

Testimony
The Nexus of Energy and Water for Sustainability
Senate Energy and Natural Resources Committee
Subcommittee on Water and Power
Anda Ray, Vice President for Environment and Chief Sustainability Officer
Electric Power Research Institute

Chairman Schatz, Chairman Landrieu, Ranking Member Murkowski, Ranking Member Lee: My name is Anda Ray, and I am Vice President for Environment and Chief Sustainability Officer for the Electric Power Research Institute, frequently referred to as EPRI.

Thank you for inviting me to testify before the Water and Power Subcommittee of the Senate Energy and Natural Resources Committee on the subject of the energy-water nexus and S.1971, the Nexus of Energy and Water for Sustainability (NEWS) Act of 2014. This is certainly a critical issue not only for the power sector, but also the long-term well being of the Nation.

EPRI conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including, reliability, efficiency, affordability, health, safety and the environment. EPRI's members represent approximately 90 percent of the electricity generated in the United States. EPRI has some 700 staff and an annual budget of nearly \$400 million. EPRI's principal offices and laboratories are located in Palo Alto, CA; Charlotte, NC; Knoxville, TN and Lenox, MA.

Water availability represents a growing concern for meeting future power generation needs. Thermoelectric plants of all types, including nuclear, coal, oil, gas, solar thermal and biofuels were designed to use the once plentiful water resources as their primary cooling component. And the need for cooling water continues today, at a time of declining supply, both globally and domestically. In the United States, projected population growth rates, energy consumption patterns, and demand from competing water use sectors will increase pressure on power generators to reduce water use. Water is critical to the electric power industry. It is also used for such things as fuel processing, ash handling, scrubbing, landscape integration, and potable requirements for power plants. In addition, the economic viability of the nation's communities served by the electric power sector depends on the availability of reasonably priced freshwater.

Approximately 40% of all fresh water withdrawals in the United States are by the electric sector. However, the electric power sector is responsible for only approximately 5% of the nation's total freshwater consumption, making it one of the least "consumptive" industry sectors. That is because, most of the water withdrawals are not consumed, but returned to its source. 90% of the water withdrawn is used for cooling purposes, primarily for condensing steam exhaust from the turbines that drive the generators.

While water is critical to the electric power industry, the reverse is also true: electricity is critical to water. Without electricity, most Americans would not have access to clean water. Approximately 2% of electricity in the United States is used to transport and treat water and wastewater.

EPRI is founded on a collaboration model and water resource research has been an important body of work since the 1970s. EPRI has focused on thermal power plant cooling, water availability and reducing energy use for the transportation and treatment of water. All of which are encompassed in the scope of the proposed NEWS Act.

I will briefly describe some of EPRI's work related to energy conservation for water, and water conservation for energy research as relevant to informing this hearing.

I'll start with an example of the need for consistently reported, high quality data. EPRI's water analytics research includes development of methodologies and tools to better understand and sustainably manage water resources and risk management needs at national, regional and local levels. EPRI's "Water PRISM" model can be used to evaluate water allocations for all sectors, including energy, municipal, agricultural, industrial and ecosystem requirements. The model can be used to project water needs for the next 30-50 years, including conservation efforts in each sector, and to assist in determining whether use of the available finite water resource can be sustained and maintained. Water Prism focuses on modeling at the watershed level, since there are significant regional variations in water use and availability. The model relies on data that is often provided by federal agencies such as the United States Geological Survey (USGS) and United States Army Corps of Engineers (USACE), state and local governments, and industry. You can see where access to high quality data sets is imperative to attain accurate modeling of future conditions.

Another example is where the adoption of innovative technologies can lead to more efficient energy utilization practices for water use. EPRI's research on energy use for water work focuses on characterization and conservation of electricity used for transport, treatment and distribution of water and wastewater. U.S. public drinking water systems use roughly 39.2 billion kWh per year, which

corresponds to about 1% of total electricity use in the U.S. Most of the energy use is related to pumping. A small percentage of water is supplied from the desalination of sea water and brackish water (less than 4%), but this is growing. Desalination is the most energy intensive process with respect to water supply. Municipal wastewater treatment systems in the U.S. use approximately 30.2 billion kWh per year, or about 0.8% of total electricity use in the U.S. There exist various technologies ready for pilot testing or proof of concept research that have the potential to increase energy efficiencies both for water delivery and waste water treatment such as advanced microbial deammonification and Supervisory Control and Data Acquisition (SCADA) systems. Collaborative and synergistic research is going to be key to leveraging the finite resources that are dedicated to research and development.

The final area of research I'd like to mention, specifically addresses thermoelectric generation. I have saved this for last because it is perhaps the most central to the hearing today. Since most of the water withdrawn by the power sector is used for cooling purposes, it is understandable that much of EPRI's research on water is directed towards improved options for thermoelectric cooling. Since one technology cannot meet all of the requirements for every power plant, EPRI has funded a suite of research projects on multiple fronts. Each technology has benefits and tradeoffs, with initial barriers such as initial cost, operating and maintenance issues, efficiency penalties, environmental impacts, reliability and safety. Our collaborative research programs have targeted these issues by addressing the following:

- Reducing the cost and energy penalties associated with dry cooling
- Developing new water saving wet, dry and hybrid cooling technologies
- Identifying and characterizing degraded water sources such as municipal wastewater treatment plant effluent, agricultural discharges, storm water runoff, water produced in association with oil and gas extraction, and brackish groundwater, and
- Researching more efficient treatment technologies to reduce the cost of wastewater and degraded water treatment and reuse.

A collaborative, public-private industry-wide effort is needed to evaluate the performance of a number of innovative new ideas, lab prototypes, and early stage commercial technologies that have the potential to reduce plant water use anywhere from 15% to 100% while substantially limiting adverse impacts on power production. Research to develop the design basis for the technologies and to demonstrate them in actual power plant environments is necessary. To help advance this research agenda, EPRI has actively pursued partnerships with the National Science Foundation and the Department of Energy, and partnered with industry and academia to leverage research funding and results. As an example industry partnership, EPRI is collaborating with Georgia Power Corporation (GPC) and Southern Company Services (SCS) to support the Water Research Center (WRC), located at Plant

Bowen in Cartersville, GA. The WRC is an important option in the Water R&D “pipeline” to accomplish the advanced cooling and water treatment research objectives described above.

The NEWS Act would encourage information exchange between Federal Departments and agencies “to leverage existing programs by encouraging joint solicitation’s, block grants, and matching programs with non-Federal entities,” and “to identify opportunities for public-private partnerships, innovative financing mechanisms, and grant challenges.” EPRI’s collaborative business model has long found such partnerships to be productive in advancing science and technology for the benefit of the public, the industry and government. There is always room for greater collaboration to increased opportunities to leverage scarce resources

For example, EPRI and the National Science Foundation have joined together to launch a joint research program to develop advanced cooling technologies. Each organization has contributed funds totaling \$6M over 3 years, and EPRI and the NSF have funded 10 promising cooling projects. EPRI and the NSF recently held a joint workshop to review these 10 projects. This public-private partnership is leveraging both industry money and federal money to develop technologies with the promise of providing novel ways of cooling with substantially less water consumption. Some of these technologies show promise not only for power plant cooling, but for many other types of cooling application as well.

EPRI has also explored developing a collaborative research arrangement with the Department of Energy (DOE) on thermoelectric cooling research. EPRI has experience coordinating research programs with DOE in other areas. For example, in 2010 EPRI and DOE executed a Memorandum of Understanding (MOU) with DOE in the area of Nuclear Plant Long Term Operations research. This MOU calls on EPRI and the DOE to periodically map the related research of each organization, helping ensure that EPRI and DOE take advantage of each other’s scientific findings, avoid duplication of effort, and advance joint objectives. Should DOE ramp up its cooling technology efforts, such an arrangement with energy-water nexus research could be helpful as well.

The NEWS Act would also serve to “coordinate and develop capabilities for data collection, categorization, and dissemination from and to other Federal departments and agencies.” I would note that coordinating and disseminating data to and within the private sector is important as well, to encourage public-private partnerships and synergies.

Since a major focus of the NEWS act is coordination of energy-water nexus efforts within the federal government and engagement with the private sector, it is appropriate to mention some of the ways EPRI can already see the many facets of government that are already engaging, in some way, in the

Energy-Water nexus. EPRI, along with other organizations representing diverse public and private water resource stakeholder groups, serves on the Federal Advisory Committee on Water Information (ACWI). Through ACWI, EPRI provides technical advice to USEPA, USDI, USDA, USACE, TVA and NOAA. EPRI belongs to the Energy/Water Nexus Group, a consortium of national energy laboratories actively engaged in studying the energy/water nexus. EPRI also partnered with national energy laboratories and the University of Texas on an investigation of the Water Constraints on Western Energy Interconnects, funded by USDOE on behalf of WECC and ERCOT. In addition, EPRI co-authored, along with Sandia, Los Alamos and NETL, the USDOE report, Energy Demands on Water Resources, Report to Congress on the Interdependency of Energy and Water (2006).

In summary, with almost 4 decades of research in this area, EPRI has identified some similar gaps as those in the NEWS Act. There is a need for better coordination of energy-water activities among federal entities, as well as the public and private sectors. There is a need for more consistent, transparent and high quality data. And of course, there is ongoing need to identify and conduct appropriate research to support the adoption of effective, efficient and affordable innovative technologies.

EPRI looks forward to continued growth in public/private cooperation to address this strategic research need. With your assistance, the United States can become a leader in water stewardship and provide the technologies needed for conservation of this vital resource. Thank you again for the opportunity to testify before the committee today.