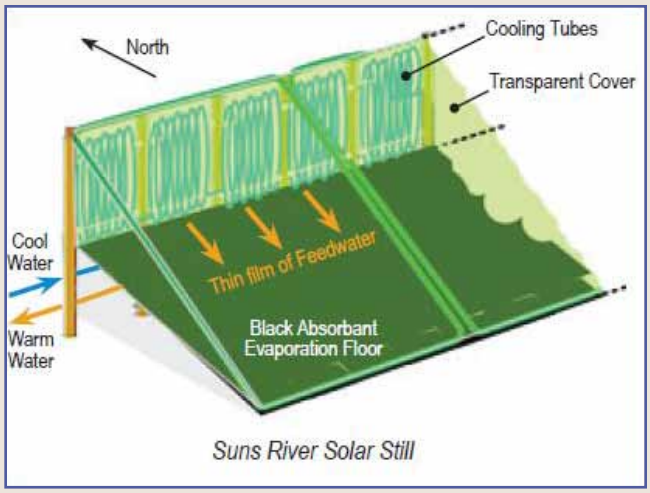
Producing potable water with renewable energy resources by removing salt and contaminants from brackish groundwater is a match that will work well in many of the water-stressed regions of the world. Several speakers at the 56th Annual New Mexico Water Conference noted the strong correlation of available solar, tidal, geothermal, or wind energy to areas that need to develop brackish water resources. In areas where there is no electrical grid and no plentiful source of water, stand-alone, distributive systems seem to be the best prospects for providing local residents with water relief.

In conjunction with the conference, the Bureau of Reclamation announced plans to begin testing a solar-powered desalination system this month at the agency's Brackish Groundwater National Desalination Research Facility (BGNDRF).

The effort highlights the complex relationship between two entities—water and energy—and their supporting industries. Water is critical to the development of energy whether it be turning generators at hydroelectric plants, cooling nuclear reactors, or as a key resource in a variety of manufacturing settings for wind turbines, photovoltaic cells, and the like. And energy is critical to the moving and treatment of water. Until the past few years, the complexity of links between the two has been little understood or studied.

Keynote speaker Guillermo Zaragoza noted that most desalination facilities focus on seawater and are large systems, while renewable energy-desalination projects tend to be small in scale. "We need industry cooperation between energy and water so that we can create systems designed for a specific use and with much better reliability," he said.

- Will Keener



Suns River Solar Still

The Suns River Solar Still was invented by Hill Kemp who received a patent on January 3, 2012. "The unit has several novel features: a tilted adsorption surface almost normal to the incident sunlight and falling film evaporation, which are expected to materially increase the rate of evaporation and a modified surface to provide improved condensation. Previously developed solar stills suffer from low productivity that limits the application of this technology." Kemp is currently constructing a pilot for testing at the BGNDRF that will continue through May 2012.

The cost of renewable energy powered systems and the energy intensity requirements of those systems is now falling, Debele said. A 2004 study characterized desalination as an option for rich countries, but now there are more opportunities as technology advances. Desalination is being looked at as an emerging solution to a projected water gap for the region, he said. "Closing the gap will be very expensive and challenging," he said, noting that renewable energy solutions also will help minimize carbon dioxide emissions.

"The cost of inaction in this region is very, very huge," he said. "If you put off investing because of the cost, the next generation won't be able to afford it."

In Australia, where six desalination projects are in operation, capacity is growing but gaps in knowledge also exist, said David Furukawa, Chief Scientific Officer for the country's Center of Excellence in Desalination. The present plants process ocean water with 80 percent of the country's population living along the coasts. "But there are thousands of tiny communities scattered across the desert with little water," he said. Thirteen universities, a government lab, and 50 industry partners are working on the inland issues with a budget of $23 million, Furukawa said.

This year's conference was co-sponsored by the New Mexico Institute for Energy and the Environment, Sandia National Laboratories, and New Mexico State University.

Geothermal Sources Provide Energy and Water for Desalination

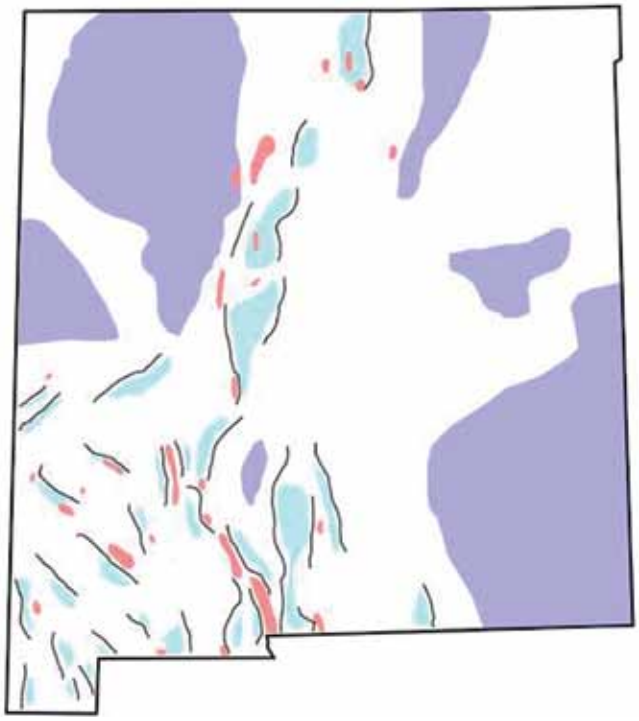
by Will Keener

High subsurface temperature, combined with readily available thermal saline water and a confined deep reservoir, make geothermal a potentially great renewable energy source for desalination in the western U.S. That's the view of James Witcher, principal of Witcher and Associates, Las Cruces, who has more than 30 years of geothermal energy experience. Witcher presented his ideas about pairing geothermal energy with desalination technology in a talk at the 56th Annual New Mexico Water Conference in December.

Surveying New Mexico's resources, Witcher pointed out that a variety of natural geothermal systems, including deep basin reservoirs in the western and central parts of the state, offer many advantages for desalination. Deep reservoirs, although costly to drill, offer a feedstock of larger amounts of thermal water for desalination and a feasible way to dispose of salt concentrate back into the geothermal reservoir, Witcher said. In places where deep confined hot water has migrated upward through "windows," such as faults or other vertical features, into shallower aquifers, smaller-scale desalination may be feasible. Shallow geothermal resources would be lower cost and lower risk to develop and could provide a way to clean up natural shallow saline groundwater plumes.

Typical components of a geothermal desalination system would be large-diameter production wells, with cemented casing to prevent any damage to formations above the resource zone, heat exchangers to extract energy, desalination equipment, and injection wells to put salt concentrate back into the reservoir. Energy generated could power the well pumps and reverse osmosis systems, Witcher said. The thermal energy could also be used as process heat for a distillation treatment system. Geothermal cooling with heat pumps may also provide efficient condensing for lower temperature geothermal and solar thermal distillation technologies.

Disadvantages to the geothermal desalination concept include greater investment risks, longer time frames to start up, which would allow for leasing, permitting, and other regulatory requirements. High silica content could also be an issue where reverse osmosis is applied, he said.



This generalized map of New Mexico shows the extent of the state's geothermal resource potential. Geothermal systems marked in red are shallower, convective systems. Deep sedimentary basin (conductive type) geothermal reservoir potential is shown in shades of blue. Map courtesy of James Witcher

The geothermal breakout group at the annual meeting suggested that surveying of existing geothermal power plants, looking at institutional issues, creating a planning document, studying heat pump applications, and investigating marketing potential of geothermal desalination brine streams were all key issues to further explore this option.

Editor's note: James Witcher is the co-author of New Mexico WRRI Technical Completion Report 330, *Sources of Salinity in the Rio Grande and Mesilla Basin Groundwater*, published in February 2004 and available online at http://wrri.nmsu.edu/publish/techrpt/abstracts/abs330.html.

56th Annual New Mexico Water Conference Highlights

Most participants of the annual WRRI water conference attended tours of the Brackish Groundwater National Desalination Research Facility in Alamogordo.

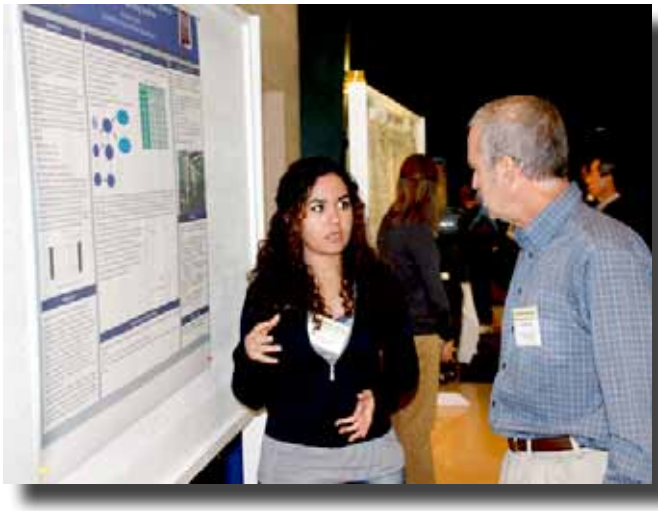
Mike Hamman of the Bureau of Reclamation's Albuquerque office presented New Mexico State University President Barbara Couture with a plaque commemorating the 2010 signing of the cooperative agreement between Reclamation and NMSU to conduct advanced water treatment research at the Brackish Groundwater National Desalination Research Facility.

Over 40 participants took part in breakout groups charged with developing project descriptions for research projects that couple renewable energy to brackish desalination systems for small communities. Reclamation's Kevin Price (standing) gave instructions to experts.

Breakout groups of five or six members met for a morning to develop project descriptions that were later presented to the afternoon plenary session.

Nearly 150 participants attended the day-and-a-half conference including desalination experts from Australia, Europe, the Middle East, North Africa, Canada, and Singapore.

New Water New Energy:
A Conference Linking Desalination and Renewable Energy



The second day of the conference included fourteen poster presentations on various water-related topics. The posters and oral presentations were sponsored by Sandia National Laboratories.

After breakout group spokespersons presented their top projects, conferees weighed in on which projects they deemed most critical. The top project from this process proposed an integrated photovoltaic and solar thermal system to treat brackish water in remote areas. Breakout members from left are Michael Landis, Guillermo Zaragoza, Ardeth Barnhart, Hill Kemp, Mitch Haws, and Kevin Black.

Fifteen oral presentations were given in response to the Call for Abstracts. Topics included algae production, sources and treatment of alternative water supplies, treatment, use, and disposal of desalination by-products, and the interaction of soils and surface water.

The project conferees deemed second-most critical is an effort to better understand the role of trace contaminants in various desalination technologies. The proposal was advanced by the group including (from the left) Ali Sharbat, Sam Fernald, Ken Rainwater, and Jaya Tharamapalan.

photos by Will Keener

Research Funding Opportunities

USGS Water Resources Research National Competitive Grants Program RFP, FY2012

The U.S. Geological Survey requests proposals for matching grants to support research on the topic of improving and enhancing the nation's water supply, including enhancement of water supply infrastructure, development of drought impact indicators, evaluation of the dynamics of extreme hydrological events and associated costs, development of methods for better estimation of the physical and economic supply of water, integrated management of ground and surface waters, the resilience of public water supplies, and the evaluation of conservation practices. Proposals are sought in not only the physical dimensions of supply, but also the role of economics and institutions in water supply and coping with extreme hydrologic conditions.

This program provides university researchers with up to $250,000 for projects of 1 to 3 years in duration. It requires a 1:1 non-federal match. The intent of the program is to encourage projects with collaboration between universities and the USGS. Funds have not been appropriated for this program but the USGS is proceeding with the proposal solicitation process in case an appropriation is received. The RFP at https://niwr.net/competitive_grants/RFP gives information on past year funding including award amounts and funding success rates. Please review the RFP carefully and if you are considering pursuing this opportunity, please contact NM WRRI Director Sam Fernald (575-646-4337; fernald@ad.nmsu.edu) as soon as possible. Proposals must be filed online by February 23, 2012.

National Water Research Institute Research Program

NWRI's research program supports multi-disciplinary, multi-geographic projects throughout the U.S. and abroad focused on water, wastewater, and water resources, including urban watershed issues. Typically, NWRI funds two to six new projects a year, with budgets ranging from $20,000 to $100,000.

Research projects must fall under the following categories: water quality assessment on treatment processes; treatment and monitoring focusing on water and wastewater treatment and management; knowledge management projects designed to gather, translate and distribute water-science information to better understand and employ water development and management; and exploratory research on new concepts for creative, non-traditional approaches to advance the water industry.

Matching funds are required on a one-to-one basis. Investigators are encouraged to seek other funding support from sources such as water and wastewater utilities, regulatory agencies, and other federal agencies (including the Bureau of Reclamation, and the U.S. Geological Survey).

The processing time for research proposals takes about 2-6 months. The principal investigator first submits a pre-proposal to NWRI describing the concept of the research and an estimated budget. If the pre-proposal is approved, the principal investigator is invited to submit a full research project proposal. For more information, go to: http://www.nwri-usa.org/proposalprocess.htm

SAVE THE DATE! **August 22, 2012, Las Cruces Convention Center**

New Mexico Water Resources Research Institute's 57th Annual NM Water Conference
Hard Choices: Adapting Policy and Management to Water Scarcity

Co-hosted by Senator Tom Udall and NMSU President Barbara Couture