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Introduction

Good morning Dr. Holdren, Mr. Deputy Secretary, members of the Task Force and fellow panelists. My name is Marcus Griswold and I am here on behalf of the Natural Resources Defense Council (NRDC). NRDC is a nonprofit organization of more than 350 scientists, lawyers, and environmental specialists dedicated to protecting public health and the environment in the United States and internationally. Founded in 1970, NRDC uses law, science and the support of 1.3 million members and online activists to protect the planet's wildlife and wild places and to ensure a safe and healthy environment for all living things.

I would like to thank the Department of Energy for taking the time to consider the water – energy nexus. Water and energy will be the two most challenging issues of current and future generations – and when combined with climate change – will involve the most important decisions our society makes. Globally, the energy sector currently withdraws as much water as flows down the Mississippi River every year [1] and of all water users, the energy sector may see the most rapid rise in water use over the next 20 years.[2,3]

As we know water is used to produce energy and energy is used to produce water. In 2010, the U.S. water sector consumed over 600 billion kWh, or approximately 12.6 percent of the nation's energy.[4] In California, conveying water from the Colorado River to southern California requires 2,000 kWh per acre foot of water[5] and California's State Water Project is the largest single user of energy in California, consuming an average of 5 billion kWh/yr, more than 25 percent of the total electricity consumption for the entire state of New Mexico.[6] It's not just surface water being used - in 2004, California used 3.4 billion kWh/yr for groundwater pumping.[7] Conversely, much less energy is used when we recycle and become more efficient with our water use.

The Water-Energy nexus is not a new concept for the Department of Energy (DOE). Section 13 of the Federal Non-Nuclear Research and Development Act of 1974 required DOE to conduct a full life cycle analysis of coal development in areas of vast energy resources such as in the

[1] http://www.worldenergyoutlook.org/media/weowebsite/2012/WEO_2012_Water_Excerpt.pdf
[2] CRS Report. 2011. Energy's Water Demand: Trends Vulnerabilities, and Management. R41507
[3] http://www.worldenergyoutlook.org/media/weowebsite/2012/WEO_2012_Water_Excerpt.pdf
[4] Sanders, K. and M.E. Webber. 2012 Evaluating the Energy Consumed for Water use in the United States. Environmental Research Letters, vol. 7, 034034.
[5] Utah Division of Water Resources. 2012. The Water-Energy Nexus in Utah. 59 pp.
[6] Cohen, R., B. Nelson, G. Wolff. 2004. Energy Down the Drain: The Hidden Costs of California's Water Supply. 85 pp.
[7] Cohen, R., B. Nelson, G. Wolff. 2004. Energy Down the Drain: The Hidden Costs of California's Water Supply. 85 pp.

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Powder River Basin in Wyoming. On the forty year anniversary of this Act our Nation stands at another fork in the road – one path where we continue to rapidly expand our use of fossil fuels and water intense energy development or a path where we expand our use of renewable energy – one where we support the development of water and energy efficient, low carbon energy sources and infrastructure.

We, as a Nation have the opportunity, skills, and knowledge today to deviate from this false dichotomy. This false dichotomy that energy and water are not connected. We can do this by ensuring that decision-making brings both elements together during the planning, implementation, and management phases for the development, production and use of energy and water. Building more pipelines and conduits for moving water and energy may appear to be the least-cost pathway, but may not be the most logical path when taking into account the potential long term damage to ecosystem health and the availability of water for drinking, agriculture, and other industries. We have an obligation to future generations to ensure that future energy and water infrastructure are co-managed and planned to minimize environmental impacts and maximize cost savings and efficiency in an increasingly water thirsty world.

Increasingly, energy infrastructure and production will be faced with water challenges associated with climate change, rising populations, and the need to protect and improve ecosystem health – driven by water quality and biodiversity. These issues collide in one of the greatest water quality and quantity issues in the U.S. – the impacts of thermoelectric power plants on our Nation's water resources – an energy system that accounts for 49% of water use in the U.S.[8] Not only does the continued use of once-through cooling systems expose the power industry to current and future environmental risks, but climate change will make production increasingly uncertain as droughts leave intakes out of the water and lower water levels means competition with other water users. Additionally, discharge from power plants kills billions of fish annually and overheats downstream waters. For these power plants, Section 316(b) of the Clean Water Act already requires the U.S. EPA to adopt standards for cooling water intake structures based on the "Best Technology Available" for minimizing adverse environmental impacts. [9] Today the federal government could and should require the use of recirculating systems or better for all power plants – immediately reducing water use by nearly 95% - as much as 190 billion gallons a day.[10] Additional benefits could be achieved if these plants utilize wastewater or reclaimed water from other sources.

Climate change will affect water availability for energy production

We have moved beyond the "if climate change occurs" phase and must recognize that even substantial reductions in greenhouse gases will not offset some of the climate impacts we expect to experience in the next few decades. Energy development, infrastructure and production will need to account for the feedback between climate change and water

[8] Kenny et al., 2009.Estimated Use of Water in the United States in 2005. U.S. Geological Survey Report circular 134.
[9] http://www.nrdc.org/water/power-plant-cooling.asp
[10]http://www.nrdc.org/water/power-plant-cooling.asp

availability. Climate change will affect the timing, amount and quality of water available and in turn affect energy production and distribution.

- Warmer temperatures, and in many arid regions less precipitation will result in higher demand for water across the country. Warmer temperatures could increase electricity demand by 18% in California by 2100.[11]
- Rising sea levels will introduce salt into some fresh water systems – as has already occurred in Florida – requiring an extensive saltwater pumping system.
- As high mountain snow cover and glaciers decline, they will store less fresh water – as is happening in the Rocky Mountains – where snowpacks are being lost at a rate faster than any other time in the past 800 years[12].
- As regions heat up, droughts will become more persistent.

The impacts of recent droughts and rising temperatures provide a window into the future impacts of climate change. Rising temperatures and less water will require more energy as power plants use more water for cooling, farmers and municipalities use more water for groundwater pumping, and people in cities turn down the thermostat to keep cool, increasing the demand on the energy system, and thus requiring more water. All the while, water is pulled from our rivers, streams, and aquifers, reducing the availability of high quality water for fisheries and ecosystems. Both warming surface waters and air temperature combined with declining water levels reduce power plant efficiencies, output, and hinder the protection of aquatic species.

Falling water levels and drought will impact water intakes for power plants and drinking water intakes alike. A study of 423 major thermo-electric plants, found that 43 percent are vulnerable to low water levels.[13] This vulnerability is already being seen in arid regions.

- Water levels at Lake Mead have declined by 135 feet since 1999, leading to the reduction in hydroelectric capacity at Hoover dam by 33% - a decline of 25 additional feet could make operations impossible.[14] California obtains water from the lake while also obtaining energy – a true nexus that lends itself to conflict during droughts.[15]
- On the Missouri River, the 2012 drought forced the Army Corps of Engineers to hold back water in a series of reservoirs, decreasing power production by 3 billion kilowatts, and forcing the Western Area Power Administration to spend an additional $1.5 billion from 2000 to 2012 to purchase power from other sources. [16]

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[11] Aroonruengsawat, A. and M. Auffhammer. 2009. Impacts of Climate Change on Residential Electricity Consumption: Evidence from Billing Data. California Energy Commission PIER Report CEC-500-2009-018-D.
[12] Pederson et al. 2011. The Unusual Nature of Recent Snowpack Declines in the North American Cordillera. Science, 333: 332-335.
[13] http://www.circleofblue.org/waternews/2013/world/choke-point-u-s-water-energy-and-the-ohio-river-valleys-new-course-2/
[14] http://www.circleofblue.org/waternews/2010/world/in-era-of-climate-change-and-water-scarcity-meeting-national-energy-demand-confronts-major-impediments/
[15] http://spectrum.ieee.org/energy/renewables/colorado-river-hydropower-faces-a-dry-future
[16] http://www.argusleader.com/viewart/20140108/UPDATES/301080067/Missouri-River-power-generation-sub-par-2013

- In Alabama, generators at Browns Ferry Nuclear Plant were shut down four out of the past six years to protect aquatic ecosystems in the Tennessee River from being impacted from high water temperatures.[17]

Many of the planned thermoelectric generation stations are projected to be located in water-stressed areas, particularly in high water stress counties in Florida, New Mexico, Arizona, Texas, and Arkansas.[18] Before proceeding down the same path, we must evaluate strategies to reduce water use in the energy sector before building more infrastructure and energy systems in water stressed regions.

One example of water and energy resilience in the face of water scarcity can be found in Texas. Investments made in low water use energy sources saved water and avoided costs to power plants during a recent drought. During the 2011 drought in Texas more than 100 days of triple digit temperatures raised annual electricity demands and generation by 6%, raising water demands for thermoelectric by 10%. Meanwhile, runoff declined by 88% and reservoir storage declined by more than half. However, power plants fared well by:

- Switching to technologies such as wet and dry cooling towers that reduced or eliminated water use by as much as two orders of magnitude in some cases.
- Switching from coal to natural gas fired systems had also reduced water use by 66%, as had an increase in wind energy of 10,000 MW.
- Lastly, in 2011, CPS Energy in San Antonio switched from exclusively pulling water from the Edwards Aquifer groundwater to using municipal wastewater from the San Antonio Water System, reducing impacts on threatened and endangered species and agricultural water needs.[19]

These efforts have reduced the impacts of energy use on ecosystems and local communities, while increasing their resilience to drought.

In addition to directly switching to low water use systems, a flexible grid system could be implemented during droughts to reduce water consumption. A study of a self-contained electric grid system in Texas found that removing drought vulnerable energy systems from the dispatch system could save 459.6 million gallons in withdrawals and 49.7 million gallons of consumptive water use a day, while reducing stress on local rivers and aquifers.[20]

A shift to water and energy efficient energy sources and renewable energy could balance our nation's water stress

President Obama's recently proposed Carbon Rule provides the initial step towards securing a low carbon future and if implemented with water in mind, could move the Nation towards a

[17] Rogers, J., Averyt, K., Clemmer, S., Davis, M., Flores-Lopez, F., Frumhoff, P., Kenney, D., Macknick, J., Madden, N., Meldrum, J., Overpeck, J., Sattler, S., Spanger-Siegfried, E. and Yates, D. 2013. Water-smart Power: Strengthening the U.S. Electricity System in a Warming World (Cambridge, MA: Union of Concerned Scientists) 50 pp.
[18] GAO. 2014. Climate Change: Energy Infrastructure Risks and Adoption Efforts. GAO-14-74.
[19] Scanlon,B.R., I.Duncan, and R. Reedy. 2013. Drought and the water–energy nexus in Texas. Environ. Res. Lett. 8:045033
[20] Pacsi,A., N.Alhajeri, M. Webster, M. Webber, and D. Allen. 2013. Changing the spatial location of electricity generation to increase water availability in areas with drought: a feasibility study and quantification of air quality impacts in Texas. Environ. Res. Lett. 8: 035029

more secure energy and water future. Reducing dependence on coal alone will reduce water use during extraction as well as at power plants. Coal mining uses 70 million to 260 million gallons of water each day, [21] and a 500 MW coal fired power plant uses 300 million gallons of water a day just for cooling.[22] However, any movement towards increased use of renewable energy sources should consider the potential impacts on water use.

Because of the broad link between climate change, efficient utilities, and water use, the Quadrennial Energy Review should consider those strategies that most effectively address all three concurrently – energy systems which are efficient, use little water, and produce little carbon. One of the most effective strategies that would provide broad environmental and economic benefits would involve moving towards a future in which energy efficiency and renewable energy production becomes the norm. A transition to energy efficient and renewable power would reduce groundwater and surface water withdrawals, protect cold and warm water fisheries, and lessen the impacts of climate change on human and ecosystem health.

One scenario that combines renewables with increased energy efficiency found that water withdrawals in 2030 and 2050 would be reduced by 17.1 trillion gallons and 6.5 trillion gallons respectively compared with the business as usual scenario.[23] At the regional level, the efficiency and renewable scenario could:

- Give back 9-13 billion gallons a year to farmers in the South Platte basin in Colorado;
- Reduce groundwater withdrawals in the Colorado River basin by a total of 325 billion gallons by 2025 and 2 trillion gallons by 2050; and
- Cool down the Coosa River in Alabama by 3-13 °F in the summer by 2039.[24]

Clearly an efficient, clean energy system would be beneficial for a low carbon and water future.

When it comes to energy use by the water sector, the Quadrennial Energy Review should be informed by a scientific approach such that investments in carbon reduction strategies in the energy sector fully take into account the largest energy uses embedded in the water sector – energy required to supply, transport, and treat water. Pumping water could take a two tiered approach, which will save water and energy – reduce pumping through a focus on local supplies and secure renewable energy sources for pumping. The end goal should be one where exploration, production, storage, transmission and use of energy should have as small an impact on water as possible.

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[21] Department of Energy (DOE). 2006. Energy demands on water resources: Report to congress on the interdependency of energy and water. Washington, DC. Online at http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf.

[22] Feeley, T., J. Murphy, and B. Carney. 2005. DOE/FE's Power Plant Water Management R&D Program Summary. 2005 Department of Energy/Office of Fossil Energy's Power Plant Water Management R&D Program

[23] Macknick, J., S. Sattler, K. Averyt, S. Clemmer, and J. Rogers. 2012. The water implications of generating electricity: Water use across the United States based on different electricity pathways through 2050. Environmental Research Letters 7; doi:10.1088/1748-9326/7/4/045803.

[24] Rogers J, Averyt K, Clemmer S, Davis M, Flores-Lopez F, Frumhoff P, Kenney D, Macknick J, Madden N, Meldrum J, Overpeck J, Sattler S, Spanger-Siegfried E and Yates D 2013 Water-smart Power: Strengthening the U.S. Electricity System in a Warming World (Cambridge, MA: Union of Concerned Scientists) 50 p

At the state level, NRDC is working with the California Public Utilities Commission to better understand the amount of energy that can be saved through efficiencies applied to "embedded energy" in the water sector and efficiencies at the point of use. We encourage DOE to evaluate embedded energy in the water sector at the national level in an effort to reduce energy use.

We also ask that DOE, through the Quadrennial Energy Review process work to resolve some of the key challenges to a low carbon – low water energy system, including:

- ***Carbon capture and storage technology*** used to reduce carbon emissions from fossil-fueled electric generating plants also increases water consumption at coal-fired utilities 40 percent to 90 percent. [25,26] Water is required for the chemical and physical processes used to capture carbon emissions from the burning of fossil fuels[27] and the use of water to produce energy required for the process.[28] Carbon capture technology is being piloted in Kern County, California. The process is expected to use 2.4 billion gallons of groundwater a year and though the water is high in dissolved solids, the Buena Vista Water Storage District hopes to use the water for irrigation of pistachio crops. A dry cooling system could save 90% of the water use, nearly reducing the water-energy conflict.[29]

- ***Concentrated Solar Panel*** systems require nearly twice as much water as coal fired plants. The Congressional Research Service estimated that 50 to 100 large solar power plants could generate 53,000 megawatts of electricity in the Southwest, equal to more than 50 large coal-fired utilities but would require 164 billion gallons of water annually.[30] To address this in an arid state, the Arizona Corporation Commission required a proposed solar plant to utilize dry-cooling technology or treated wastewater in lieu of the 780 million gallons of groundwater that would be required annually.

- ***Unconventional oil and gas development*** uses 5 times as much water as conventional natural gas[31] – which could double or triple with enhanced recovery. In addition to water use, approximately 2.3 billion gallons of wastewater are produced daily from onshore oil and gas production.[32] A lack of systematic energy and water infrastructure planning has led to inefficiencies in water and energy distribution.

Energy development and infrastructure affects water quality

[25] http://www.circleofblue.org/waternews/2010/world/in-era-of-climate-change-and-water-scarcity-meeting-national-energy-demand-confronts-major-impediments/
[26] CRS. 2011. Energy's Water Demand: Trends, Vulnerabilities, and Management. CRS Report R41507
[27] Macknick, J., S. Sattler, K. Averyt, S. Clemmer, and J. Rogers. 2012. The water implications of generating electricity: Water use across the United States based on different electricity pathways through 2050. Environmental Research Letters 7; doi:10.1088/1748-9326/7/4/045803.
[28] Freese, B., S. Clemmer, and A. Nogee. 2008. Coal Power in a Warming World: A Sensible Transition to Cleamer Energy Options. Union of Concerned Scientists. 70 pp.
[29] http://energy.gov/nepa/downloads/eis-0431-draft-environmental-impact-statement
[30]http://www.circleofblue.org/waternews/2013/world/choke-point-u-s-water-energy-and-the-ohio-river-valleys-new-course-2/
[31] Grubert, E. A., F.C.Beach, and M.E.Webber. 2012. Can switching fuels save water? a life cycle quantification of freshwater consumption for texas coal- and natural gas-fired electricity Environ. Res. Lett. 7 045801
[32] BP. 2013. Water in the energy industry: An introduction.

The amount of available water should not only be measured by the total volume of water used, but the resulting volume of clean water. Subpar water quality not only impacts ecosystem health, but reduces access to recreation, affects human health, and increases costs and energy use for the treatment of water for beneficial uses. Thus, the siting and design of energy systems, should take into consideration risks to water quality.
Water quality and quantity are closely linked and any impacts on water use will affect water quality. Similarly, impacts of energy development and infrastructure on surface or groundwater quality will affect those who depend on those sources of water.

- In Montana, brine disposal from conventional oil and gas development has seeped into drinking water sources for the Fort Peck Tribe and a legacy of saltwater spills on farms in North Dakota has rendered land unusable for crop production.
- Acid mine drainage has eliminated life from streams on the East Coast and mountain top removal has buried headwater streams.[33]
- Coal ash, a by-product of coal-fired power plants has leaked from waste sites, polluting millions of gallons of river water with heavy metals.[34]
- Discharge from power plants kills billions of fish annually and overheats downstream waters – the Bayshore coal plant in Ohio killed more than 60 million adult fish and more than 2.5 billion fish eggs and larvae in 2008.[35] On average water from power plants with once-through cooling systems is 17°F that the water in the rivers and lakes around it and in 2008, water from 350 power plants exceeded 90°F – impacts that have led to cases of fish kills. [36]
- Spills have increased by 42% in the past year in the Bakken shale play, adding up to a million gallons of oil and a million gallons of brine. Pipelines and trains transporting crude oil have also been problematic – increasing spill volume within the Bakken and in region's across the country.<Special places>

Given that much of this waste is exempt from environmental regulations, we should take every step to ensure we first reduce the generation of toxic waste. Until we reduce, reuse, and regulate waste, the legacy of conflict between energy and development and water quality will continue.

The best option for any energy development process is one with closed use water use – recycling water to the highest extent scientifically possible. For power plants, Section 316(b) of the Clean Water Act already requires the U.S. EPA to adopt standards for cooling water intake structures based on the "Best Technology Available" for minimizing adverse environmental impacts. [37] The EPA should establish such standards and work with DOE to develop similar standards for other energy systems. Unconventional oil and gas sites can reduce infrastructure

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[33] Environmental Protection Agency (EPA). 2010. EPA issues comprehensive guidance to protect Appalachian communities from harmful environmental impacts of mountain top mining. Online at http://www.epa.gov/ wetlands/guidance/pdf/appalachian_mtntop_mining_press_release.pdf.
[34] http://switchboard.nrdc.org/blogs/bhayat/coal_ash_disaster_in_north_car.html
[35] Agwer,D., D. Marttila, and P. Patrick. 2008. Bay Shore Power Plant Cooling Water Intake Structure Information and I&E Sampling Data. Kinetrics Report, January 2008, Exh. 11.
[36] North Carolina Division of Water Quality (NCDWQ). 2010. Annual report of fish kill events 2010. Raleigh, NC: Department of Environment and Natural Resources. Online at http://portal.ncdenr.org/c/document_library/get_file?uuid=e2a22a36-0283-459cb354-c3e31a9b3a59&groupId=38364.
[37] http://www.nrdc.org/water/power-plant-cooling.asp

needs by reusing water onsite - water recycling has been shown to decrease long term water management costs by as much as 44% in the Eagle Ford play in Texas.[38] Additionally, siting and design should account for the high likelihood for spills and implement stringent best management practices for energy systems and infrastructure which has the potential to affect water resources, both above and belowground.

Full life cycle impacts of energy on water

While DOE has done exceptional work on life cycle analyses, these data have not been broadly incorporated into a systemic, national assessment of water use by each energy sector. As was completed following the development of the Federal Non-Nuclear Research and Development Act of 1974, we ask that DOE, through the Quadrennial Energy Review process, complete a full life cycle analysis of potential energy infrastructure scenarios.

For instance, water is necessary for nearly every component of the hydraulic fracturing process – the mining of sand as a proppant, water for casing, drilling, and fracturing; water for maintenance and refracturing and water that is disposed of in injection wells – never to be seen again; and lastly water for refining.

Ideally, a life cycle approach would evaluate the water intensity of any proposed energy system – including resource development, transmission and distribution, processing, and end use – as has been recommended by the American Petroleum Institute.[39] We encourage an approach that includes cumulative impacts of various energy development scenarios on water and aquatic ecosystems as well as a water intensity analysis of energy systems. We encourage DOE to model the potential energy futures to identify the potential outcomes of these futures on ecosystem and climate resilience and water quantity and quality with a focus on ensuring the local and sustainable use of energy and water. Such an effort would help to identify tangible and intangible risks and benefits of each energy sector by region.

Planning to prioritize sustainable development at the energy and water nexus

As demonstrated above, lack of systematic planning for energy and water infrastructure has exacerbated the impacts of droughts on ecosystems and people. This is the case even in "water-rich" regions of the U.S. Because of the local nature of energy and water siting, design, and operation, planning often does not span beyond a few counties or states. However, at least nine states—Arizona, California, Colorado, Connecticut, Nevada, South Dakota, Washington, West Virginia and Wisconsin—have statutes that recognize the nexus between water and energy.[40] The Department of Energy, in partnership with sister agencies has a role to play in providing the framework for energy and water planning across the country.

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[38] Robart, C. 2012. Water management economics in the development and production of shale resources. International Association of Energy Economics.
[39] American Petroleum Institute in API Guidance Document HF2, First Edition, June 2010, Water Management Associated with Hydraulic Fracturing
[40] http://www.ncsl.org/research/environment-and-natural-resources/overviewofthewaterenergynexusintheus.aspx

The federal government should take a lead role in ensuring water data are reported, standardized and collected in a manner that allows for adequate management across states. While states play a large role in ensuring high quality water withdrawal and use data, gaps in the data exist when using data on a national data – resulting in less than ideal resolution. To adequately understand the water challenges facing us now and in the future, water use and withdrawals should be quantified for construction, to distribution, to refining, and in home or commercial use. Agencies responsible for water data from energy use, such as USGS and EIA should account for gaps in data and under reporting of water use – a problem that has occurred in the past. USGS has attempted to overcome the reporting challenge by providing guidance[41], however the outcomes of this remain to be seen. Additionally, the federal government should take the lead role in collecting use data on water recycling and use of reclaimed water – a process that could provide critical information on water savings by the energy sector.

The DOE should continue to partner with other agencies such as USGS to ensure that sufficient data are available to make decisions at the water-energy nexus. Supporting the Water Census and beyond will be necessary to determine future "water-energy collisions. USGS surface and groundwater monitoring sites are critical for federal, state, and local water and energy decisions, but these stations continues to be shut down – in the process losing the value of decades of data collection. According to a recent report from the Western States Water Council (WSWC) many states do not have a statewide system for tracking consumptive uses or return flows and some water use is self-reported – particularly domestic and agricultural use – thus national estimates are likely inaccurately reported. Additionally a number of states do not track data on thermoelectric power plants such as fuel type or type of water allocated to the plants. As aptly stated by the WSWC, water availability is not constrained merely by water available in rivers, but the legal requirements to send water downstream or provide environmental water to species.[42] DOE and its partner agencies should provide guidance, support, and funding towards a unified water withdrawal, use, and reporting system to reduce water constraints on the energy system.

During the development of any national or interstate framework for energy production, supply, and transmission, DOE should ensure that a water resources plan is concurrently developed. Such a plan should identify potential outcomes of any energy scenario on water quantity, quality, and ecosystem services. Further, any DOE funding should prioritize those energy systems which have the least impact on water resources in the face of rising water demand and climate change.

Conclusion

Without due consideration for existing water stresses and future water stress due to growing populations and climate change, energy prices will rise and water conflicts will become more

[41] http://pubs.er.usgs.gov/publication/sir20135188
[42] Western States Water Council. 2014. Western State Water Program Capabilities Assessment Survey and Report. http://www.westernstateswater.org/wp-content/uploads/2014/06/Western-State-Water-Program-Capabilities-Assessment-Survey-Report-FINAL-June2014.pdf

widespread. Planning now for anticipated energy and water infrastructure and needs can curtail both energy and water use and reduce or eliminate any potential environmental impacts.