

SUSTAINABILITY INVESTMENT REPORT

MAY 2016

# U.S. WATER AND WASTEWATER

## Opportunities and Challenges in Western States



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# U.S. Water and Wastewater Opportunities and Challenges in Western States

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## Introduction and Conclusions

Water volatility, scarcity and quality issues are driving the need for major investments in a number of water and wastewater market segments in the United States. Prolonged droughts in Western states have heightened awareness of the severity of the problem and the need for change.

Many institutional investors and funds are searching for ways to enter or expand their exposure to water and wastewater markets. Finding sources of private capital is not the issue. The biggest challenge is building a portfolio of repeatable and scalable projects, especially with the right time frame and risk profile.

There is no substitute for water. Because water is essential for human survival, food and agriculture, energy generation, environmental resources and many water-intensive industries, there are water and wastewater management regulations at the federal, state and local level. In the United States, these rules vary from state to state, and sometimes from water district to water district. Understanding the relevant water laws and regulations is critical before working to develop a replicable and scalable investment strategy.

Water and wastewater infrastructure investments also require strong alliances between financing partners and experienced co-developers with excellent track records and connections at the state and local level. From irrigation districts to municipalities to companies wanting to improve their infrastructure, managers are looking for partners who they know and trust. Design-build-operate (DBO) firms must have strong regulatory, technical and operational experience in general, as well as in specific states. And if they are open to private investments and sharing control of their assets, the managers want to partner with seasoned financing firms who are committed to their projects' long-term success. These must be win-win deals for all of the participants.

Water investments require long-term capital. Not only does it take time to structure the deals properly and win approval to move forward, many of these deals require longer-term investment horizons. The private equity model of selling assets and returning capital to investors in 5-7 years does not work for most projects.

This analysis is an opportunity scan prepared by Equilibrium. While Equilibrium has previously developed and bears responsibility for managing several funds that incorporate water asset management into the core of their strategies, including ACM Permanent Crops, LLC (ACM maximizes the water assets on their permanent crop farms by using advanced technology for water efficiency, as well as building on-farm water storage and distribution infrastructure) and the Wastewater Opportunity Fund (WOF invests in Waste and Wastewater Treatment assets that generate energy as they treat the waste and wastewater streams), the purpose of this research has been to explore the state of the market for private investments in which the water value *is* the strategy. This paper does not constitute an investment recommendation, nor does it go into detailed investment risk assessments.

We took a value chain approach to evaluating opportunities and researched three potential investment themes:

- **Water Storage and Distribution:** Aquifer Storage & Recovery (ASR) and Aquifer Recharge (AR)
- **Strategic Water Assets + Water Storage:** Greater agricultural crop value with AR and water efficiency
- **Wastewater Treatment:** Industrial Wastewater Treatment and Water Reuse

Aquifer Storage & Recovery (ASR) and Aquifer Recharge (AR) projects are critical, especially in California and other arid states which have dangerously low groundwater levels. But there are numerous obstacles which make these more opportunistic deals versus repeatable and scalable projects.

The investment strategies with near-term potential for investors that appear most promising are in the Industrial Wastewater Treatment and Water Reuse sector. Each water-intensive industry has its own set of requirements, so it is important to initially focus on just a few industries and build experience in key states. The U.S. Food & Beverage (F&B) industry has high potential because of the large number of firms and the wide range of F&B water-intensive processes. U.S. Power Plants also have a high need for water reuse projects. California and Texas are the top two Western states. For some Industrial Water Reuse projects, there also may be opportunities to incorporate ASR to store reclaimed water or desalination treatment of brackish water.

As in the rest of the world, water is inherently local in the United States. Regulations, water pricing, wastewater costs and conveyance infrastructure vary between water districts. The key to success is local knowledge and experience – collaborating in communities with local authorities and co-development partners. It is important to understand the legal path within water districts and nature's path within watersheds.

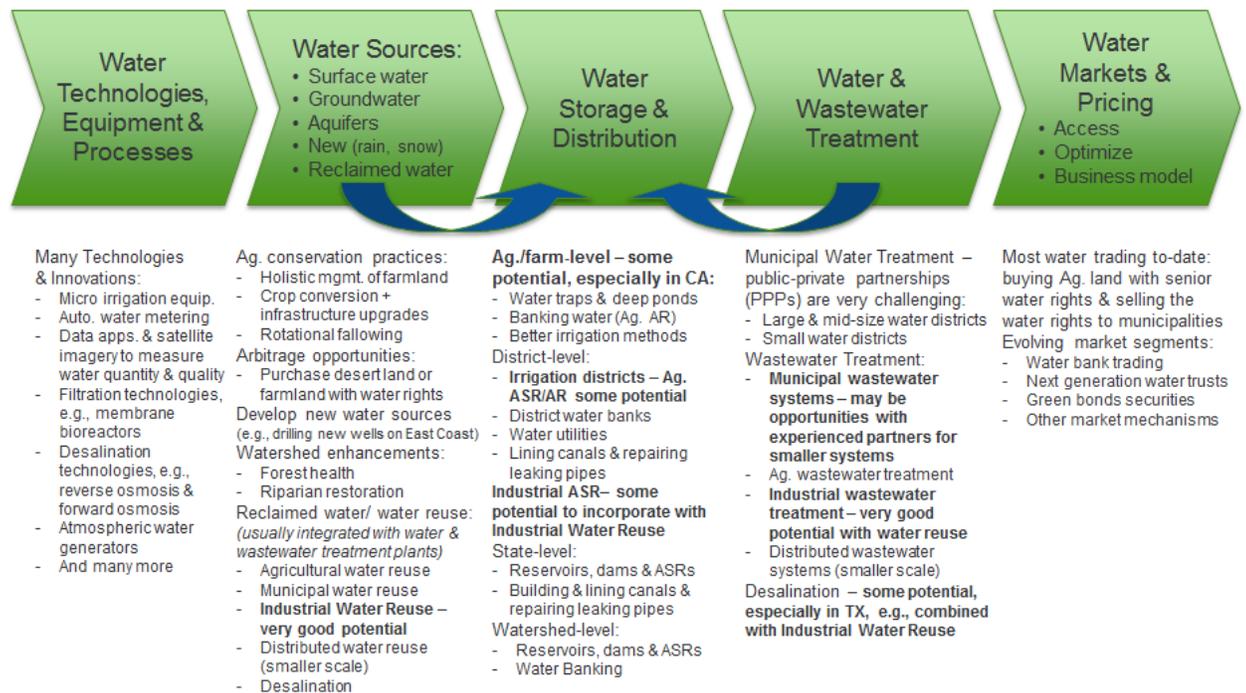
### Scope of Work for This Analysis

Because the U.S. water value chain is so broad, we focused our research on the following topics:

- **9 Western states** (all but Nevada) – **Water Laws and Water Markets & Pricing**
- **Water Storage:** Aquifer Storage & Recovery (ASR) and Aquifer Recharge (AR)
- **Water Sources + Wastewater Treatment:** Industrial Wastewater Treatment and Water Reuse

We did not analyze Water Technologies, Equipment and Processes for this analysis, because Equilibrium invests in real assets, not technologies. Water Storage and Distribution is a critical nexus point, so we touched briefly on other sub-segments, such as reservoirs and conveyance. Water and Wastewater Treatment includes important Municipal sub-segments, but because our initial reading and interviews underscored the major challenges surrounding public-private partnerships (PPPs), we decided to not include Municipal markets in this analysis. One of the key “lessons learned” from talking with approximately 55 experts was the importance of focusing on a few investment themes.

## Opportunities in the U.S. Water Value Chain



Source: Equilibrium

### There are five broad categories in the U.S. Water Value Chain:

- **Water Technologies, Equipment and Processes** – There is a wide range of products and processes that serve all of the water and wastewater market segments. Many of these are proven technologies, but there also are some innovations which could be game changers in the future. For example, data applications combined with satellite imagery to measure water quantity and quality can locate water sources and identify what remediation efforts might be needed to improve the water quality for agricultural or environmental needs. Forward osmosis has the potential to reduce energy requirements and costs for desalination plants. Equilibrium does not invest directly in this category, but all water and wastewater asset infrastructure projects need to incorporate the most cost-effective, best technology solutions to meet key requirements.
- **Water Sources:** surface water, groundwater, aquifers, new sources (rain, snow) & reclaimed water – Water conservation practices and watershed enhancements are important for preserving scarce water resources, but it is difficult finding good opportunities to put private capital to work with these types of projects. Many of the U.S. water investments to-date have been arbitrage deals, i.e., purchasing farmland with senior water rights and later selling the water at a higher price to a Municipal or Industrial buyer. The opportunities to develop new water sources are limited, especially in Western states, but infrastructure projects focused on reclaimed water/ water reuse have very good potential.
- **Water Storage and Distribution** – This is a very important category that is essential for Water Sources and Water and Wastewater Treatment facilities. Water storage is critical, especially in arid regions that are suffering from multi-year droughts. Aquifer Storage and Recovery (ASR) and Aquifer Recharge (AR) investments are more effective and less expensive ways to store stormwater and

excess water supplies than reservoirs, which lose a lot of water to evaporation.<sup>1</sup> There are ASR and AR opportunities from the Agricultural/farm-level, to the irrigation district, Municipal, state and multi-state watershed levels. Water and wastewater distribution systems also need major cash infusions to line canals and repair leaking pipes, but it is difficult putting private capital to work on projects focused only on conveyance infrastructure.

- **Water and Wastewater Treatment** – This category includes Municipal drinking water treatment facilities, wastewater treatment facilities (Municipal, Agricultural, Industrial and distributed systems) and desalination plants. Public-private partnerships (PPPs or P3s) for Municipal Water and Wastewater projects are challenging, taking 12-30+ months to negotiate, if the municipality is open to private ownership. Industrial wastewater treatment systems, coupled with water reuse capabilities, have very good potential for private investments. In states like Texas, which have areas with brackish water, there also are opportunities to integrate desalination treatment with Industrial Wastewater Treatment and Water Reuse systems.
- **Market and Water Pricing** – Most water trading to-date in the United States has been buying farmland with senior water rights and selling the water rights to municipalities. There also has been some water bank trading activity, most notably in Arizona. Long-term, other market segments may evolve, e.g., next generation water trusts and green bond securities, but these will require significant regulatory and policy changes.

## It Starts with the Law

The best way to understand what it will take for a water market to function smoothly and trade at scale in the United States is to learn about the evolution of Australia's Southern Murray-Darling Basin water market. Approximately 90% of the water trading activity in Australia occurs in this region.<sup>2</sup>



Source: The Murray-Darling Basin Authority ([www.mdba.gov.au/managing-water/water-markets-trade/interstate-water-trade](http://www.mdba.gov.au/managing-water/water-markets-trade/interstate-water-trade))

It took several decades for the Australian water markets to evolve. Trading began in 1983, but the volume was low until after the 1994 Water Reform Framework (WRF), which provided a national-level,

legal framework and created tradeable water licenses separate from land titles. WRF established a comprehensive system of entitlements (permanent ownership) and water allocations (seasonal/ annual sales). The early years of Australia's protracted drought called the "Big Dry" spurred additional important regulatory changes. The National Water Initiative (NWI) in 2004 included definitions for best practice cap-and-trade systems for managing water resources across Australia and other reforms to facilitate efficient water markets and opportunities for trading.<sup>3</sup>

#### Key policy changes that enabled water trading in Australia's Southern Murray-Darling Basin: <sup>4</sup>

- **Fully unbundling water rights from land ownership rights**
- **Water rights are fully adjudicated** – The national WRF and NWI policies clearly defined the water rights for entitlements and allocations, making them easily traded, uniform units with no legal entanglements.
- **Annual effective caps on total sustainable water allocations** – cap first, then trade.
- **Streamlined transfer process for trading water rights**
- **Water leasing allowed** – The Australian water allocation system allows farmers and other owners to lease/ sell part or all of their water for a year, while still maintaining permanent ownership with their entitlements.
- **No "Use It or Lose It" restrictions** – Unlike many states in the United States, Australian water entitlement owners are not at risk of losing their rights if they do not use all or part of their allotted water for a specified number of years.
- **Water metering and monitoring** – All surface water in the Southern Murray Darling Basin is owned by an individual, company or government entity. Water metering is strictly enforced.
- **Big enough water trading area** – Water rights can be freely traded between rivers across state borders within the Southern Murray-Darling Basin. This is a major reason why this region accounts for approximately 90% of the water trades in Australia.

#### Water Trading Hurdles in Western States

One of the biggest obstacle for water trading in the United States is that the majority of water rights are tied to land ownership. Some unbundling has occurred, for example when farmers sell their permanent water rights to nearby municipalities, but Agriculture accounts for approximately 80% of the United States' nationwide consumptive water use.<sup>5</sup>

The most common types of water rights in the United States are:

- Prior Appropriation: "First in time, first in right," which means that a person who first puts the water to a beneficial use acquires a water right that is more senior and better than later "junior" appropriators of the water. This is the predominant type of ownership in Western states.
- Riparian: A riparian right entitles a landowner to use a correlative share of the water flowing past his or her property. This type of water right is predominantly used in Eastern states.

Water rights have been over-allocated throughout the West, and prolonged droughts increase the risk of legal battles. For example, water shortages in the Colorado River Basin system negatively impact the owners of water rights in seven states – Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming.<sup>6</sup>

## Ranking Western States' Readiness and Potential for Water Markets

Australia vs. 8 Western States		Ranking Based on Key Equilibrium Criteria														Overall Relative Ranking of Western States
		Low Regulatory Hurdles for Water Ownership & Water Rights Transfers							Big Enough Water Trading Areas							
		Fully Unbundled Rights	Type(s) of Water Rights	Rights Are Fully Adjudicated	Streamlined Transfer Process	Water Leasing Allowed	No "Use It or Lose It" Restrictions	Water Metering & Monitoring	Rain & AR Storage Allowed	Big Enough Water Trading Areas	Water Scarcity Driving Demand	Water Prices on the Rise	Water Market Readiness & Timing	Market Size & Growth Potential		
Australia - Southern Murray-Darling Basin	Yes	Entitlements & Allocations	High	High	High	High	High	Med.-Low	Med.-High	High	High	High	Med.-High	High		
California	No	Prior Appropriation, Riparian, ...	Med.-Low	Low	High	Medium	Low	High	Medium	High	Medium	Medium	Med.-High	High		
Arizona	No	Prior Appropriation	Med.-Low	Medium	High	Medium	Med.-High	High	Medium	High	Medium	Med.-High	Medium	High		
Texas	No	SW: Prior App. GW: ROC	SW: High GW: Low	SW: Med. GW: Low	High	High	Low	Rain - Med. AR - Low	Med.-Low	High	Medium	Medium	Med.-High	Med.-High		
Colorado - NCWCD/CBT Market	Mostly	CBT Units (310K shares)	High	Med.-High	High	High	Low	Low	Medium	High	Medium	High	Medium	Med.-Low		
Colorado - Rest of the State	No	Prior Appropriation	Med.-High	Low	Med.-Low	Low	High	Rain - Low AR - Varies	Low	High	Medium	Med.-Low	Medium	Low		
New Mexico	No	Prior Appropriation	Low	Low	Medium	Medium	Medium	Medium	Low	High	Medium	Low	Med.-Low	Low		
Washington	No	Prior Appropriation	Medium	Medium	Medium	Medium	Medium	Rain - Med. AR - Low	Low	Medium	Low	Low	Med.-Low	Low		
Oregon	No	Prior Appropriation	Medium	Low	Medium	Medium	Medium	Medium	Low	Medium	Low	Low	Low	Low		
Utah	No	Prior Appropriation	Low	Low	Medium	Low	Low	Medium	Low	Medium	Low	Low	Med.-Low	Low		
Idaho	No	Prior Appropriation	Medium	Low	High	Medium	Medium	Medium	Low	Med.-Low	Very Low	Low	Low	Low		

### Definitions of Key Water Market Terms:

- Unbundled means that ownership of water rights has been fully separated from ownership of land. This critical national policy change was a major enabling factor for the Australian water market.
- Entitlements The Australian term for permanent ownership of water rights
- Allocations The Australian term for seasonal/ annual sales or leasing of water rights
- Prior Appropriation "First in time, first in right", which means that a person who first puts the water to a beneficial use acquires a water right that is more senior & better than later "junior" appropriators of the water.
- Riparian A riparian right entitles a landowner to use a correlative share of the water flowing past his or her property. This type of water right is predominantly used in the Eastern U.S. states.
- Texas acronyms SW = surface water; GW = groundwater; & ROC = "Rule of Capture", often called "the law of the biggest straw"; landowners own the water under their property.
- Adjudicated Adjudicated water rights are clearly defined based on legal rulings to determine who has a valid water right, how much water can be used & who has priority during shortages.
- "Use It or Lose It" If you don't use a water right for the assigned beneficial use within a specified # of years, you may lose your right to use a portion or all of the water. Each state has different forfeiture regulations.
- AR AR stands for Artificial Recharge or Aquifer Recharge. It's a simpler & less expensive way of recharging an aquifer than Aquifer Storage & Recovery (ASR), with fewer regulatory hurdles.

To compound the problem, ownership is still not well documented in many water districts. Fully adjudicated water rights are important to determine how much water can be used and who has priority, especially in times of water scarcity.

A few of the other legal rules which are hurdles in some of the Western states are:

- **The beneficial use doctrine, also known as “use it or lose it”:** All water must be used for the approved beneficial use. Water that is not used within a specified number of years may be forfeited. This rule undermines important water conservation efforts, when farmers or other property owners are worried that they may lose part or all of their water rights if they do not maintain the same level of historical water use.<sup>7</sup>
- **Restrictions on storing rainwater and/or aquifer recharge on private property**

Trading of permanent water rights and water leases has been happening in all of the Western states for more than three decades, but the number of transactions has been relatively small.<sup>8</sup> Other major obstacles are:

- The buying and selling process is informal and very local in most Western states.
- In most areas, the transfer process is cumbersome and time consuming.
- Transfers can be expensive, especially if the water rights have not been fully adjudicated.

Water is a grossly undervalued asset in the United States, but as water scarcity drives demand, water prices will continue to rise. This trend is already happening in California, Arizona, Texas, Colorado, New Mexico, Utah and Nevada.

Every state has its strengths and weaknesses in terms of regulations and other key criteria for growing their water markets. The top three Western states in terms of market readiness combined with long-term market potential for real asset investments are California, Arizona and Texas.

### **When Will Water Be Market Priced and Tradeable at Scale?**

Even though most Western states are experiencing long-term water supply issues, the legal and market structures do not allow for market-priced mechanisms and trading at scale. Water markets will continue to be state-specific and trading will remain within watersheds. Part of the challenge is that in most areas trading is limited by the need for conveyance of a shared water source using existing pipes and canals.

- **California** – It probably will be a minimum of 5 years before a more formalized trading system starts taking shape. Water pricing will continue to increase, but it may take 10 years or more before water is tradeable at scale. The Sustainable Groundwater Management Act (SGMA) of 2014 was an important step forward. Despite the regulatory challenges, California is a key state for water infrastructure investments – near and long-term.

*“We are at an inflection point on regulation in California.”*

*Steven Moore, California State Water Resources Control Board*

- **Arizona** – Water banking and trading are well established within each of the five Active Management Areas (AMAs) in the state’s major metropolitan areas. Arizona’s market is relatively efficient, but future water supplies are a major concern. If the drought continues and Lake Mead falls below 1,075’

on any January 1<sup>st</sup>, the federal government is legally required to declare a shortage and Arizona could face serious shortages in their junior Colorado River Project (CAP) rights.<sup>9</sup>

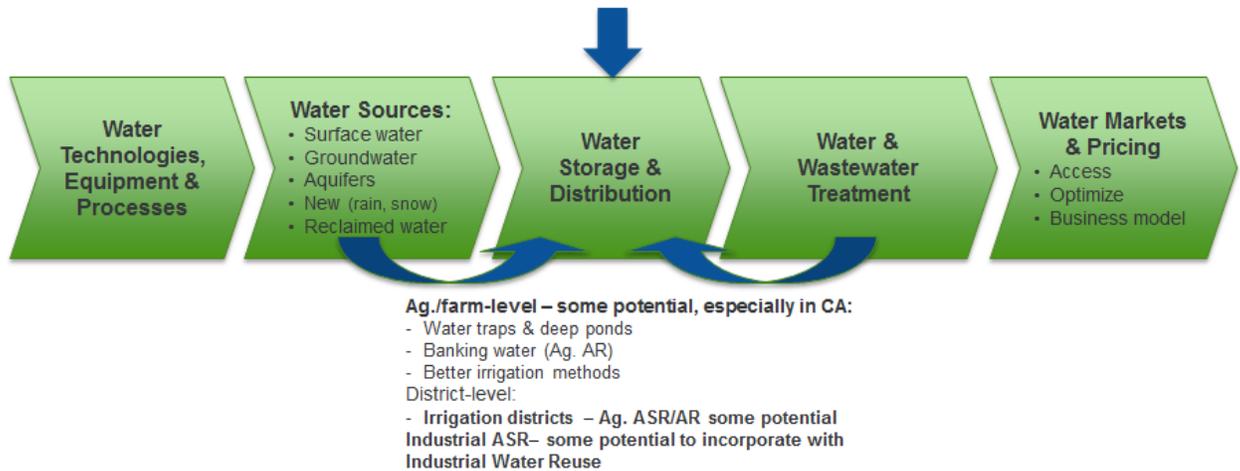
- **Texas** – Water trading is relatively active in Texas with rising prices, but the dual-doctrine system for surface water and groundwater limits scale. Texas is the only Western state which uses "Rule of Capture" (ROC) for groundwater, also called "the law of the biggest straw."<sup>10</sup> Landowners own the water under their property and can withdraw as much as they like, as long as it is not intentionally wasted. The Edwards Aquifer Authority is the only groundwater conservation district (GCD) which has the power to establish trigger levels for limiting withdrawals from the aquifer. They have a groundwater permitting process which has enabled a functioning groundwater market.<sup>11</sup> But the Texas Supreme Court's 2012 ruling against the Edwards Aquifer Authority in favor of property owners' groundwater rights could lead to more water disputes in this GCD too.<sup>12</sup>

Trading of surface water rights is more common in Texas. For example, the Lower Rio Grande has a well-established market for surface water rights, including a separate set of rules with no seniority of rights.<sup>13</sup> Despite the groundwater market trading obstacles, Texas is an important state for private capital investments, because of the large size of their Industrial and Municipal Wastewater Treatment and Water Reuse markets.

- **Colorado** – There is a bifurcation between the Northern Colorado Water Conservancy District (NCWCD) and the rest of Colorado. The NCWCD water market is the most mature and active in the United States, because there are well-defined laws and annual allotments for Colorado-Big Thompson (CBT) units. The NCWCD has established simple mechanisms for distributing and trading the CBT water units.<sup>14</sup> For the rest of the state, the process of obtaining a water right is a complex and expensive process, taking from 4 months to  $\geq 2$  years.<sup>15</sup>
- **New Mexico** – Water scarcity is driving prices higher in New Mexico, but adjudication challenges, lawsuits and a cumbersome transfer process are market roadblocks. Most parts of New Mexico are experiencing serious water shortages.<sup>16</sup> Compounding the problem, the state has an obligation to deliver a minimum stream flow to Texas from the Rio Grande. In a case currently before the U.S. Supreme Court, Texas claims New Mexico is violating the Rio Grande Compact by using water in excess of its allowed diversions of surface water and groundwater. This will be a lengthy and expensive lawsuit.<sup>17</sup>
- **Pacific Northwest (Washington, Oregon and Idaho)** – Water prices and trading are significantly lower than other Western states, especially in Idaho.<sup>18</sup>
- **Utah** – Population growth is driving water prices higher in some districts, but influential water lawyers and large water districts have no incentive to improve and streamline their water trading market.
- **Nevada** – Nevada was not included in this analysis, because we did not see many opportunities for investing in real assets, but there are signs of support for a transparent and efficient water market. A pilot project in Nevada's Diamond Valley and Humboldt Basin is trying to unbundle water rights and facilitate a transition to an active water trading market.<sup>19</sup> It is important to note, though, that even if this pilot project is successful, it will take time before standards and practices are widely adopted, even within this one basin.

## Overview of Three Investment Themes

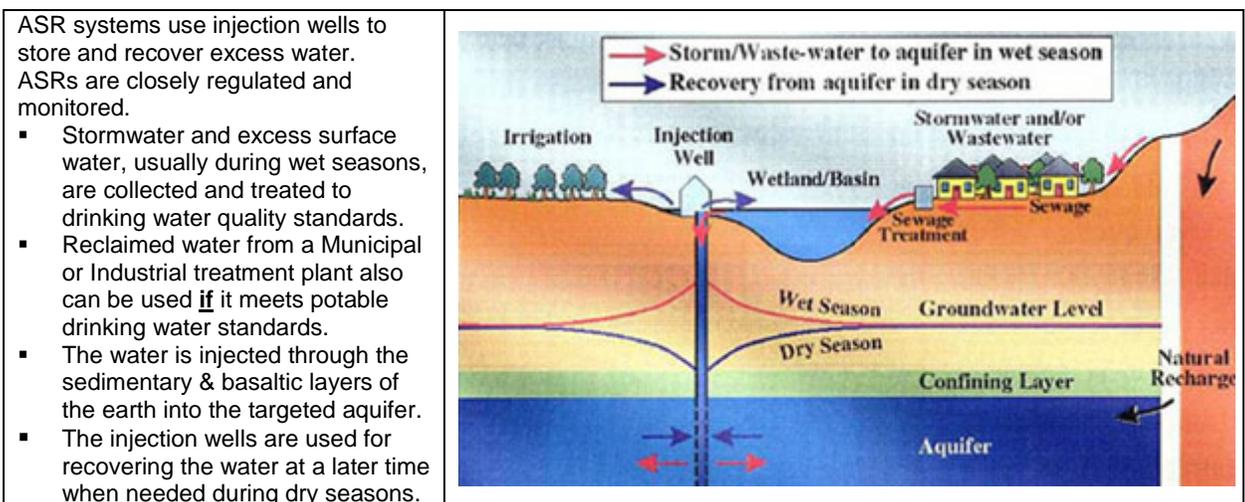
### Aquifer Storage & Recovery (ASR) and Aquifer Recharge (AR)



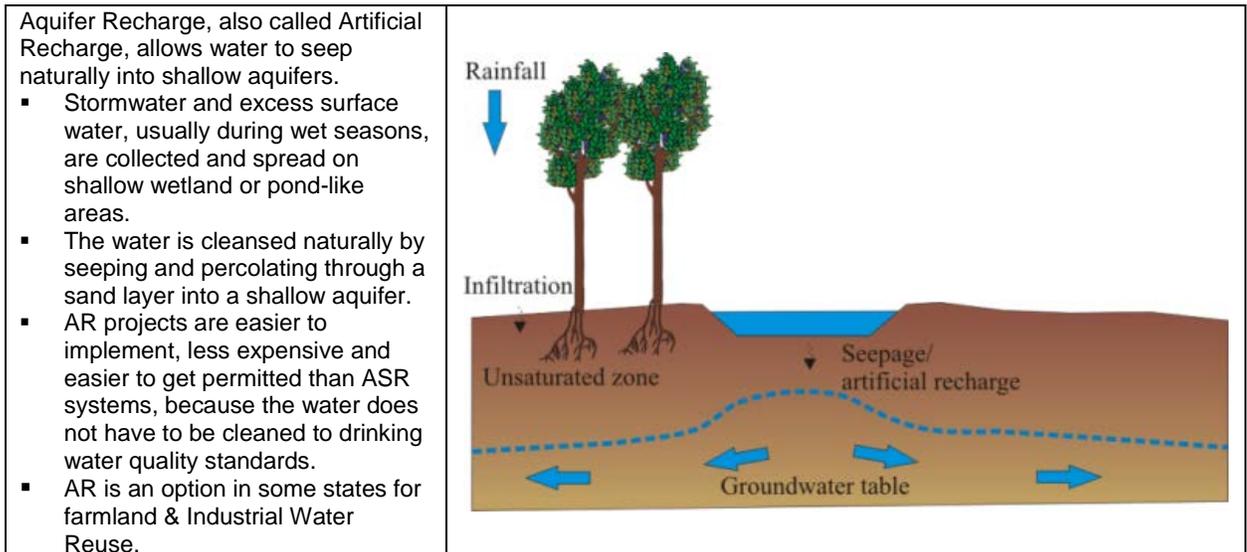
The prolonged drought in many parts of the West has seriously impacted surface water and groundwater resources. In the states where groundwater is not regulated and monitored, farmers and other property owners have been over-pumping from their wells, lowering water levels of the groundwater and deep aquifers at an alarming rate. This has put long-term water supplies at risk and caused major subsidence problems with land areas sinking and damaging buildings, roads and other infrastructure.

ASR and AR are the best, most cost effective methods for recharging depleted groundwater and aquifer levels. In an October 2014 report by the Stanford Woods Institute for the Environment, the authors estimated that groundwater storage could provide approximately 6 times more storage capacity than surface water storage for the same amount of invested capital.<sup>20</sup> Reservoirs also are ineffective in terms of retaining stored water, especially in arid regions. A James A. Baker Institute May 2015 blog cited estimates that Texas loses between 5-6 million acre feet of water per year due to evaporation from reservoirs; this is equivalent to 25% of Texas' total water demand in 2010.<sup>21</sup>

### How Aquifer Storage & Recovery (ASR) Works <sup>22</sup>



## How Aquifer Recharge/ Artificial Recharge (AR) Works <sup>23</sup>



But despite the great need for ASR and AR systems, especially in California, this is not a market segment with repeatable, scalable projects. Capital constraint is not the issue. It is the lack of projects.

### The biggest ASR and AR challenges are:

- Finding experienced deal sourcing and co-development teams.
- Building consensus among the stakeholders.
- Regulatory hurdles for getting projects approved can be cumbersome and time consuming. The process is different in each state and sometimes varies between water districts.
- The biggest issue in California, Arizona, New Mexico & Nevada: will there be excess water to store?
- ASR and AR sites must have good hydrogeology and water conveyance infrastructure.
- There is no “cookie cutter” approach.

Private investors need to bring more than just capital to the table. They must have a good understanding of, and relationships with, local stakeholders. Without a track record, most irrigation districts will not work with design-build-operate (DBO) or financing firms. Long-term capital is needed to put together an ASR portfolio.

### The best places to look for opportunistic ASR and AR deals are:

- **Industrial Water Reuse** – There is potential to integrate ASR into some Industrial Water Reuse projects, depending on the source of water, local water district regulations and hydrogeology.
- **California** – This is a challenging, but very important market. Efforts to streamline the ASR regulatory process are happening at the state and groundwater basin level, because ASR projects are critical solutions for California’s drought and groundwater problems.
- **Arizona** – The ASR and water bank leasing markets in Arizona are relatively efficient and mature. When excess allocations come to market, they are purchased and stored by existing players. The biggest ASR obstacle in Arizona is there has been significantly less excess water to store since 2009.<sup>24</sup> 2016 marks the 21<sup>st</sup> year of Arizona’s long-term drought.<sup>25</sup>

## Greater Agricultural Crop Value with Aquifer Recharge

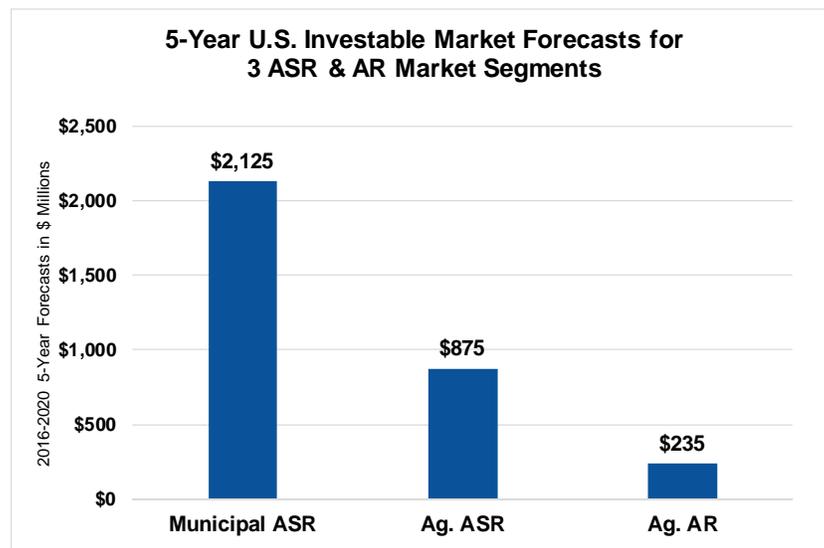
One way to invest in water is by combining Aquifer Recharge (AR) with more water efficient irrigation equipment and farming practices. The return on investment comes from higher value crops.

### California is the best state for deploying this strategy.

- Rain, stormwater and conserved water can be stored, sold and leased in California.<sup>26</sup>
- There already are ASRs and ARs in irrigation districts, and state-level support to promote ASRs.
- A diverse range of permanent and row crops are grown in California.
- The state has a major Agricultural market with large landowners.
- There also is some interest in the state for rotational fallowing programs. The water saved by farmers by fallowing some of their land can be leased to nearby farms or municipalities.<sup>27</sup>

### Sizing the ASR & AR Market Opportunities

Our preliminary estimate of the total 2016 - 2020 U.S. market opportunity for 3 ASR & AR market segments is \$3.2 billion. Municipal ASR is the largest segment with a \$2,125 million 5-year market forecast, followed by Ag./Irrigation Districts' ASRs at \$875M. Our preliminary estimate for Ag. AR infrastructure projects is low at only \$235M for 2016 - 2020. The market value and investor return will come from the increased value of crops and farmland. We do not have enough data yet to forecast the Industrial ASR market opportunity.

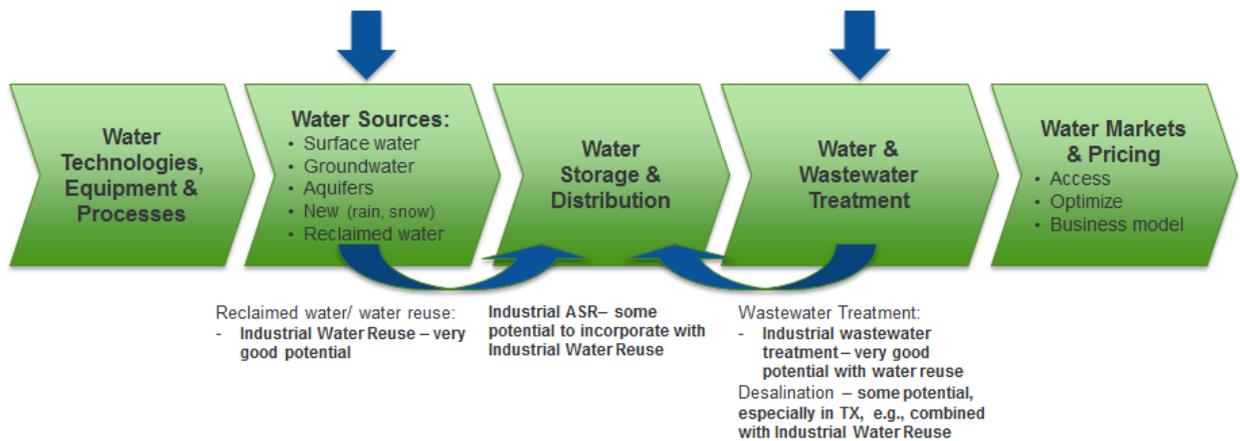


Source: Equilibrium

## Industrial Wastewater Treatment and Water Reuse

Industrial Wastewater Treatment and Water Reuse spans three categories in the U.S. water value chain:

- Water and Wastewater Treatment – wastewater & water reuse systems + sometimes desalination
- Water Sources – reclaimed water
- Water Storage and Distribution – some potential to incorporate ASR with water reuse projects



Industrial Wastewater Treatment and Water Reuse is a mature market sector with good momentum in water-intensive industries. Each industry has its own requirements, but there are some common processes to remove contaminants, e.g., water filtration, softening and disinfection. Some typical examples of water reuse are:

- Cooling towers, chillers and boilers
- Process water – rinsing, washing, spraying and coating applications
- Irrigation – reclaimed water used for landscaping, nearby farms and golf courses
- Ultra-pure water (UPW) – for manufacturing semiconductors, micro-electronics, pharmaceuticals and medical products

**Many large firms are actively addressing their water exposure and have water reuse programs.**

#### Examples of Corporations Focused on Water Issues

Anheuser Busch (AB-InBev)	Eco-Lab	Nestlé
Apple	Hewlett-Packard	Nike
Chevron	Hitachi	Nissan Motor Co.
Coca-Cola	Intel	PepsiCo
Colgate-Palmolive	Kellogg's	Royal Phillips
ConAgra Foods	Keurig Green Mountain	SABMiller
Constellation Brands	Levi Strauss	Unilever
Dow Chemical	Merck	Volkswagen
	Micron Technologies	Wal-Mart ...
	MillerCoors	

**There are numerous water-intensive vertical industries with water reuse applications.**

- **Food & Beverage (F&B) manufacturers** – Large players have built facilities to address a wide range of internal issues, such as growing water scarcity and pricing, wastewater treatment costs, risk management, meeting sustainability standards, growing their production base and public relations.
- **Power Plants** – Power plants are high water users, primarily for cooling towers.
- **Mining** – Mining is a water-intensive process with environmental and regulatory pressures.
- **Semiconductors & Microelectronics** – These firms have high margin use for ultra-pure water (UPW). Because UPW is critical for manufacturing products, probably most of these firms own and operate their water treatment facilities.

- **Data Warehouses** – A large volume of high quality water is needed to cool these data facilities.
- **Oil & Gas** – Substantial needs, but there are high pollution-related regulatory and liability risks.
- **Other industries: Pulp & Paper; Steel Mills; Computer & Electronic Product Manufacturing; Chemical Plants; and Pharmaceuticals.**

### **Industrial Wastewater Treatment and Water Reuse Market Drivers**

Water volatility and scarcity are major market drivers for Industrial Water Reuse because they increase business risk. And as competition for water grows, the Industrial sector will be hardest hit. The Municipal and Agricultural/Food sectors will have higher priority.<sup>28</sup> Reducing business risk is the primary reason why firms in water-intensive industries are investing in water reuse projects.

There are several financial incentives:

- Industrial Water Reuse systems can significantly reduce the high costs charged by municipalities to collect and treat wastewater discharged to sewer systems. U.S. sewer rates rose 35% to >270% more than the Consumer Price Index (CPI) for 2002 through 2014, and the National Association of Clean Water Agencies (NACWA) is forecasting yearly increases of 4%-5% through 2019.<sup>29</sup>
- In arid areas, the cost of reclaimed water may be lower than fresh water. This trend will increase as technology prices drop and water prices rise.
- Firms in expansion mode want to invest their capital in new production plants, not in wastewater treatment and water reuse facilities – great opportunities to provide off-balance sheet financing.

Another major market driver is reducing regulatory and liability risks. Companies must ensure their wastewater meets specific federal, state and local requirements before being released into municipal sewer systems. In addition, some firms are required to reduce their wastewater volumes when there is a lot of rain to alleviate stress on municipal wastewater systems. Deployment of more robust infrastructure with experienced design-build-operator (DBO) firms can reduce these risks, especially for mid-size firms which do not have the internal resources to develop their own water reuse teams.

The other market drivers are good publicity and responding to pressure from shareholders and customers. Some firms' investors and customers are setting new water sustainability requirements, e.g., Wal-Mart, McDonald's and other large volume customers.

Interviews with numerous experts confirmed our analysis that the Industrial Wastewater Treatment and Water Reuse is a promising market segment.

### **Reasons why this market sector has very good potential for real asset investments:**

- Long-term attractiveness of several vertical industries
- Size of transactions ranging from \$5M to \$30M
- Multiple revenue streams
- Potential for multi-faceted and add-on projects with several stakeholders
- Ability to incorporate multiple end users within a water district, e.g., Industrial Parks
- Opportunities to replicate across a firm's other manufacturing facilities in different states

## Industrial Wastewater Treatment and Water Reuse Market Challenges

Every industry has its own set of water reuse applications, and systems need some customization to meet companies' corporate, state and local requirements. DBO firms with in-depth experience in a vertical industry and region can speed up the design process, but these still are not "cookie cutter" projects.

Industrial Water Reuse systems must meet federal, state and local regulatory wastewater treatment requirements. The overarching federal laws for water and wastewater projects are the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA) and Environmental Protection Agency (EPA) regulations. There also are specific requirements for water reuse. For example, the EPA limits the mineral contents and concentration in water for some industries, which can require having to use more, not less, water for cooling systems.<sup>30</sup>

Some municipalities limit what firms can do with reclaimed water, if the original water source is municipal water. A municipality may own a firm's treated water.<sup>31</sup> For example, a company may be able to reuse water several times within a manufacturing plant, but may not be able to sell excess reclaimed water to a nearby farm or golf course.

Conveyance is a potential obstacle too. There can be a lack of connectivity between where reclaimed water is generated and the demand centers/potential off-take customers. Reclaimed water must be transported through dedicated "purple pipes."

There are several potential financial challenges. If the cost of delivered fresh water is low, it can make it harder for companies to justify the expense of installing water reuse systems. This may limit opportunities in the Pacific Northwest, where water prices are well below other Western states.

From a private financing perspective, some firms, especially large corporations, may want to retain ownership of their wastewater treatment and water reuse projects and related infrastructure. Investors need to work with trusted co-development partners to propose complete project solutions to companies – design, build, operate, and own/ finance.

Another challenge is the current low cost of capital. If companies can get project financing for  $\leq 3\%$ , it is more difficult to make the economics work for private capital investments.

There is a risk that a company could relocate or go out of business. It is important to research a firm's long-term strategy and financial health before entering a wastewater treatment and water reuse deal.

Finally, in the United States, there are general public and PR concerns about water reuse, even if the treated water is only used for non-potable uses, such as landscape irrigation. It will be an on-going educational process to help people understand "fit for purpose" water.

Many applications do not need to meet potable drinking water quality standards. There needs to be more regulatory flexibility at the federal and state level for using lesser quality reclaimed water for non-potable uses.

**For this analysis we used four criteria to prioritize water-intensive industries:**

- **Number of Potential Customers in the U.S.** – Is it a big enough market?
- **Simpler Wastewater & Water Reuse Treatment Processes** – This is important for repeatability and scalability. Complex, advanced tertiary treatment requirements are expensive to implement.
- **Low Regulatory & Liability Risks** – Avoid highly toxic wastewater streams.
- **Trend toward Design-Build-Operate (DBO) or Build-Own-Operate (BOO)** – How receptive are the companies in this industry to co-development and financing partners? We need to do more in-depth research and interviewing to refine these preliminary rankings.

**Ranking Industrial Wastewater Treatment and Water Reuse Market Segments**

Water-Intensive Industries	Water Reuse Sector Ranking Based on Key Equilibrium Criteria				
	# of Potential Customers in the U.S.	& Water Reuse Treatment Processes	Low Regulatory & Liability Risks	Build-Operate (DBO) or Build-Own-Operate (BOO) *	Overall Sector Ranking
Food & Beverage Manufacturing	High	High	Medium	Medium *	High
Power Plants, <u>excluding</u> Coal & Petroleum	High	High	Medium	Med.-Low *	Med.-High
Mining	Medium	Med. or Low * (varies by type of ore)	Med. or Low * (varies by type of ore)	Medium *	Medium *
Semiconductors & Other Components Mfg. – primarily Ultra Pure Water (UPW)	Medium	Low	Medium	Low *	Med.-Low
Pulp, Paper & Paperboard Mills	Low	Med.-High	Med.-High	Medium *	Med.-Low
Iron Mills, Steel Mills & Ferroalloy Mfg.	Low	Med.-Low	Medium	Medium *	Med.-Low
Data Warehousing	Low	High	Med.-High	Medium *	Med.-Low
Oil & Gas	High	Low	Low	Medium *	Low
Computer & Electronic Product Mfg.	Medium	Low	Low	Medium *	Low
Basic Chemical Manufacturing	Medium	Low	Low	Medium *	Low
Pharmaceuticals & Medicine Mfg.	Medium	Low	Low	Low *	Low

\* Preliminary rankings which require more research and interviewing

Source: Equilibrium

This Industrial Wastewater Treatment and Water Reuse ranking table summarizes our preliminary analysis of all the water-intensive industries in the United States. Based on our four criteria, the industries with the most potential are:

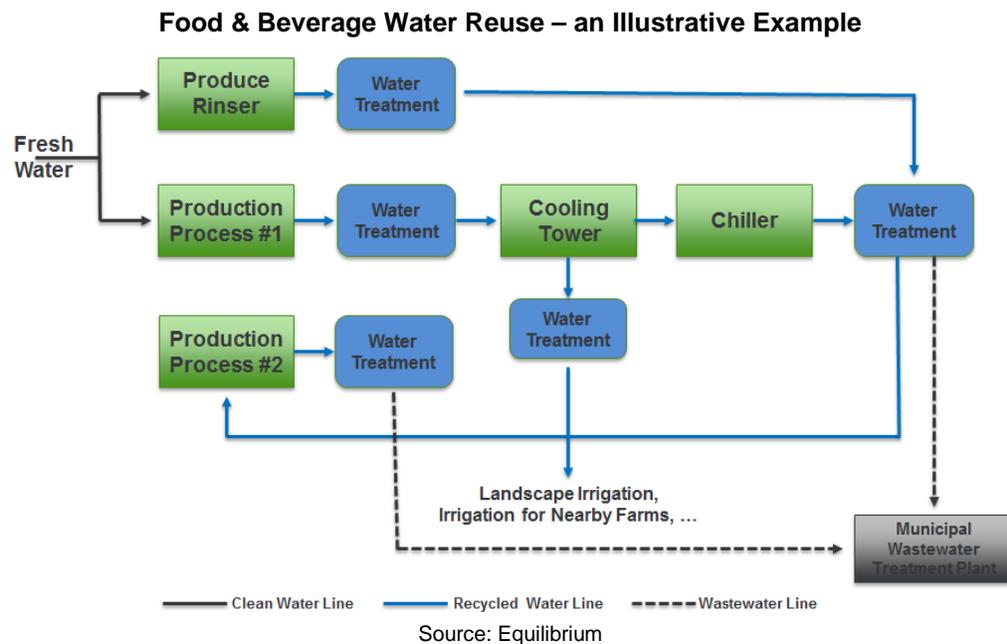
1. Food & Beverage Manufacturing
2. U.S. Power Plants
3. Mining

Mining is a distant third. We need to do more research to determine if there are sub-segments in the industry which are worth pursuing.

As we develop good working relationships with DBO firms with strong expertise in Industrial Wastewater Treatment and Water Reuse, there may be opportunities longer-term to expand into other water-intensive industries. Many DBO players have experience working with customers in multiple vertical industries.

## Food & Beverage Manufacturing

The United States had about 9,700 Food & Beverage (F&B) Manufacturing establishments with 20 or more employees in 2012 – far more potential customers than any other water-intensive industries. The top 4 Western states are: #1 California; #2 Texas; #3 Washington; and #4 Oregon.<sup>32</sup> There are a wide range of F&B processes that are potential water reuse applications: cooling towers; chillers; boilers; produce rinsing; transport of produce; tank washing; bottle washing; scrubbers; spraying & cooling livestock; ... The treatment process also can vary for wastewater streams from different production processes before reusing or combining the reclaimed water sources. These range of options can add to the size of F&B water reuse projects.



Another advantage of the F&B industry is that most of the manufacturing steps produce just “dirty water,” as opposed to potentially toxic contaminants in other industries’ wastewater. The wastewater and water reuse treatment processes are much simpler than most of the other water-intensive industries. The regulatory and liability risks also are lower.

In addition, there are other options that can lead to greater revenue streams for F&B firms, co-development partners and investors, if the high volume of their reclaimed water exceeds the water reuse needs within their manufacturing plants. Because most F&B wastewater streams require only minimal treatment for non-potable uses, firms may be able to sell their excess reclaimed water to nearby farms or golf courses. And if the soil hydrogeology is suitable, they also may be able to store the excess water in an ASR system to use or sell at a later time. These options, though, are highly dependent on state and local regulations.

On a cautionary note, there are several market challenges. The majority of U.S. F&B firms have installed wastewater treatment systems to meet regulatory requirements before discharging their wastewater streams into municipal sewers. And many firms, especially large corporations, already have made investments in water reuse.<sup>33</sup> We need to learn more about the potential for private capital funding of

projects that expand existing wastewater treatment and water reuse facilities, as well as projects involving new water reuse systems.

The best opportunities for new projects will be to target firms that are in expansion mode who want to invest in their production plants vs. water reuse facilities. It also might be easier closing deals with mid-size firms.

Because of the types of products they make, F&B firms have greater PR concerns than other industries. Consumers worry about potable water reuse – i.e., any contact with food or beverages. Many F&B firms also have slim profit margins, which can limit the opportunities for private capital investments with good returns.

As with other industries, currently the issue is more about reducing the high municipal costs for wastewater disposal and treatment than it is about water supply sources, and costs. But water volatility, scarcity, quality issues and rising prices will continue to fuel demand for water reuse.

### **U.S. Power Plants**

There is a large number of power plants in the United States. According to the U.S. Energy Information Administration (EIA), there were 7,677 in 2014. Even excluding coal and petroleum power plants, because many may be decommissioned during the next 5-10 years, this is a big market with 6,104 power plants.<sup>34</sup> As with Food & Beverage Manufacturing, the top two Western states are California and Texas.<sup>35</sup>

Most power plants use very large volumes of water, primarily for cooling towers. Water reuse is an important application for recycling the water. In addition, there is a growing trend of power plants purchasing municipalities' treated reclaimed water to reduce their consumption of fresh water.<sup>36</sup> Environmental regulations are driving new investments in wastewater treatment and water reuse.

The wastewater treatment processes for power plants are simpler with relatively cleaner water and there are fewer regulatory and liability risks than in other industries. Depending on the local regulations, some power plants can sell their reclaimed water with minimal treatment for non-potable uses, e.g., nearby farms growing non-food crops.

One of the market limitations for this industry is that there are far fewer water reuse applications than in the F&B industry. We need to do more research to find out what percentage of U.S. power plants need new or upgraded systems, as well as how receptive this vertical industry is to private financing of projects.

### **Mining**

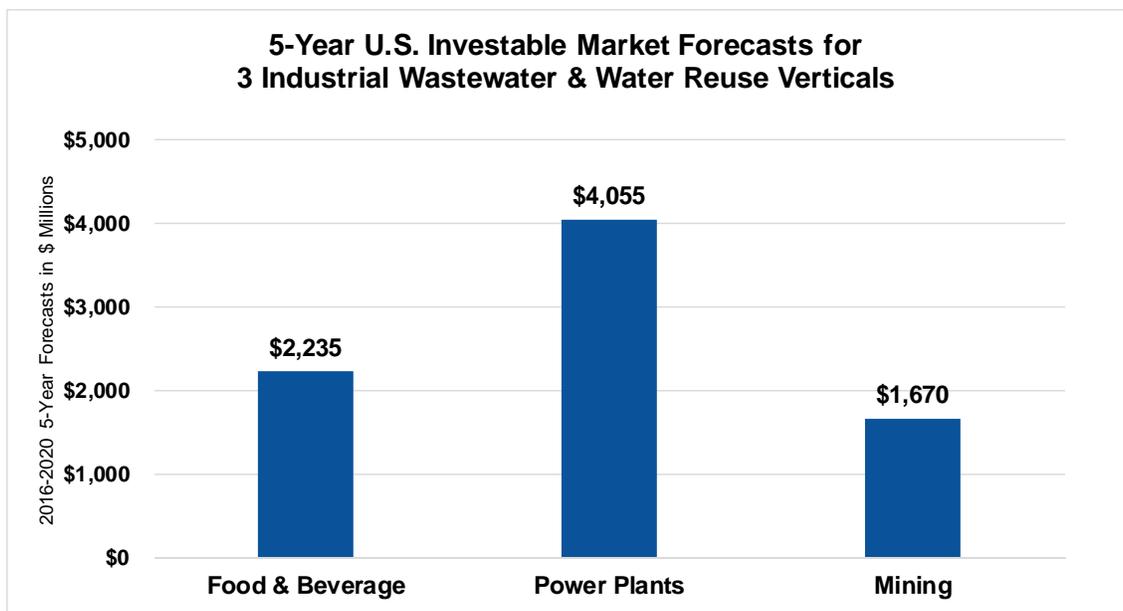
According to the 2012 U.S. Census, there are 1,585 mining establishments with 20 or more employees. Over 90% of the operations are in Western states, with the greatest presence in: #1 Texas – 355 establishments; and #2 California – 244 establishments.<sup>37</sup>

Mining requires a large amount of water, and most operations are in water scarce areas. Other market drivers are regulatory, environmental and public pressure for improved wastewater treatment and water reuse.

The biggest market challenge is that some ores and mining processes have very toxic contaminants. It is important to be selective on the type of ores, the age of mines and location of mines to avoid high regulatory and liability risks. We need to do more research to find out if any ores have low enough levels of toxic contaminants to meet our risk requirements. And if there are, how many mining establishments would be in the target market? Because of these concerns, Mining is a distant third on our list of potential vertical industries.

### U.S. Market Forecasts for Three Potential Vertical Industries

Based on our preliminary estimates, U.S. Power Plants is the biggest of these three vertical industries, even after excluding coal and petroleum power plants, with a 5-year investable market forecast of \$4.1 billion for 2016 through 2020. We are estimating that the Food & Beverage Manufacturing 5-year investable market forecast reaches \$2.2 billion, followed by Mining at \$1.7 billion.



Source: Equilibrium

For all three vertical industries, California and Texas are the top two Western states, underscoring the importance of focusing on these states across the U.S. water value chain. Washington and Oregon have potential on a smaller scale, especially since they rank #3 and #4 in terms of the total number of F&B establishments with 20 or more employees.



There are many global and regional players in the U.S. water value chain involved with building and operating real assets and providing a range of products and services. The primary business models are:

- Design-Build-Operate (DBO) Firms
- Design-Build Firms, e.g., Engineering, Procurement & Construction (EPC) companies
- Design Firms, e.g., engineering & consulting firms
- Owner-Operator Utilities &/or Public-Private Partnerships (PPPs), e.g., long-term concessions
- Technology & Equipment Players

The most important partners for investors are DBO firms which build and operate Industrial Wastewater and Water Reuse facilities, especially companies that have excellent experience working with Food & Beverage manufacturers. In addition, the large players, like CH2M Hill, CDM Smith and Veolia, have expertise working with power plants, mining firms and other water-intensive industries. It also is important to develop partnerships with experienced regional DBO firms to build and operate projects.

A few of the other global players who have extensive experience working with F&B customers are:

- Design-Build Firms – HDR, Inc.
- Owner-Operator Utilities &/or Public-Private Partnerships – Veolia Environnement (also a DBO).
- Technology & Equipment Players – GE Water & Process Technologies, Dow Water and Process Solutions, and Evoqua Water Technologies (formerly known as Siemens Water Technologies).

Water and Wastewater Investors	Asset Class				
	Public Equity	Fixed Income	Private Equity	Venture Capital / Growth Equity	Real Assets / Infrastructure
<b>Water-Focused Funds/ Investors</b>					
Aqua Capital Management					
Blue Sky Alternative Investments/ Blue Sky Water Partners					
Cadiz Inc.					
Greenstone Resource Partners					
PICO Holdings (PICO)/ Vidler Water Company					
Poseidon Water					
Renewable Resources Group					
Summit Global Management					
Table Rock Capital					
Water Asset Management					
XPV Water Partners					
<b>Private Equity &amp; Infrastructure Funds with Water Exposure</b>					
Global Infrastructure Partners (Blackstone)					
Global Water Development Partners (Blackstone)					
Goldman Sachs Infrastructure Fund					
KKR & Co. L.P.					
Signina Capital AG					
<b>Public Equity-Focused Funds</b>					
AllianzGI Global Water Fund					
Calvert Global Water Fund					
Capital Innovations					
Impax Asset Management Group					
Kleinwort Benson Investors/ KBI Institutional Water Fund					
Pictet Global Water Fund					
<b>Other Real Assets Investors</b>					
AltBridge Capital Partners					
Capricorn Investment Group/ Vision Ridge joint venture (SAF)					
Equilibrium					
T. Boone Pickens					
Ultra Capital					

Source: Equilibrium

There are more than 25 firms and funds with water and wastewater investments. In the Western states, a large percentage of the transactions have been investing in farmland with senior water rights and later selling the water rights at a higher price, primarily to municipalities. Aqua Capital Management, Vidler Water and Water Asset Management are a few examples of firms who have successfully implemented this strategy. These investors have a thorough understanding of state water laws and years of experience researching water rights, regulations and economic growth projections in communities with water scarcity challenges. That knowledge is an essential requirement, but their deals are done after developing a local presence and a very good understanding of the community dynamics from the sellers' and buyers' perspectives.

## Summary

### Market Opportunities and Obstacles for 3 Themes in 9 Western States

#### Equilibrium's Water Market Opportunities

Western State	Aquifer Storage & Recovery (ASR) & AR	Opportunity?	Greater Ag. Crop Value with AR	Opportunity?	Industrial Water Reuse	Opportunity?
California	Statewide need & irrigation district-led projects in Central CA. <u>Key risks:</u> lack of water to store during dry winters; competition for good deals; irrigation district politics; & lack of good teams with local experience.	<b>Yes, but challenging</b>	Stormwater & conserved water on farms can be stored, sold & leased in CA; large Ag. sector; & interest in the state in rotational fallowing programs.	<b>Yes</b>	<u>Great target market:</u> large # of firms in water-intensive industries; drought conditions driving need; & growing # of case studies in Southern CA.	<b>Yes</b>
Arizona	Well established water banks & Long-Term Storage Credits (LTSC) market. <u>Key risks:</u> lack of excess water to store; & only demand may be tied to Industrial water reuse.	<b>Limited</b>	<u>Major obstacle:</u> lack of excess water to store; farmers will have allocation cutbacks if Lake Mead falls below 1,075' on any January 1 <sup>st</sup> .	<b>Limited</b>	<u>Good target market:</u> supportive regulatory structure; drought conditions driving need; & medium # of firms in water-intensive industries.	<b>Yes</b>
Texas	<u>Obstacles:</u> burdensome permitting; dual-doctrine system limits ability to store stormwater; & concerns about regaining control of stored water due to the "rule of capture" law.	<b>No</b>	<u>Obstacles:</u> burdensome permitting; dual-doctrine system limits ability to store stormwater; & concerns about regaining control of stored water.	<b>No</b>	<u>Great target market:</u> large # of firms in water-intensive industries; supportive regulatory structure; & drought driving need in some regions.	<b>Yes</b>
Colorado	<u>Obstacles:</u> ASR only allowed in a few areas of CO; lack of excess water to store; can't store rain or stormwater; & primarily a municipal ASR market.	<b>No</b>	<u>Obstacles:</u> AR only allowed in a few areas -- the "use only once" water reg. applies to most of CO; & can't store rain & stormwater.	<b>No</b>	<u>Major obstacle:</u> Water reuse only allowed in a few areas; in most of CO, requests handled on a case-by-case basis.	<b>No</b>
New Mexico	<u>Obstacles:</u> chronic lack of excess water to store; NM has a complicated & expensive ASR regulatory process.	<b>No</b>	<u>Obstacles:</u> chronic lack of excess water to store; & complex AR regulatory process.	<b>No</b>	<u>Major obstacle:</u> not enough water-intensive industrial firms in NM.	<b>No</b>
Washington	<u>Obstacles:</u> ASR & AR are not allowed in WA; & water prices are too low.	<b>No</b>	<u>Major Obstacle:</u> Aquifer Recharge (AR) is not allowed in WA.	<b>No</b>	WA has a good # of F&B & other water-intensive industrial firms. Do low water prices limit # of water reuse deals?	<b>Yes</b>
Oregon	<u>Obstacles:</u> lack of water to store, even during winter months (Columbia River politics); & water prices are too low.	<b>No</b>	<u>Major Obstacle:</u> lack of water to store, even during winter months (Columbia River politics).	<b>No</b>	OR has a good # of F&B & other water-intensive industrial firms. Do low water prices limit # of water reuse deals?	<b>Yes</b>
Utah	Population growth & drought concerns are driving some interest in ASR, <u>but major obstacles:</u> little incentive for conservation; & influential water lawyers & large water districts have no incentive to improve & streamline processes.	<b>No</b>	<u>Obstacles:</u> little incentive for farmers to conserve water with some using 3x what they need to preserve water rights; & major lack of metering & data.	<b>No</b>	<u>Obstacles:</u> not enough water-intensive industrial firms; little incentives for conservation; & major lack of metering & data.	<b>No</b>
Idaho	<u>Obstacles:</u> limited demand; water scarcity is not a big issue; & water prices are very low.	<b>No</b>	<u>Obstacles:</u> limited demand; & water scarcity is not a big issue.	<b>No</b>	<u>Obstacles:</u> not enough water-intensive industrial firms; & water prices are very low.	<b>No</b>

Source: Equilibrium

The Industrial Wastewater Treatment and Water Reuse market segment has high potential in the U.S. water value chain. The top 5 states are: #1 California; #2 Texas; #3 Washington; #4 Oregon; and #5 Arizona. For our other two investment themes – ASR & AR projects and greater Agricultural crop value with AR – California again is the key Western state, followed by Arizona, whose opportunities are limited by the lack of excess water to store. Industrial Wastewater and Water Reuse projects in California could lead to opportunistic good ASR and AR deals in the same watershed, especially in Southern California.

## Main Takeaways:

- When water assets are fully valued and market priced, the laws of supply and demand will kick in. But the Western states' legal and market structures do not allow for market-priced mechanisms and trading at scale. Water scarcity is driving positive developments in some of the states, but it will take time. For example, it may take 10 or more years before water is **tradeable at scale** in California.
- Water markets will continue to be state-specific and trading will remain within watersheds.
- Despite regulatory hurdles, California and Texas are the best Western states for Water and Wastewater infrastructure investments – near and long-term. Arizona's water market is relatively efficient, but future water supply risks limit investment opportunities.
- The key to success is local knowledge and experience. It is important to understand the legal path at the water district level and nature's path at the watershed level.
- Water investments require long-term capital.
- The biggest challenge for investors is building a portfolio of repeatable and scalable projects.

Looking ahead, we will continue to learn more and refine our analysis of industry-specific Wastewater Treatment and Water Reuse opportunities and challenges in Western states and other regions of the United States. And as we expand our network of co-developers, we also will research the U.S. Municipal Water and Wastewater markets.

Equilibrium is committed to investing in real assets in the U.S. water value chain. We are focused on developing strong, long-term alliances with experienced partners to build and operate successful and profitable projects.

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- Water Asset Management – Matt Diserio
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