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## Policy Memorandum

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**SUBJECT: Water and Energy: All My Nexus Live in Texas**

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**DATE:** 21 October 2015

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### Topic and Purpose

Energy and water use are intimately linked. It takes large amounts of water to generate the electricity and extract the fuel we use in our homes, transportation, and businesses. Treating and transporting water to businesses and residential homes conversely requires a significant amount of energy. This memo details the interrelationship between water and energy in municipal areas, how Texas addresses this water-energy nexus in municipal areas, and presents policies that may adequately address issues in the water-energy nexus. Policymakers can address the water-energy nexus in municipalities by connecting water and energy planning, implement programs that simultaneously reduce energy and water use, and begin to take into account the effects of climate change and water and energy availability during the planning process.

### Background

Water and energy planning occur at all scales in Texas. Water demand estimates and management strategies are developed at municipal and county levels, and aggregated into one of fourteen Regional Water Plans across the state. These plans are then combined by the Texas Water Development Board and presented in the State Water Plan every 5 years.<sup>1,2</sup> In this fashion, water planning for each region is often disconnected from other regions, except for in cases of interregional conflict and/or water transfers. Meanwhile, energy extraction is largely a private sector operation, with municipalities exercising influence through investments and operation of generation projects.<sup>3</sup> Finally, electricity generation and management of distribution occur at the state level, and are managed by the Texas Public Utility Commission (PUC) and the Electricity Reliability Council of Texas (ERCOT). Therefore, while water is currently accounted for in a local and/or regional sense, the state-wide electricity market in Texas does not allow for the same level of planning in the energy sector. These scales can provide insight into some of the challenges in developing an integrated energy and water planning policy for Texas.

Beyond the mismatched scales for water and energy planning, the water-energy nexus is not yet fully understood, though recent research has seen progress in understanding this topic. Specifically, there is a wealth of research examining water withdrawals and consumption in the energy extraction and electricity generation sectors in Texas. Surface water for the electricity sector is primarily used for cooling in fossil-fuel power plants (i.e., coal- and natural gas-fired plants) and nuclear power plants with negligible water use observed for renewable energy sources (i.e., wind and solar PV).<sup>4</sup> At the same time, energy is used in the water sector at almost all stages of operation; these include acquisition of raw water, conveyance to

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<sup>1</sup> "Regional Water Planning in Texas". *Texas Water Development Board*. April, 2015. <http://www.twdb.texas.gov/publications/shells/RegionalWaterPlanning.pdf>

<sup>2</sup> "Water for Texas: 2012 State Water Plan. *Texas Water Development Board*. 2012. [https://www.twdb.texas.gov/publications/state\\_water\\_plan/2012/2012\\_SWP.pdf](https://www.twdb.texas.gov/publications/state_water_plan/2012/2012_SWP.pdf).

<sup>3</sup> "Austin Energy At-A-Glance". *Austin Energy*. (accessed 10/19/2015)

<sup>4</sup> Scanlon, B.R.; Duncan, I.; Reedy, R.C. 2013. *Drought and the water-energy nexus in Texas*. *Env. Res. Let.* (8):045033.

water/wastewater treatment plants and water utility customers, as well as treatment processes within the plants themselves.<sup>5</sup> Additionally, water and wastewater treatment can offset their net energy consumption due to the production of methane and nutrients that results from some treatment processes.<sup>6</sup>

The role of the municipality in planning with respect to the water-energy nexus is multi-faceted. Because Texas operates a deregulated electricity market, most power consumers have the option to purchase electricity from a variety of retail electricity providers (REPs), unless they are located within a regulated area (approximately 15% of the state population).<sup>7</sup> In these deregulated areas, municipalities still own and maintain electricity transmission and distribution infrastructure. Additionally, the municipality can influence energy consumption via building code ordinances and incentive programs. However, the REP is responsible for rate-setting in deregulated areas and must balance rates that are competitive with other providers but also create enough revenues to finance future electricity generation projects. Municipalities in regulated areas (primarily Austin and San Antonio) have the added ability to direct utility investments into electricity generation projects across the state. This flexibility allows these municipalities to exert more influence on the energy mix used to provide electricity to its residents.

Municipalities have more control in water planning and management. Most urban areas own and operate their own water utilities, responsible for procuring, treating, and transporting water supplies to city residents. In rural areas, water is typically provided to customers by one of several types of water districts. Examples include Municipal Utility Districts (MUDs), Special Utility Districts (SUDs), Water Control and Improvement Districts (WCIDs), and River Authorities (RAs).<sup>8</sup> These entities are created by legislative action as granted by the Texas Constitution and approved by the Texas Commission of Environmental Quality (TCEQ), and are all tasked with the mission to provide safe and reliable water supplies for residents located within its boundaries, and can charge customers accordingly.<sup>9</sup> Therefore, local governance of water use is more feasible than that of electricity consumption.

## **Issues and Assessment of Current Policy**

Though consideration of the water-energy nexus has benefits at all levels of water and energy policy in Texas, this memo will focus on the role of municipalities. As mentioned previously, municipalities inhabit a unique space that can influence both local management of water resources and statewide management of energy resources and electricity generation. For this reason, there are unique policy issues that must be addressed for more effective planning, particularly in the water sector.

### ***Issue 1 - Disconnected energy and water planning in Texas at all levels***

The disconnect between water and energy planning in Texas is partly due to the difference in planning scales and the power of the municipality for each resource. Because electricity generation and corresponding consumption does not always occur within the same area, it is difficult for municipalities to also consider the implications on water resources that result from electricity consumption. Similarly,

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<sup>5</sup> Stillwell, A.S.; King, C.W.; Webber, M.E.; Duncan, I.J.; Hardberger, A. 2009. *Energy-Water Nexus in Texas*. The University of Texas at Austin and Environmental Defense Fund.

<sup>6</sup> King, C.W.; Stilwell, A.S.; Twomey, K.M.; Webber, M.E. 2010. *Coherence Between Water and Energy Policies*. ENV/EPOC/GSP(2010)21.

<sup>7</sup> "Texas Electricity Rates - Make Your Own Choice". *SaveOnEnergy*. accessed October 17, 2015..

<sup>8</sup> "Texas Water Districts: A General Guide". 2004. *Texas Commission on Environmental Quality*.

<sup>9</sup> "Invisible Government: Special Purpose Districts in Texas". 2008. *Texas Senate Research Center*. <http://www.senate.state.tx.us/SRC/pdf/SL-SpPurposeDistricts.pdf>

energy used for water sector operations within a municipality or water district is often sourced from multiple generation plants, depending on the spot market price of electricity at any one time. Municipalities often instead focus efforts on conservation within their borders.<sup>10, 11, 12, 13</sup> To date, there are no instances of simultaneous energy and water planning by the relevant entities in Texas.

While municipalities and water districts are tasked to provide clean reliable water supplies to their service areas, little attention is given to the energy requirements of these operations. However, when planning for future resources, water providers have the responsibility to recognize any current action that can be taken to secure these resources. Alternatively, municipalities that provide electricity in regulated areas must consider the impact of future water scarcity on their ability to purchase reliable power from the spot market.

### ***Issue 2 - Energy use has decoupled (somewhat) from growth but water use has not***

Following national trends, Texas has decreased its per capita energy consumption by approximately 20% between 2000 and 2011.<sup>14</sup> Similarly, energy consumption per dollar of gross state product has decreased by more than 50% between 2000 and 2011.<sup>15</sup> Unfortunately, this trend has not occurred for water use within the state for the same time period, although annual fluctuations range from -15% to +4%.<sup>16</sup> While there is no single reason for this trend, droughts during this time period have likely influenced statewide water usage, especially due to increased residential outdoor water use. Coherence between energy and water policies in Texas can help resolve this apparent gap in per capita resource use. Specifically, net-zero development goals can promote cross-linked reductions in resource use by motivating simultaneous conservation of water and energy as well as identifying successful energy conservation policies that can be recreated in the water sector.<sup>17</sup>

### ***Issue 3 - Climate change impacts increase uncertainty in water and energy consumption***

The absence of climate change impacts in water and energy planning in Texas is a glaring issue that requires future attention. Climate change is expected to exacerbate extreme weather events in Texas and increase water scarcity, which in turn will generate a rise in conflicts over water resources.<sup>18</sup> While some adaptive management measures are included in local planning circles, statewide recognition of the threat of climate change remains an elusive goal.

Municipalities in Texas will need to develop robust strategies to secure water and energy supplies in the future, and increasing resilience to shocks in water availability and local climate will help ensure that the

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<sup>10</sup> "PowerSaver Program". *Austin Energy*. accessed October 14, 2015.

<sup>11</sup> "Water Conservation - Rebates". *Austin Water*. accessed October 14, 2015.

<sup>12</sup> "Conservation". *San Antonio Water System*. accessed October 14, 2015.

<sup>13</sup> "New Throne for Your Home Toilet Replacement Program". *Dallas Water Utility*. accessed October 14, 2015.

<sup>14</sup> "Texas Energy Consumption". *U.S. Energy Information Administration*.

<http://apps1.eere.energy.gov/states/consumption.cfm/state=TX> accessed October 15, 2015.

<sup>15</sup> U.S. Energy Information Administration. accessed October 15, 2015.

<sup>16</sup> "Annual Statewide Water Use". 2015. *Texas Water Development Board*.

[http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/data/TexasStatewideReport\\_6\\_12\\_15\\_Revision.pdf](http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/data/TexasStatewideReport_6_12_15_Revision.pdf)

<sup>17</sup> Dickinson, M.A. 2015. *No Water, No Growth: Are Water Neutral Growth Policies the Key to Building Sustainable Communities?*. Alliance for Water Efficiency.

<sup>18</sup> Henry, T. 2014. "More Drought, Heat and Water Wars: What Climate Change Already Means for Texas". *State Impact - National Public Radio*. <https://stateimpact.npr.org/texas/2014/05/06/more-drought-heat-and-water-wars-what-climate-change-already-means-for-texas/> accessed 10 October, 2015.

future impacts of climate change will not affect Texas' ability to operate and accommodate anticipated population growth.

### **Relevant Stakeholders and Key Influencers**

The patchwork of regulatory actors and relevant stakeholders pertaining to the water-energy nexus gives some insight into the nature of the disconnect planning mention in this memo. Water resource permits and quality regulations are administered by the TCEQ and water planning is managed by the Texas Water Development Board (TWDB). These authorities coordinate with regional planning groups, municipalities, water districts, and individual stakeholders to develop new water supplies and manage existing water treatment and transport infrastructure.<sup>19</sup> Further, surface and groundwater rights in Texas are not managed by the same authority, due to public ownership of surface water supplies (governed by the *prior appropriation doctrine*) and mostly private ownership of groundwater resources (governed by the *rule of capture doctrine*). Finally, groundwater conservation districts (GCDs) and groundwater management areas (GMAs) are entities created by the state legislature to manage groundwater resources in a manner that protects the desired future conditions of groundwater in Texas. Finally, municipalities and water districts work to secure water supplies for their service areas, while adhering to water management rules enforced by the previously mentioned entities.

Electricity generation is monitored and managed by the PUC and ERCOT. These entities work with municipalities in regulated areas and retail electricity providers to ensure sufficient electricity is generated for customers, statewide. Additionally, the Railroad Commission of Texas (RRC) manages and regulates energy extraction activities through the state.<sup>20</sup> Municipalities must interact with agencies in each of these sectors (water provision, electricity generation, and energy resource extraction) in the municipality, which provides a unique opportunity to influence water-energy nexus consideration by agency heads and planners.

### **Assessment of Current Public Discussion**

Because conservation of energy directly contributes to conservation of water, and vice versa, much of the discussion on the water-energy nexus in cities concerns simultaneous conservation of energy and water. This has meant looking at the supply--namely municipal energy and water utilities--as well as demand from residents. Residents have been encouraged by the government to consider xeriscaping as a way to cut down on both water and energy use.<sup>21</sup> Tools are available from organizations like Pecan Street Inc. to provide homeowners information about how much water they use.<sup>22</sup> Water monitoring tools made available from organizations like Pecan Street allow municipal water users to learn how they can smartly conserve water.<sup>23</sup> Power plants are regulated in such a way to ensure that their water use does not harm the surrounding ecosystem.<sup>24</sup>

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<sup>19</sup> Arechiga, J.; Mullican III, W.F.; Norvell, S.D.; Phillippi, B. 2014. "Energy-Water Nexus". The Essentials of Texas Water Resources. (3)34:21-28.

<sup>20</sup> Arechiga, J., et al. 2014

<sup>21</sup> "Landscaping Water Conservation," *United States Department of Energy*, accessed October 2, 2015, <http://energy.gov/energysaver/landscaping-water-conservation>.

<sup>22</sup> McCracken, B. Panel Presentation. "The Water-Energy Nexus." October 7, 2015.

<sup>23</sup> McCracken, B. Panel Presentation. "The Water-Energy Nexus." October 7, 2015.

<sup>24</sup> Cook, M. Panel Presentation. "The Water-Energy Nexus." October 7, 2015.

At the federal level, the Environmental Protection Agency is moving forward with the Clean Power Plan.<sup>25</sup> The Clean Power Plan will require power plants to significantly reduce carbon emissions. This plan, according to a representative of the Environmental Defense Fund, has the potential to be one of the most significant policy changes to address the water-energy nexus.<sup>26</sup> The Plan will reduce energy produced in carbon emitting power plants, which will reduce the amount of water used in producing energy.<sup>27</sup> If the Clean Power Plan goes into effect, Texas will create a new regulatory regime that will conserve both water and energy.

### **Assessment: Current Policy not Ideal**

There is progress is being made in Texas on addressing the water-energy nexus in municipalities. However, the issue of “silo-ing”, the tendency of agencies to work independently of each other without conference or cohesion of policy objectives, is still a challenge for of energy and water entities. The Texas Commission on Environmental Quality (the commission that primarily oversees the regulation of water resources in the state) and the Public Utilities Commission of Texas (which oversees power plant regulation) do not generally jointly plan future water and energy use, despite the fact that water and energy are so interconnected.<sup>28</sup> Municipal water and energy utilities also do not generally work together to plan for future water and energy use. If regulators and providers at the state and local level are not working together on this issue, planning for future energy and water use is disjointed and will not reflect the reality of the water-energy nexus in municipalities. The state of Texas also does not take into account how climate change will affect energy and water resources.<sup>29</sup>

### **Possible Policy Alternatives**

#### **1. Joint planning of water and energy resources**

The most pressing problem facing Texas with regards to the water-energy nexus is the disconnect in planning between water and energy. Energy planning that does not take into account the water necessary to produce energy and water planning that does not take into account the amount of energy needed to provide water to homes and businesses will almost surely create energy and water problems.

The Texas legislature and Governor can take steps that require PUC, the TWDB, and TCEQ to jointly plan future water and energy use. The TWDB state water plan does acknowledge that certain strategies of water development, such as desalination, do require significant amounts of energy.<sup>30</sup> Future water plans could go into greater depth into how much energy will be necessary to meet municipal water demands. Another example of joint planning of water and energy use is Texas Senate Bill 991, passed in the 2015 session of the Texas Legislature.<sup>31</sup> This bill will require the

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<sup>25</sup> “Clean Power Plan for Existing Plants,” United States Government, *United States Environmental Protection Agency*, (October 16, 2015), <http://www2.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants>.

<sup>26</sup>Zerrenner, K. Panel Presentation. “The Water-Energy Nexus.” October 7, 2015.

<sup>27</sup> Zerrenner, K. Panel Presentation. “The Water-Energy Nexus.” October 7, 2015.

<sup>28</sup>Zerrenner, K. Panel Presentation. “The Water-Energy Nexus.” October 7, 2015.

<sup>29</sup> Sajita, N. “Texas Scientists Bothered by Climate Change-Denying Politicians.” *Governing: The States and Localities*. July 14, 2014. <http://www.governing.com/news/headlines/gov-texas-scientists-bothered-by-climate-deniers.html>. Accessed 17 October 2015.

<sup>30</sup>“Water for Texas: 2012 State Water Plan,” *Texas Water Development Board*. 2012.

<sup>31</sup> State of Texas, “SB991,” *Texas Legislature Online*, June 16, 2015, <http://www.capitol.state.tx.us/BillLookup/history.aspx?LegSess=84R&Bill=SB991>.

General Land Office to conduct a study of utilizing wind or solar energy in the desalination of brackish groundwater.<sup>32</sup>

Similarly, local governments can begin requiring that energy and water utilities work together to jointly plan water and energy use. Ending “silo-ing” of water and energy agencies and acknowledging the water-energy nexus in planning energy and water use could go a long way in addressing the water-energy nexus in Texas municipalities. For example, the Austin Water Utility currently maintains a water planning task force dedicated to evaluating the city’s water needs and making recommendations regarding future water planning. This entity is an ideal vehicle to begin incorporating energy considerations into water planning and would benefit from representation of energy interests, as well as other stakeholders not typically represented in water planning, on the task force.

## **2. Employ jointly sponsored programs to achieve simultaneous reductions of water and energy use.**

Methods to integrate water and energy conservation programs could include allowing the use of energy utility funding for water conservation programs and vice versa. Energy use in the residential water sector has been estimated to occur primarily at the point of water end-use i.e., in the home or business), largely due to water heating.<sup>33</sup> However, incentives for water end-use efficiency are typically provided by the water utility or district, despite simultaneous benefits to energy consumption. In California, the Public Utilities Commission has recently approved the use of software tools by energy utilities to evaluate the impacts of water efficiency technology adoption on energy used in the water sector.<sup>34</sup> This type of program allows energy utilities to account for the water-energy nexus at the point of end-use, and signals the merging of water and energy utility operations.

Additionally, energy utilities and retail electricity providers alike should fund research and pilot projects to generate energy from water and wastewater treatment plant operations. Though this practice exists for some large water utilities,<sup>35</sup> smaller water and wastewater treatment plants are not likely to have the funding required to initiate these programs. This is especially of concern, given that the majority of water and wastewater treatment plants in the US are considered “small systems”.<sup>36</sup> Therefore, local electricity providers could play the role of a funding source, to promote cohesive planning between the two entities.

## **3. Lobby for state water and energy planning that are robust to climate change impacts and uncertainties.**

Currently, the state of Texas does not plan for the effects of climate change.<sup>37</sup> The state should begin the process of planning for how climate change will affect water and energy consumption. The state and municipalities can begin promoting investments in renewable resources that reduce the reliance

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<sup>32</sup> State of Texas, “SB991.”

<sup>33</sup> Kenway, S. 2012. *The Water-Energy Nexus and Urban Metabolism - Connections in Cities*. Urban Water Security Research Alliance. Technical Report No. 100.

<sup>34</sup> Osann, Ed. “Counting Kilowatts by the Gallon”. 2015. *Switchboard: A Natural Resources Defense Council Staff Blog*. accessed 04 October, 2015.

<sup>35</sup> “Center for Environmental Research”. *Austin Water*. accessed 20 October, 2015.

<sup>36</sup> Mo, W.; Zhang, Q. 2013. *Energy-nutrient-water nexus: Integrated resource recovery in municipal wastewater plants*. *J. Env. Mgmt.* (127): 255-267.

<sup>37</sup> Satija, N. “Texas Scientists Bothered by Climate Change-Denying Politicians,” *Governing: The States and Localities*, July 14, 2014.

electricity sources that are water intensive, as water intensive sources of electricity also tend to put the most carbon into the atmosphere.<sup>38</sup> Texas SB 991 is a good first step toward addressing this issue. As climate change makes traditional infrastructure intensive water sources less feasible (i.e. reservoir water evaporating at a faster rate), alternative water sources like rainwater capture and gray-water recycling can be studied and used. However, some alternative sources, like rainwater capture, can be more energy intensive than traditional water provisions, partially due to efficiency benefits in the water sector from the scale of centralized treatment and distribution systems and oversizing of pumps in decentralized rainwater harvesting systems.<sup>39</sup>

## **Conclusions**

As the population of Texas continues to grow, consumption of water and energy in municipalities will continue to increase. Increased demand is exacerbated by the interconnectedness of water and energy. It is critical that policymakers at the state and local level begin to address the water-energy nexus. Specific issues to be addressed are the disconnected planning between energy and water resource, mirroring the decoupling of energy consumption and population growth in the water sector, and lack of consideration of climate change impacts in the planning process. Unfortunately, the “silo-ed” regulatory framework for water and energy planners only leads to further disconnect. Therefore, the role played by the municipality offers an opportunity to promote cross-linked energy and water policies. Planning for water and energy should be done in tandem. Programs that simultaneously reduce energy and water should be employed. Climate change and its affect on water and energy needs to be addressed. We are confident policymakers have the tools to begin to take on the water-energy nexus in Texas.

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<sup>38</sup> Cook, M. Panel Presentation. “The Water-Energy Nexus.” October 7, 2015.

<sup>39</sup> Vieira, A.S.; Beal, C.D.; Ghisi, E.; Stewart, R.A. 2014. “Energy intensity of rainwater harvesting systems: a review”. *RENEW SUST ENERG REV.* 34: 225-242.