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Does Thinking About Water as a Commodity Advance Global Water Security?

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**Note*: These remarks are exclusively my personal opinions and assessments and do not reflect any official positions of Rice University or the Baker Institute for Public Policy*

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Words matter. They influence the way we think—and water issues are no exception to this cognitive reality.

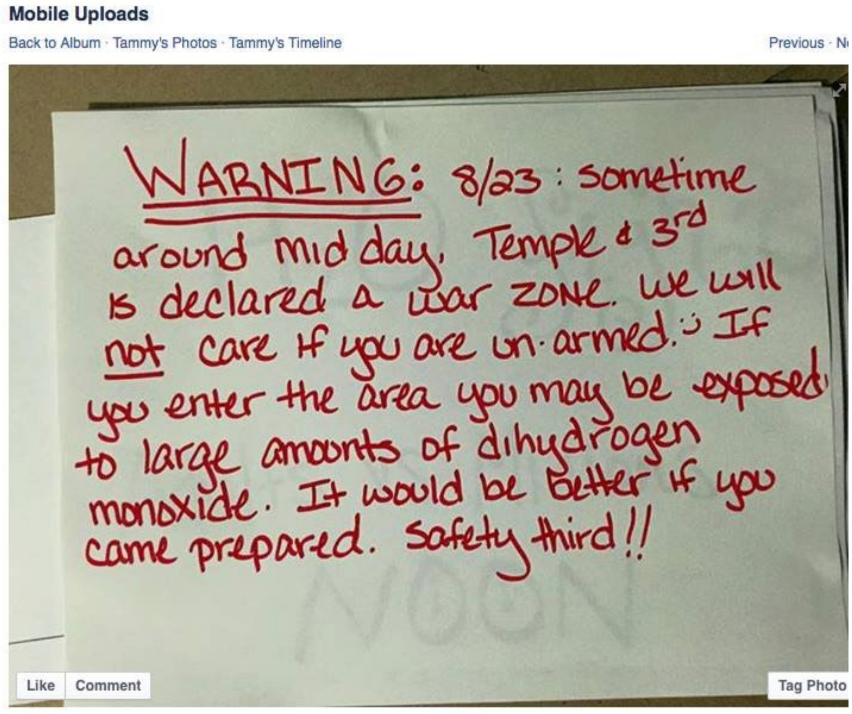
Consider how you might react if you encountered the following message posted on a street sign in your neighborhood:

> *"Sometime around midday, Temple & 3rd is declared a war zone. We will not care if you are unarmed. 😊 If you enter the area you may be exposed to large amounts of dihydrogen monoxide. It would be better if you came prepared. Safety third!!"*

Would you call the police? If yes, turns out you're not alone. Someone in Long Beach, California *did* indeed call law enforcement after a local woman posted this sign prior to a 2015 neighborhood water fight that was apparently a local tradition.[i]

For reader entertainment, I've included a screen shot of the offending signage from the *Long Beach Post* article describing the incident.

Exhibit 1: Words Matter When You're Talking About Water



Source: Long Beach Post

The smiley face might clue you in to the fact that this isn't what it might seem. But even if your sense of humor is malfunctioning, you can still dissect the molecular structure of "dihydrogen monoxide" and realize it's nothing more than H2O.

Words profoundly shape emotive reactions that can overwhelm our rational brains. Water sounds innocent, but dihydrogen monoxide sounds instinctually ominous. Similarly, using the words "water" and "commodity" in the same sentence can also be a trigger event, depending on whose company you're in at the time.

In some camps, the word "commodity" evokes an ugly "Blood Diamond"-type image of despoilation and exploitation. Viewed through that prism, "commodity" can be tossed into the bin of other "C-words" that are best not used in public, if at all.

Water's life-essential character magnifies these unfavorable impressions. We can live several weeks without food, but only a few misery-wracked days without water.

Water embodies many contradictions—it is necessary for life, but can also destroy and kill. It is spatially distributed in ways that often don't necessarily conform to how and where we want to farm, live, fish, boat, etc. And—at least here in Texas—some incarnations of water can be private property but still retain many characteristics of a public good.

Few—if any—other basic materials are as complex. Water forces us to think at a moral level that copper, corn, oil, and soybeans usually do not. And when those other commodities do force us to confront philosophical issues—such as deforestation in Brazil's cerrado—water is often directly or implicitly one of the core motivations for our concern.

So is water a "commodity" after all? Let's consult the Merriam-Webster Dictionary and see how some of water's characteristics do—and perhaps don't—align with the traditional definition of a "commodity."

According to Merriam, a commodity can be "an economic good" (for instance, one derived from a farm or mine), "something useful or valued," "a good or service whose wide availability typically leads to smaller profit margins and diminishes the importance of factors (such as brand name) other than price," and an item "that is subject to ready exchange or exploitation within a market."[ii]

Water Resembles a "Traditional" Commodity…

On the definitional checklist laid out above, water meets several of the criteria.

It is an economic good. It is useful. It is valued—although often not as fully as it should be.

Wide availability can certainly diminish the importance of factors other than price—especially externalities and long-term sustainability of how we utilize the resource. Better use of price signals can help us more effectively manage these challenges, a topic we'll address shortly.

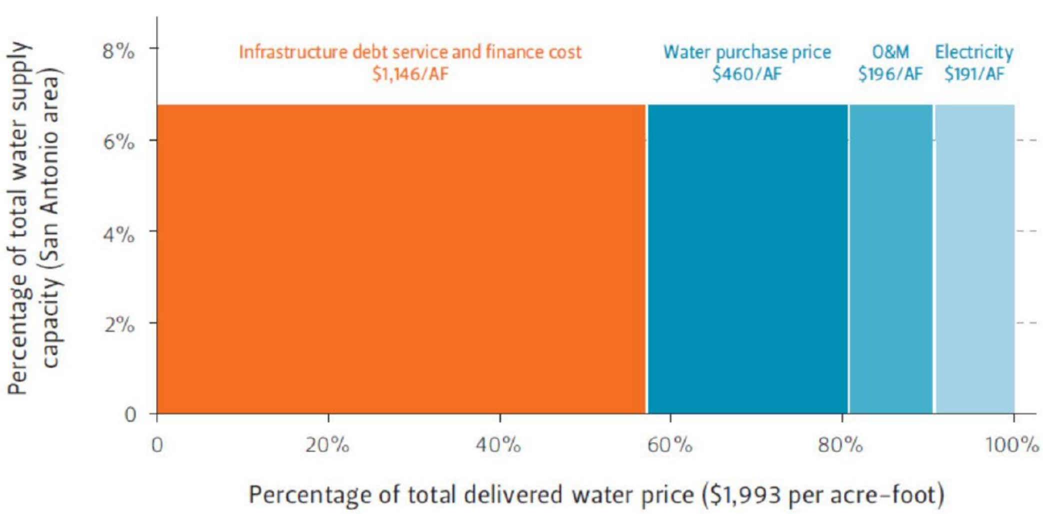
…But Water Is Also Different in Important Ways

Water's stable molecular structure pushes back hard against the forces of entropy. When we refine crude oil into gasoline and diesel fuel, the conversion is irreversible. Likewise when we eat corn or rice and convert it to glucose and then water and CO2.

But not water itself. It functions variously as a solvent, catalyst, coolant, etc., but its molecular structure almost never changes during use (unless we electrolyze it to produce hydrogen). Rather, it acquires contaminants. And if we apply enough energy to treat it, no matter how contaminated it becomes, it can be made usable or potable again. For an extreme example, consider the International Space Station, where astronauts' drinking water incorporates recycled urine![iii] Likewise for cooling water from the melted down nuclear reactor core at the Fukushima site in Japan, which is being purified to a point that Japanese officials are likely to discharge it into the ocean.[iv]

Water is also often not "subject to ready exchange or exploitation within a market" because it is heavy and costly to transport. For most commodities, transport and logistics costs are a small fraction of the overall market price. For instance, moving crude oil from the Permian Basin oilfields to Gulf Coast refineries and export terminals generally costs 5-8% of the oil's prevailing market price.[v] Moving soybeans roughly 1,400 miles across challenging roads in Brazil to seaports for sale abroad can cost 33% of the beans' market price.[vi] Water delivered to San Antonio through the 142-mile Vista Ridge Pipeline incurs transportation-related costs that are approximately 300% of the price actually paid to the water producer.[vii]

Exhibit 2: Transportation Drives Delivered Cost of Vista Ridge Water to San Antonio



Source: San Antonio Water Services, Baker Institute for Public Policy

These logistical hurdles have shaped human civilizations for millennia. They are why ancient Egyptian civilization arose along the Nile's banks (and why even today, most of the population in Egypt and also Sudan lives within a few miles of the river). Indeed, even in the modern era of prolific energy supplies, deep tubewells, and powerful pumps, farmers still seek to locate themselves atop the groundwater they use or next to the river that fills their canals.

To let you in on an imagery analysis shortcut, anyone seeking to find the most prolific groundwater in an arid place just needs to train their computer vision algorithms to looks for center pivot crop circles.

But locating cities is a more complex process than choosing where to establish farms—and water challenges increasingly arise as our recent technological progress bumps up against longstanding hydrological realities. Through most of sedentary human history, we tended to construct settlements in places in places with sufficient water to sustain ourselves. Navigable rivers' facilitation of trade and transport provided additional incentives to choose such spots—think St. Louis, Pittsburgh, Budapest, Khartoum, Wuhan, and innumerable other cities around the word.

But patterns of growth in some parts of the world—including Texas and most of America west of the Mississippi River—increasingly defy the limits traditionally imposed by the need for nearby water. Now we have long-distance water conveyance schemes that in some cases move water hundreds of miles to support thirsty metros that have in many cases grown into demographic and economic hubs the size of small-to-medium countries.

For example, the Phoenix Metropolitan Statistical generates about the same nominal economic output as Romania or Vietnam.[viii] The Austin and San Antonio MSAs generate a nominal GDP roughly equivalent to Chile—itself an OECD member country.[ix] Once such oases emerge, the water supply arteries that sustain them become critical infrastructure.

Water is also an unusual commodity because we only price it at certain points in the hydrological cycle. And even then, the price often only partially reflects the true value. Imagine if oil and the products such as gasoline that it yields were only priced according to the cost of production and delivery. How would our vehicles and use patterns look if gasoline only cost $0.25 per gallon?

It's not a perfect analogy to how we value water molecules at various stages of the cycle—underground, at the wellhead, delivered to a field, factory, or city, or as water vapor waiting to be precipitated from the sky and into a lake—but it's close enough to highlight water's difference from "typical" commodities.

How Putting a More Accurate Price Tag on Water Can Incentivize Conservation and Optimize Investment

Water thought in many of these areas has traditionally focused primarily on delivering *supply* of water. And that neglects the vital *demand* side of the equation. Treating water as a priceable commodity can help cut through this Gordian knot—to the benefit of consumers and the environment. Rationing consumption through changes in price is an old idea, but in the water space usually isn't seriously considered until there is a crisis.

Let me share an example of how a boomtown in the desert used the price mechanism to address an acute water supply crisis. I use Midland, Texas (my birth city) for three core reasons.

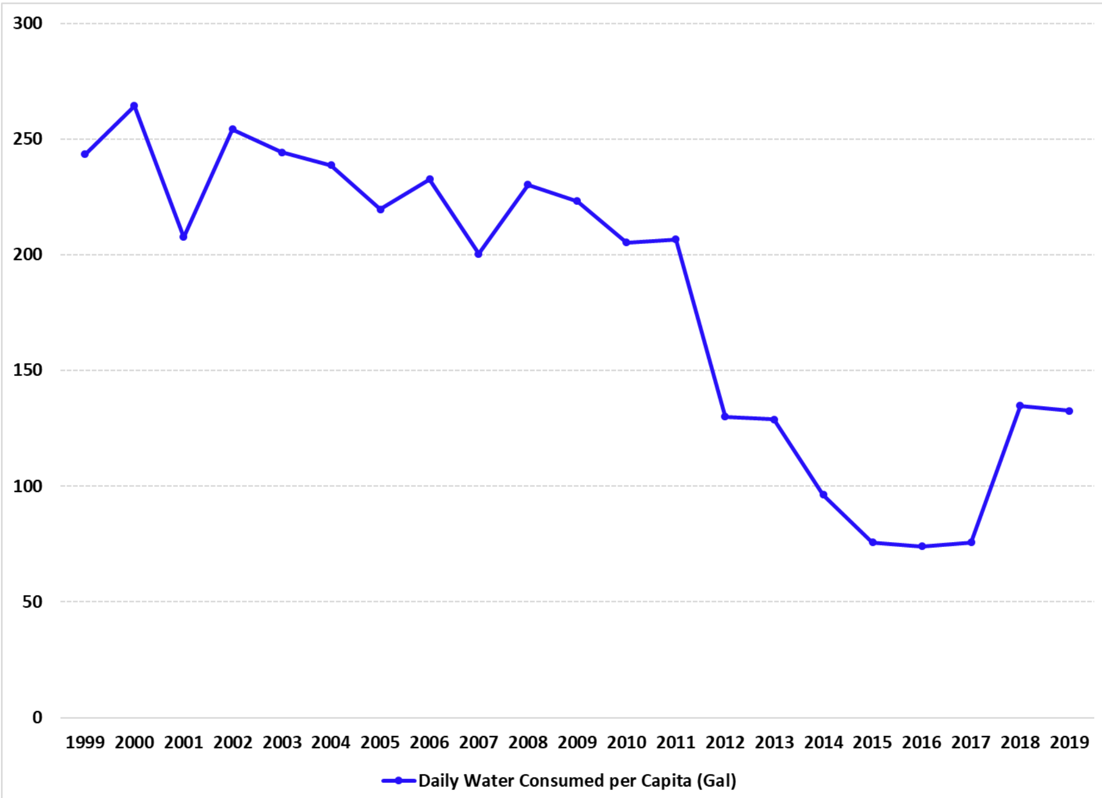
First, it is a city that has historically been strongly oriented toward free market, minimal government solutions. Second, it exists in a dry climate where precipitation varies substantially year-to-year. Third, it has experienced tremendous population growth over the past 15 years as the unconventional oil & gas revolution took off in the Permian Basin.

To make a long story short, the City faced a water supply crisis after the 2011 drought and in the spring of 2012, essentially quintupled the price of water for customers using more than 10,000 gallons per month.[x] As a City of Midland Spokeswoman explained a few years later:

> "*Water was becoming more costly on our end, and we enacted outdoor watering restrictions. But people didn't really listen to that. We even set up a hotline where people could call in to report each other and that still wasn't really doing the trick*." [But once the city imposed dramatically higher rates on heavy water users in 2012] "*then we just saw it drop*".[xi] [explanation added]

Exhibit 3: Midland, Texas Daily Water Consumption (Gallons Per Day)

Note: Population is for Calendar Years (Jan-Dec) and Water Volumes For Fiscal Years (Oct-Sep)

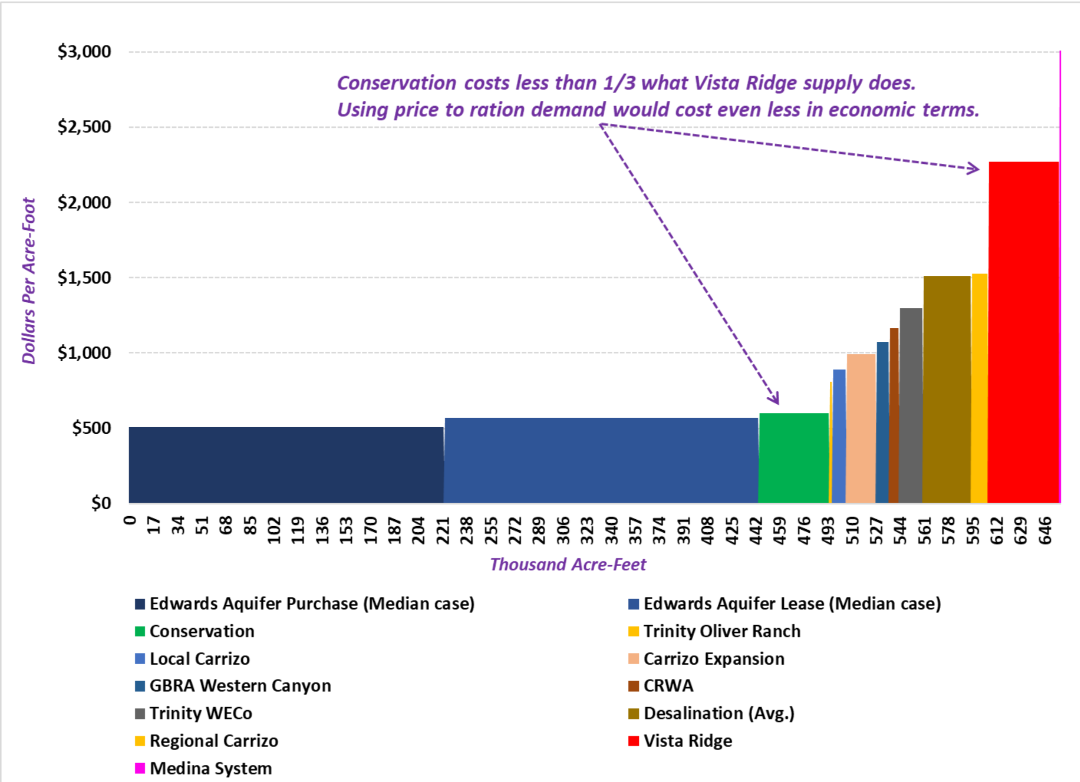


Source: City of Midland, Author's Analysis

If pricing water can engender such rapid, deep, and durable shifts among water users in West Texas where "hands off" is a staple of governance, the potential is clear for other parts of the world as well.

Here it bears noting that water usage itself is multidimensional, with increased prices not only reducing lawn watering and other less life-essential uses of water, but also easing burdens on downstream sewage treatment facilities. Using price to ration demand can also defer a consuming entity's moves toward the highest cost water supply source (**Exhibit 4**).

Exhibit 4: Water Supply Cost Curve for San Antonio, Texas



Source: San Antonio Water Services, Texas Water Development Board, Author's Analysis

<u>Key Questions for the Next 10 Years</u>:

1. **Water & Infrastructure: Does more fully pricing water enable large-scale infrastructure, or potentially, take certain places down different paths?** The biggest geographic and political impact points for water will very likely be the same ones we encounter when confronting other energy and environment challenges (which are often intertwined with water issues)—urban areas that in some cases may be adding tens, if not hundreds of thousands of new residents per year.

   These growth points offer a tremendous source of challenge and opportunity. Will these be met with more centralized, water grid solutions, or does a fuller financial accounting potentially instead inspire distributed solutions tailored at the district or neighborhood level?

I'll give you a little food for thought to illustrate how different water supply and demand challenges are in the OECD countries versus much of the non-OECD world—which is where the growth is occurring now and could continue for decades to come, especially in Sub-Saharan Africa.

Urbanized populations use far less "direct" water per capita than their rural cousins, but the supply is often much more infrastructure-intensive and cannot be interrupted. Farm fields can be fallowed during the worst droughts, but cities and factories cannot. Efficient U.S. cities (Austin, TX, for example) have per capita average water consumption rates of around 500 liters per day—two to four times higher than middle and wealthy consumers in Kenya, for instance.

The gap suggests the latent potential for further water demand growth in the non-OECD world and the resultant policy challenges are very much there and alive. The interaction between water pricing and a diverse range of urban metabolisms is going to be critically important.

2. **Water & Climate: How might we choose to price externalities—particularly emissions—into what we pay for water in various parts of the world?** Extracting groundwater and conveying water of any stripe over long distances is a very energy-intensive activity and carbon taxes, among other proposed measures, will also likely bite along the water supply chain.

   Consider the following—obtaining 10 million liters of irrigation water (a season's worth for 1 hectare of irrigated corn in a dry climate) can require 880 kWh of energy.[xii] Pumping that same quantity from a 100-meter deep tubewell can increase the energy need to 28,500 kWh.[xiii]

   In arid locations with heavy agricultural activity, water extraction can become a dominant driver of energy use. A 2005 study from India suggests that agricultural water pumping—primarily from tube wells—could have accounted for nearly one-third of India's total power consumption at the time of the study.[xiv] The story of energy-water interaction remains to be written in many other parts of the non-OECD world—especially Sub-

Saharan Africa—but the case of India and Iran illustrate that greater agricultural and municipal call on water supplies and most pointedly, groundwater, can strain local energy systems.[xv]

The energy-water nexus is not an abstract economic concept. Empirical investigation shows that energy poverty can kill by denying people clean water. A sample of more than 200 countries and territories analyzed by the author reveals a strong negative relationship between access to electricity and mortality from waterborne illnesses.

We also need to think about excessive phosphate and nitrate emissions through fertilizer usage, as well as plastic pollution and the effects each of these have on water supplies in various parts of the world.

3. **Water & Equity: How should societies price water when as currently done, water costs are often highly regressive relative to income? What are practical, sustainable, and politically acceptable ways to price a life-critical good, especially in societies with often extreme economic inequality?**

One of the core themes of 21st century water governance around the world is likely center on a question with profound implications for billions of people and trillions of dollars per year in economic activity: what happens when the interplay of supply and demand yields a "market price" for water that exceeds a substantial portion of the population's ability to pay?

If a family can't afford gasoline in a given month because money is short, there is an economic stunting that occurs and it detracts from their overall wellbeing. But gasoline is not existential for survival in a way that economic impediments to water access can be.

Coming back to the energy, water, and health chart shown in Slide 10 of the accompanying presentation, we see how lethal lack of access to clean water can be. We thus cannot afford to be passive. But we also cannot be purists and insist that water is "above being priced."

Commodification can ultimately invite a higher degree of standardization, quality control, visibility into consumption trends, and internalization of environmental externalities. This in turn can weld together governance frameworks that help aggregate diverse private interests and overcome the collective action problems that afflict water provision and takeaway—especially in developing countries. The process is rough, its imperfect, but it all starts with putting a price tag on the precious H2O molecule.

Water security invokes a range of environmental, hydrological, infrastructural, behavioral, and economic dimensions. Welding these together into cohesive and actionable governance systems is fiendishly difficult. The process of overcoming collective action problems in the water space is difficult and imperfect.

The pursuit of improved water security is the ultimate "beta" product that will need to be continually improved and updated in real time and amidst often trying circumstances.

I look forward to working alongside all of you for years to come as each of us does our part to make the world a more water-secure place—thank you for your time and attention today!

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[iii] "Astronauts Drink Recycled Urine, and Celebrate," Space.com, 20 May 2009, https://www.space.com/6733-astronauts-drink-recycled-urine-celebrate.html

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[v] Gabriel Collins, "Economic Valuation of Groundwater in Texas," Presentation to Texas Water Research Network, 14 September 2018, Austin, TX, https://www.bakerinstitute.org/files/13532/

[vi] Ibid.

[vii] Gabriel Collins, "Economic valuation of groundwater in Texas," Texas Water Journal

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[ix] U.S. Bureau of Economic Analysis, Total Gross Domestic Product for Austin-Round Rock, TX (MSA) [NGMP12420], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/NGMP12420, October 29, 2020; U.S. Bureau of Economic Analysis, Total Gross Domestic Product for San Antonio-New Braunfels, TX (MSA) [NGMP41700], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/NGMP41700, October 30, 2020.

[x] Kate Galbraith, "In Era of Drought, Texas Cities Boost Water Rates," The Texas Tribune, 8 June 2012, https://www.texastribune.org/2012/06/08/drought-and-rate-hikes-show-texans-value-water/

[xi] Brandon Mulder, "Midlanders reduce daily water use, still fall behind pack in state," Midland Reporter Telegram, 12 April 2015, https://www.mrt.com/news/article/Midlanders-reduce-daily-water-use-still-fall-7404847.php

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[xiii] Ibid.

[xiv] Ibid., citing M.D. Kumar, "Impact of electricity prices and volumetric water allocation on energy and

groundwater demand management: analysis from Western India," Energy Policy 33, 1 (2005): 39–51.

[xv] Collins, Gabriel. "Iran's Looming Water Bankruptcy." (2017) James A. Baker III Institute for Public Policy of Rice University: https://www.bakerinstitute.org/research/irans-looming-water-bankruptcy/