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hearing on

The Energy Water Nexus: Drier Watts and Cheaper Drops
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By

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Dear Chairman Lamb and Ranking Member Weber, I appreciate the opportunity to submit testimony for this hearing on energy, water, and their interconnections.

My name is Michael Webber, and I presently serve in two roles. I'm the Josey Centennial Professor in Energy Resources at the University of Texas at Austin and also the Chief Science and Technology Officer at ENGIE, which is a global energy and infrastructure services firm. At the University of Texas I have supervised more than two dozen PhD students over the last decade who have studied energy and water in collaboration with national labs, environmental groups, municipal water companies, and some of the world's most prominent energy companies. At ENGIE, I oversee their research activities, which includes 900 staff and an annual budget of more than $200 million. By way of introduction, ENGIE is a diversified energy and infrastructure services firm with 160,000 employees active in 70 countries. With 115 Gigawatts of installed capacity, it is the largest independent power company in the world. It also has built 5% of the world's seawater desalination facilities. ENGIE has a large presence in the United States, with 4500 employees and more than $3 billion in revenues for low-carbon power generation, energy storage, and other services.

It is from this mix of academic and corporate experience that I offer my remarks today.

The energy-water nexus presents unique challenges and invites cross-cutting solutions.[1] Because the energy system depends so extensively on water and the water system depends so extensively on energy, they are both vulnerable to cascading failures from one sector to the other.[2] For example, a water constraint can become an energy constraint, and an energy constraint can become a water constraint. If water is not available at the right place and time with the right abundance or temperature, then the power sector might struggle to generate and deliver electricity. If energy is not available, then the water sector struggles to treat and deliver water. Thus, the interdependence of energy and water is ultimately a resilience question for planners.

Thankfully, the interdependence also offers up the opportunity for cross-cutting solutions, especially for conservation and efficiency. Because of their interconnections, saving water saves energy and saving energy saves water. Reducing the energy intensity of the water system and the water intensity of the energy system avoids environmental impact and improves infrastructure resilience.

The energy-water nexus is extensive, so I will focus on two aspects: 1) the energy use for the water system, which invites the opportunity for integrating renewable energy, and 2) specific challenges related to managing wastewater from oil and gas production.

Energy for Water, Wastewater and Steam

The combined water and wastewater system is a hallmark of a modern society. Because of their economic and public health benefits, investing in networks to treat and distribute drinking water and collect and sanitize wastewater are among the most important and beneficial public investments a society can make. These systems also require vast sums of energy for pumps, blowers, chemicals and mechanical equipment. Beyond that, we use much more energy in our buildings to heat water for bathing, cleaning, cooking and sterilization. Industry will also often invest more energy to treat water even further, for example to make ultrapure water for semiconductor fabrication or to make steam for use at refineries.

All told, according to Professor Kelly Sanders at the University of Southern California, about 13% of national energy usage is consumed for direct water and steam services.[3] About one-third of that energy, or about 4% of national energy consumption, is just for water heating in our homes and businesses. That is about twice the amount of energy that Sweden consumes for running their entire country.[4] Because we use so much energy for water heating, it represents an important opportunity for saving energy and avoiding emissions. Considering today's mix of fuels in the power sector, shifting from electric towards natural gas or solar water heating offers significant energy and CO_2 emission reductions in most US regions.[5] However, in regions where the electricity mix is very clean, for example the Pacific Northwest, which is predominantly powered by hydroelectric dams, electric water heating is an excellent option. Cleaning up the grid in general by replacing coal power plants with wind, solar, nuclear or renewable natural gas would make electric water heating even cleaner. Incentives and information guides to encourage adoption of more efficient appliances that use heated water, such as dishwashers and clothes washers, would also continue to provide non-trivial savings. According to Professor Ashlynn Stillwell at the University of Illinois, the average U.S. household could save 7600 kWh of electricity and nearly 40,000 gallons of water by making appliance upgrades that have negative abatement cost, meaning they save money in addition to reducing consumption.[6]

As Professor Corey James from the U.S. Military Academy at West Point found, managing the end-uses of water wisely also improves the resiliency and efficiency of military installations, which provides security benefits.[7] So, this issue is bigger than just how we use energy and water in our homes.

Another opportunity is to use the water sector's energy intensity to integrate higher fractions of renewables into the power sector. Water treatment, wastewater treatment, and modern desalination plants are particularly electricity dependent. They are also systems that can be operated flexibly, meaning they can be ramped up and down to match when electricity is available. That makes them a convenient companion for variable resources such as wind and solar power.[8] Furthermore, it is much easier and cheaper to store water than to store electricity. For example, simple tanks instead of expensive batteries can be used. Thus, by integrating renewables with water treatment and production, the water sector can help make the electricity sector more resilient while providing valuable grid services and speeding the adoption of cleaner forms of power.

Managing Wastewater From Oil and Gas Production

Another relevant issue for the energy-water nexus is the amount of water produced alongside oil and gas extraction. The ongoing boom in oil and gas production has yielded important economic and security benefits for America's energy supply while bringing forth cheap natural gas that displaced coal in the power sector, simultaneously reducing emissions and costs. However, the water and wastewater challenges that accompany this boom present some important environmental risks that are worthy of greater investment of money and attention.

Handling significant volumes of wastewater with high levels of total dissolved solids requires energy for collection, pumping, treatment and disposal. In some locations there is energy available, such as the energy contained in flared gas, for on-site treatment.[9] However, generally speaking, wastewater needs to be collected for centralized treatment as a way to achieve specialized capabilities with economies of scale.

Unfortunately, water and wastewater are often moved by trucks, which are less efficient, dirtier, more disruptive to communities, and more destructive to roads than pipelines. Building a pipeline-based wastewater collection system would improve the safety and pose much less environmental risk compared with truck-based collection. Thus, by enabling the construction of a vast water collection pipeline network, the environmental risks and energy requirements for wastewater treatment would go down. Such a system would also reduce the costs for energy production, helping to propagate the energy, environmental and security benefits of the energy boom in places like west Texas.

The federal government has important roles to play. The nascent water re-use and water recycling industry only works for oil and gas if you can build a pipeline network (to avoid trucks, reduce costs, improve economies of scale, etc.). But, uncertainty about gaining right-of-ways on federal lands make it harder for developers to build wastewater collection networks. This uncertainty and other barriers to water pipeline systems inhibit the ability to build treatment and recycling systems, leaving underground disposal as the primary wastewater management option and putting pressure on aquifers as sources of water for hydraulic fracturing. Facilitating water pipeline construction would help accelerate the adoption of better water management pathways. As noted earlier, those treatment systems are compatible with renewable sources of power. Thus, ironically, the oil and gas sector's water clean-up needs can help expedite the adoption of renewable energy.

Because there is significant oil and gas production on federal lands, it is also important for the federal government to operate efficiently and predictably. Events such as the government shutdown introduces uncertainty and delays major capital investments that are required for water collection and treatment systems. In addition, policy whiplash from presidential administration to administration raises costs for developers. Just as keeping the government open and functional would reduce costs for oil and gas producers while helping to bring forward environmental solutions, policy stability and certainty is important for planning projects with long-lived assets.

Recommendations and Closing Thoughts

In addition to facilitating the development of water collection networks and treatment systems for the energy sector, the federal government has other actions it can take to improve the resilience, efficiency and cost of energy and water. Encouraging the Department of Energy to have water in mind for its programs is a good place to start. Encouraging water planners to keep energy in mind is also important. In addition, data collection and sharing programs can make a big difference.

Data on urban water resources are scarce,[10] especially in comparison with our data collection on energy usage. As a consequence, consumers and planners are hamstrung in their efforts to manage their usage or improve system resilience. After the first energy crisis in the early 1970s, the U.S. government created the Energy Information Administration to collect data on our energy production, movement and usage. Before that, data had been limited and policymakers recognized that it was hard to improve the situation without more rigorous facts at their disposal. The EIA datasets are the gold standard worldwide and help illuminate opportunities to improve the efficiency and resilience of the nation's energy supplies. We need something comparable for water, perhaps by creating an agency tasked with collecting water data or by expanding the EIA's mandate to track water demand and supply.

Lastly, one of the most important policy levers for the federal government is to sponsor R&D. Incremental improvements will not solve these challenges quickly enough, so there is need to scale-up the effort dedicated to creating stable and resilient energy and water supplies for the nation's industries and communities at lower cost and impact. Notably, the U.S. Department of Energy is pursuing a national research effort intended to lower the cost and energy requirements of desalination and treatment of non-traditional water sources. I recommend that the House Science Committee endorse this investment and other bold initiatives that prioritize innovation, conservation, and efficiency as a pathway to improving the energy-water relationship.

Thank you for the opportunity to share my thoughts. I would be happy to answer questions.

References

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