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# A Perspective on the Department of Energy's Energy–Water Nexus 2017 Budget Justification

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## INTRODUCTION

Between July and October 2015, the U.S. Department of Energy (DOE) held a series of roundtable discussions to gain new insights to aid in the preparation of its Energy–Water Nexus Budget Justification for fiscal year 2017.[1] In doing so, the DOE acknowledged the deepening and increasing interdependence between water and energy systems and the disconnect arising from the fact that, historically, those systems have been developed, managed, and regulated independently.

DOE underscored the urgency to transition to more resilient energy–water systems by implementing integrated solutions that respond to trends such as changes in weather and precipitation patterns, population growth with increasing migration to arid regions of the U.S., accelerated drawdown of important groundwater supplies, and the introduction of new technologies that could affect water and energy demand.

Each roundtable[2] involved between 14 and 43 stakeholders representing government, industry, non-profit organizations, research institutions, and academia. The makeup at each meeting varied depending on the theme. The four organizing themes were fuel production, the electricity sector, water infrastructure, and systems integration.

## DOE CAPSTONE MEETING

The capstone meeting, chaired by Secretary of Energy Ernest Moniz, reflected on issues and refined takeaways as determined by the DOE on the basis of the previous discussions. The "takeways" were provided in advance and included the following recommendations on four major issues.[3]

*Climate Change:* New approaches to technologies, policies, and markets are required to effectively address climate change. They should take into account the interconnection of energy, water, and climate to avoid exacerbating one problem to solve another.

*Energy Security:* Energy systems analysis, design, planning, business models, and technology deployment should include water-related risk.

*Lifecycle Environmental Responsibility:* Include lifecycle and system analysis in technology and policy development to help avoid unintended negative environmental impacts.

*Systems Complexity and Systems Change:* Data, models, and analysis of water and energy systems are important to understand the possible implications of system interactions and regional changes.

**Broad collaborative action is necessary to overcome challenges and successfully enable the beneficial use of non–fresh waters, especially produced water.**

**The interconnection of energy, water and climate should be taken into account in new approaches to effectively address climate change.**

### DOE Next Steps

Based on these points, the DOE prepared a list of "next steps," which the capstone meeting participants were to review with the aim of enhancing the ability to address climate change, energy security, and lifecycle environmental responsibility going forward. These steps include:

1. Target and engage in technology solutions of national impact. Specifically:
   a) As outlined in the DOE's "The Water Energy Nexus: Challenges and Opportunities 2014" report,[4] reduce fresh water use in energy production, increase energy-efficient use of non-traditional sources of water in multiple applications, and ensure sustainable energy and water utilities for the future.
   b) Partner with cities to inform the development of integrated energy and water policies.
   c) Work through the Energy Water Initiative[5] to pursue opportunities in treating wastewater from oil and gas production for beneficial use.
2. Collaborate with the Environmental Protection Agency (EPA), US Department of Agriculture (USDA), the White House, and others to pursue more integrated and optimized policies that relate to energy, water, and carbon.
3. Partner to develop data, modeling, and analysis to support understanding of regional systems and the decision-making processes within them.
4. Conduct analysis and measure the impact of water policies on energy systems.
5. Pursue efforts to integrate the energy-water systems in both the physical market and policy domains.

The capstone meeting involved 28 stakeholders invited because of their special knowledge and expertise in water and energy systems, including a co-author of this brief, Linda Capuano.

## BAKER INSTITUTE RECOMMENDATIONS

Based on the summaries of previous roundtables and the aforementioned "takeways" and "next steps" and informed by a water-energy workshop[6] and conference[7] organized by the Baker Institute in May and October of 2015, respectively, Capuano formulated five policy suggestions for DOE's consideration in implementing its policy goals in the area of water-energy nexus.

### Expand emission-energy-water modeling to explicitly include agriculture, land use, water transport/storage, and other relevant variables

DOE has shown leadership in providing useful models that help understand energy and CO2 emission tradeoffs. The agency's current efforts to consider water within this complicated mix will be vital in moving the nation forward. However, it is also important to anticipate additional complexity and explicitly include the capacity to optimize around elements such as land use, agriculture, and the transportation and storage of water. The complexity of this effort amplifies the need for interagency cooperation between the DOE, USDA, and, perhaps, the Department of Transportation. It also emphasizes the need to build relationships between regions and localities when considering tradeoffs such as on-road vs. pipeline transport.

### Emphasize the identification of multiple pathways to technical solutions

Water issues are local and regional in nature and solutions will vary depending on specific circumstances. Thus, we need to identify a variety of technical solutions so that we may select the optimum emission-water-energy-land solutions for specific local conditions. For example, local saline concentrations would determine which desalination technology is optimum. Or, since water transportation is often expensive, distances between water source and use would determine if reuse of oil and gas produced water is more economic than transporting fresh water to the application site.

**Recognize the immediate need for DOE laboratories to fulfill their historic role of defining, evaluating, and measuring water quality and treatment technologies**

Industry and municipalities have an urgent need for rapid testing and analysis methods to accelerate water reuse. Water is often stored for extended periods until analyses that determine treatment are completed. This can be expensive and can impact the environment and land use. DOE laboratories have demonstrated expertise and could play an important role in evaluating water composition analysis and treatment methods. Independent testing by the national labs would give industry and municipalities confidence in the accuracy and reliability of the results and could help accelerate the adoption of innovative water treatment techniques.

National laboratories can also play an important role in helping to define guidelines for acceptable water quality concentration ranges. One example is determining the acceptable range of total dissolved solids (TDS) in thermoelectric cooling, industrial manufacturing, and various agricultural uses. This is consistent with the concept of "fit for purpose," or the right treatment for the specific water use.

Guidelines would also help define the technical challenges of designing water treatment for specific applications and help focus policy discussions on removing barriers and accelerating progress.

**Go further in emphasizing a systems approach and broaden involvement of all stakeholders recognizing the important leadership role already undertaken by the industry**

Industry is motivated and already proactively working with stakeholders through organizations such as the Ground Water Protection Council (GWPC), Energy Water Initiative (EWI), International Association of Oil and Gas Producers (IOGP), and Interstate Oil and Gas Compact Commission (IOGCC), as well as through GWPC's Risk Based Data Management System. Industry is showing clear signs that this proactive attitude and leadership will continue into the foreseeable future.

The Baker Institute has facilitated interactions by hosting workshops that brought together industry participants, including oil and gas, water treatment companies, service companies, system integrators and future technology innovators, as well as national laboratories, state and federal officials, and academics.[8] For example:

- On October 14, 2015, a water–energy conference at the Baker Institute expanded the discussion between agriculture and unconventional oil and gas sectors to include produced water reuse,[9] while another conference on December 9, 2015, examined modeling and interdisciplinary insights.[10]
- Recognizing water's regional and interdisciplinary nature the Baker Institute teamed with the Ground Water Protection Council to sponsor its Annual UIC Conference (February 24–25, 2016), where participants discussed the produced water from oil and natural gas production, aquifer management, and underground injection.[11]
- In an effort to reach more stakeholders, the Baker Institute also teamed with the GWPC, States First,the National Rural Water Association (NRWA), and the Interstate Oil and Gas Compact Commission (IOGCC) to host a produced water forum on August 18, 2016.[12]
- Subsequent workshops, such as the Baker Institute moderated workshops during the GWPC Annual Forum co-located with the National Rural Water Association WaterPro Conference during September 2016[13], will bring together potential users of alternative water and suppliers. Again industry has been proactively engaged in designing this line of inquiry.

**DOE and its labs are uniquely positioned and trusted in their role to inform and educate**

Industry has begun to reuse produced water from oil and natural gas production water, but larger efforts are stymied by a kaleidoscope of local and national policies as well as public opinion, which can often be unfriendly. With industry responding

**The DOE is uniquely positioned and trusted to inform and educate a broad stakeholder community about more efficient and resilient energy–water systems.**

**DOE's budget submission aligns well with our efforts to elevate the conversation about the energy–water nexus through data–driven analysis.**

proactively, DOE can bring attention and focus to the positive and negative impact of 20th century policies on 21st century needs. DOE can be of particular help in educating regions and municipalities in ways that industry cannot. Efforts to expand interagency efforts to include state and municipalities, and to build on the work of organizations such as Groundwater Protection Council and States First initiative, should intensify.

It is also important for consumers to understand that treated water is clean and that conservation and reuse is important; it is also essential to educate all water users about the possibility of delivering alternative water sources to agriculture, power, municipal, industrial, and other applications. Potential water suppliers need to be informed of the ranges of water composition that can be used in different applications. For instance, understanding acceptable salinity composition ranges in industrial applications will assist in optimizing technologies for "fit for purpose" water treatment.

## CONCLUSIONS

Many agencies touch the water–energy nexus, and DOE's energy focus is important in assisting the nation in developing meaningful solutions that move toward resilient energy–water systems. The $96.1 million Fiscal Year 2017 Budget Request for the Energy–Water Nexus (EWN)[14] submitted by the DOE is responsive to that objective and consolidates the above elements into a set of cross–program collaborations. These build on DOE data and modeling platforms, and target crosscutting technology research, development, demonstration, and deployment opportunities. The budget proposal also includes focused policy analysis, outreach, and stakeholder engagement such as the aforementioned roundtables and capstone meeting. DOE intends to measure success by its ability to (1) influence the optimization of efficient water use in the energy sector through water treatment and management, (2) encourage the increased use of non–traditional water resources, and (3) improve the reliability, resilience, and productive synergies among energy–water systems.

To this end, the proposed activities are organized around four pillars:

*Advancing Data, Modeling, and Analysis (DMA):* to gain insights into technical opportunities in the complex systems dynamics in planning the resilient, efficient, and competitive energy–water systems needed for the future; to begin design and deployment of three regional climate and watershed management model (DMA) test beds.

*Technology Research Development, Demonstration, and Deployment:* to develop technology and infrastructure options that reduce vulnerability, increase resilience, and offer efficiency improvements and cost reductions that are demonstrated during technology deployment.

*Policy Analysis:* to improve understanding of diverse stakeholders; aid in prioritization questions examined in DMA; and identify technology implement barriers and opportunities.

*Outreach and Stakeholder Engagement:* to help identify pathways and potential partners while sharpening the understanding of end–user needs.

The document also outlined some accomplishments anticipated in 2017 under the proposed budget, such as:

- Testing of national lab desalination prototypes, preparation for field demonstrations, and launch of a desalination hub.
- Reducing power plant water consumption and providing options for use of non–traditional water and fluids.
- Initiating the build out of DOE data layers, commencing and subsequently evaluating an initial modeling framework, and launching four regional–scale DMA test beds.

We are encouraged by the DOE's budget submission to pursue the energy–water initiative crosscut; it aligns well with our continued efforts to elevate the conversation about the energy–water nexus through data-driven, fact-based analysis and engage a broad stakeholder community in policy discussions. The stated intentions to support meaningful work are important in supporting sustainable economic growth by moving us toward more efficient and resilient energy–water systems. The DOE budget submission is part of the president's 2017 Budget Request, which is currently undergoing the Congressional appropriations process for the 2017 fiscal year. DOE's intent to more fully engage in the energy–water nexus is an important component in a multi-stakeholder effort to develop innovative ways to use and reuse water in the energy sector.

## ENDNOTES

1. U.S. Department of Energy, "Energy–Water Nexus Budget Justification," available at http://energy.gov/under-secretary-science-and-energy/downloads/energy-water-nexus-budget-justification.

2. U.S. Department of Energy, "Energy–Water Roundtables," available at http://energy.gov/under-secretary-science-and-energy/downloads/energy-water-roundtables.

3. U.S. Department of Energy, "Takeaways from the 2015 DOE Energy–Water Nexus Roundtable Series," available at http://energy.gov/sites/prod/files/2016/05/f31/Takeaways%20from%20the%202015%20DOE%20energy-water%20nexus%20roundtable%20series%20.pdf.

4. U.S. Department of Energy, "Energy–Water Nexus: Challenges and Opportunities," available at http://energy.gov/under-secretary-science-and-energy/downloads/water-energy-nexus-challenges-and-opportunities.

5. "The Energy Water Initiative (EWI) is a collaborative effort among participating members of the U.S. oil and natural gas industry to study, describe, and improve lifecycle water use and management in upstream unconventional oil and natural gas exploration and production." See "U.S. Onshore Unconventional Exploration and Production Water Management Case Studies," prepared by CH2MHILL, page 1, January 2015.

6. "Water and Energy Workshop—Understanding Impacts and Trade-Offs to Facilitate Transitions, " Rice University's Baker Institute for Public Policy, Houston, Texas, May 14, 2015. Summary available at: http://bakerinstitute.org/research/summary-water-and-energy-workshop/.

7. "Water and Energy Conference: Challenges and Opportunities in the Nexus," Rice University's Baker Institute for Public Policy, Houston, Texas, October 14, 2015. Event information available at http://bakerinstitute.org/events/1744/.

8. "Water and Energy Workshop," Baker Institute, May 14, 2015.

9. "Water and Energy Conference," Baker Institute, October 14, 2015.

10. "Water and Energy Workshop–Enabling and Modeling Sustainability in the Nexus," Rice University's Baker Institute for Public Policy, Houston, Texas, December 9, 2015. Event information available at: http://bakerinstitute.org/events/1761/.

11. "Aquifer Management & Underground Injection" (the 21st Annual Groundwater Protection Council UIC Conference, Denver, Colorado, February 23–25, 2016). Conference information available at: http://www.gwpc.org/sites/default/files/events/2016Agenda-FinalWebVersion2-23-16_0.pdf.

12. See Interstate Oil and Gas Compact Commission at http://iogcc.ok.gov/producedwaterforum.

13. Ground Water Protection Council's 2016 annual forum, co-located with WaterPro and the National Rural WaterAssociation, Orlando, Florida, September 11–14, 2016, http://www.gwpc.org/events/2016-annual-forum.

14. Department of Energy, "Energy–Water Nexus Budget."

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