



Water: Emerging Risks & Opportunities

Introduction

On February 8, 2013, Goldman Sachs (GS), General Electric (GE), and World Resources Institute (WRI) convened a summit on “Water: Emerging Risks & Opportunities.”

More than 250 representatives from private sector companies; local, state and federal agencies; investors; as well as non-governmental organizations participated to help address key questions related to the intersection of capital, technology, and policy in meeting the U.S. water challenge.

The event coincided with the Northeast blizzard, Nemo, which brought home the acute impact of weather extremes. Despite the significant undertaking of addressing our nation’s water infrastructure deficit and the considerable economic consequences of extreme drought that has affected more than half the continental U.S., the discussion throughout the day was notably optimistic and highlighted a number of significant opportunities.

The following paper summarizes key takeaways from the summit.

Introduction

David Solomon – Goldman Sachs, Co-Head of Investment Banking Division

Water – Debunking The Myth

Ken Kopocis – Senior Advisor, Nominated EPA Assistant Administrator for Water
David Sunding – UC Berkeley, Professor / The Brattle Group, Principal
Kyung-Ah Park – Goldman Sachs, Head of Environmental Markets Group

Policy – Opening the Floodgates

U.S. Congressman Bill Pascrell (*D-NJ*)

Water and Energy – Friend or Foe

Paul Faeth – CNA, Sr. Fellow & Director of the Energy, Water, & Climate Division
Virginia Grebbien – Parsons Corp., President of Environment & Infrastructure
Sandy Stash – Talisman Energy, Global SVP, Health, Safety, Security, Environment, & Operational Assurance
Charles Iceland – World Resources Institute, Aqueduct Alliance Manager

Pricing Water – Journey to Efficiency

Pat Mulroy – Southern Nevada Water Authority, General Manager

Water Risk Management – Emerging Tools

Andrew Steer – World Resources Institute, President & CEO

Technology – Challenge of Scale-up

David Arison – MIYA, Director of Global Business Relations
Heiner Markhoff – GE Power & Water, Water & Process Technologies, President & CEO
Colin Sabol – Xylem, Senior Vice President and Chief Strategy & Growth Officer
Betsy Otto – World Resources Institute, Aqueduct Director

Capital Flow – Quenching the Thirst

Leigh Abramson – MetalMark Capital, Managing Director
Don Correll – Water Capital Partners, CEO & Co-Founder
Matt Diserio – Water Asset Management, President & Co-Founder
Jud Hill – NGP Global Adaptation Partners, Managing Director
Tim Romer – Goldman Sachs, Head of West Region Public Sector & Infrastructure Banking

Water Infrastructure – The Local Perspective

Cas Holloway – New York City Deputy Mayor for Operations
Jeff Kightlinger – Metropolitan Water District of Southern California, General Manager
Jon Freedman – GE Power & Water, Water & Process Technologies, Global Leader – Government Relations

** moderators are italicized*

Disclosures: This document has been prepared by the Goldman Sachs Environmental Markets Group and is not a product of Global Investment Research. The opinions summarized are not those of Goldman Sachs, are not endorsed by Goldman Sachs, and are shared in good faith based on public statements made by conference participants. This document should not be used as a basis for trading in the securities or loans of the companies named herein or for any other investment decision. This document does not constitute an offer to sell the securities or loans of the companies named herein or a solicitation of proxies or votes and should not be construed as consisting of investment advice. We are not soliciting any action based on this material. It does not constitute a recommendation or take into account the particular investment objectives, financial conditions, or needs of individual clients.



Capital Flow

The municipal debt market and state revolving loan funds have served most of the financing needs for U.S. water and wastewater infrastructure investment. However, funding resources at federal, state, and local governments are becoming scarcer. In the current market, where there are large pools of private capital looking for long-term yield, water investments offer a compelling alternative investment class. Investing in water infrastructure can offer long-term regulated rates that are inflation protected and less susceptible to economic cycles.

With this as a backdrop, unlocking greater private capital to address the water and wastewater infrastructure needs was a key theme of the summit.

Public-Private Partnerships:

Approximately 85% of the water and wastewater infrastructure in the U.S. is publicly-owned⁵. With growing financial constraints and aging water systems, there are signs of increasing willingness from municipal water and wastewater utilities to partner with private sector participants through public-private partnerships (P3s). P3s can offer an added financing mechanism to complement traditional tax-exempt municipal bonds.

Carefully constructed P3s enable the municipal water utility to retain ownership and oversight while bringing private sector management of the water and wastewater assets.

The private sector brings not only much needed capital to meet deferred investment but also the added benefit of operating expertise, innovative technologies, and economies of scale. In addition, there can be benefits from certain risk transfer to the private sector and expertise in managing maintenance and upgrades in an increasingly complex water and wastewater regulatory environment. The public-private sector synergies in turn can improve service reliability and quality while maintaining long-term rate stability.

For investors, P3 concessions can provide long-term inflation adjusted returns. Exit horizons can often be longer for infrastructure investors than traditional market investments, but concessions can be constructed to allow for exit by the investor and replacement, for example in 6 to 10 years, if terms of the contract are met.

Water utilities:

The water utility sector is very fragmented. There are approximately 155,000 different public water systems, and of that, around 50,000 provide urban water to over 300 million U.S. citizens⁷. Financial investors are finding

U.S. Water Facts

- American Society of Civil Engineers gives our nation's water systems a D- grade, the lowest of any infrastructure system¹
- \$633 billion in capital improvements are needed over the next two decades for drinking water and sewage to maintain current levels²
- U.S. economic implications
 - 2011 Texas drought caused \$8 billion in agricultural damages³
 - On average, 14% of water treated by water systems is lost to infrastructure leaks⁴

Private Capital (2012)⁶

- Global pension assets: \$27 trillion
- Uncommitted global infrastructure fund assets: \$68 billion
- US Corporate Cash (excluding financials): \$1.3 trillion

Bayonne, NJ Public-Private-Partnership

Don Correll (Water Capital Partners) shared an innovative P3 example. Bayonne Municipal Utilities Authority (BMUA) recently partnered with United Water and KKR on a 40-year water and wastewater concession. United Water and KKR will make an upfront payment of \$150 million to BMUA, which will be used to repay existing debt and improve general finances. Another \$157 million capital investment is committed over the life of the contract in the water systems to improve operational efficiency and quality. BMUA will retain ownership, provide oversight of the partnership, and maintain control of rates charged to the user, which will be guided by a formula in the agreement.

[Click here to read more about the Bayonne P3](#)

¹ American Society of Civil Engineers Infrastructure Report Card (2009)

² US EPA Drinking Water Infrastructure Needs Survey (\$334.8 Bn), US EPA Clean Watersheds Needs Survey (\$298.1 Bn)

³ AgWeb: 2011 Texas Agricultural Drought Losses Total \$7.62 Billion

⁴ EPA Water Efficiency Strategies

⁵ EPA Public Drinking Water Systems: Facts & Figures

⁶ Pension Fund Assets: Towers Watson Global Pension Asset Study 2012 (Top 13 countries); Infrastructure Fund Assets: 2012 Prequin Global Infrastructure, US Corporate Cash: GS Research S&P 1500 companies (excluding financials)

⁷ EPA Public Drinking Water Systems: Facts & Figures



opportunities to aggregate small water systems that might not have access to the tax-exempt municipal markets and do not have the economies of scale commensurate with well run larger water utilities. Leigh Abramson (MetalMark) discussed the opportunity in South Carolina to acquire a water infrastructure system, where the city recognized the value private ownership can bring. Through additional acquisitions and creating scale, there are significant efficiencies, which enable greater sum-of-the-parts valuations and enhanced returns. Matt Diserio (Water Asset Management) made a compelling case for investing in water utilities, where investors can earn returns that are inflation protected and can range from 10% to the low teens. Investor-owned water utilities have regulated rates that are set by Public Utility Commissions and cover the upfront cost of capital and operating expenses, which is often not the case for municipal water utilities. For example, in the UK, water infrastructure systems are mostly investor-owned, with privatization creating some GBP200 billion in value-add over the past twenty years.

Water rights:

Another investment thesis is in water rights, which is fundamentally about buying at lower values and selling at higher prices that the market can bear. Water rights are legally authorized rights to use water from a water source, and generally emerge from property ownership and the right to use adjacent bodies of water. The rights can also be created by contract when one person transfers the rights to another. Apart from buying and selling water rights, success highly depends on stewardship of the water resource. Stewardship entails respecting the resource and its value, and providing solutions in a way where everybody wins. There are opportunities for water rights investors to work with municipalities in helping aggregate water rights or provide annual allocations. The private sector can often bring nimbleness and value-add to negotiations with families and individuals who own the rights and help allocate the resource to higher value needs.

Other opportunities:

Jud Hill (NGP Global Adaptation Partners) described the global water market as a ~\$650 billion sector with multiple dimensions, complexities, and local considerations. Beyond the municipal sector, industrial companies have strategic needs to secure access to water supplies and high quality water. For example, microchip manufacturing and pharmaceutical companies require assurance to reliable pure water. There are opportunities related to this, given water becomes a value-driven proposition instead of solely price driven. There are also opportunities in the agriculture-energy-water nexus as in technologies that enable the recycle, repurpose, and reuse of water.



Policy Levers

A number of policy levers were emphasized at the summit, which could help stimulate private capital flow and greater adoption of technologies.

Private Activity Bonds:

U.S. Congressman Bill Pascrell (D-NJ) stressed the importance of a bill he introduced, the [Sustainable Water Infrastructure Act](#), which looks to expand private activity bonds (PABs) for water and wastewater infrastructure. PABs are tax-exempt debt, which local and state governments issue to fund qualified private projects. By lifting the cap on PABs, greater private capital could flow into water and wastewater investments, as is the case for airports and high speed rail projects, which are exempt from state volume limits. According to the Congressman, the tax-exemption of PABs would require approximately \$354 million in federal funds; however, this would translate into an estimated \$50 billion in private capital flow, which could support 1.4 million jobs in the first ten years. It also is estimated that the tax-exemption could add \$8.97 to the economy for each dollar spent in water infrastructure investment.⁸

⁸ Time to Invest in our Water Infrastructure by Rep. Bill Pascrell; Upgrading Water Infrastructure by Rep. Bill Pascrell



Pricing:

David Sunding (UC Berkeley) articulated the case for the appropriate pricing of water. According to a survey of 100 municipalities, residential water bills in at least one in four places have doubled in the previous twelve years.⁹ Despite the rate increases, U.S. water rates remain among the lowest of OECD countries¹⁰ though it is not actually cheaper to provide and treat water. Approximately 80 to 90% of total costs for water utilities are sunk or fixed costs; therefore the water pricing problem is fundamentally a cost recovery issue. Public agencies have a large degree of flexibility to cross-subsidize water utilities to artificially keep rates low. Pricing should ideally reflect the true economic worth of water, inclusive of its full lifecycle costs.

Ken Kopocis (EPA Office of Water) underscored the challenge of pricing water, which is done at the local level. While it is not the role or purpose of the EPA to determine the fair market price of water, the agency hopes to raise public awareness around the value of water and why it is essential to our economy. The EPA is undertaking a study on [The Importance of Water to the U.S. Economy](#), which will act as an agent of change to help shape conversations on the value of water at the state and local level.

Technology Innovation



Several leading water technology companies discussed the current environment of constrained capital flow from the municipal sector and why low water tariffs make adoption of technologies less attractive. Despite the constraints, there are increasing opportunities for technologies that enable greater efficiency in existing water infrastructure systems and solutions that convert wastewater to a resource.

Smarter water – Increasing water efficiency:

Measuring and reducing non-revenue water, the gap between the amount of water injected into the distribution system and the amount of water billed to consumers, is important in addressing our water inefficiencies and an increasing opportunity for the sector. High levels of non-revenue water reflect a mixture of physical water loss through infrastructure leaks or metering and data issues. There is a direct relationship between high water pressure and leakage in municipal water systems. Therefore, appropriately managing water pressure results in fewer leaks and decreased consumption. David Arison (MIYA) discussed technology suites such as NetBase Water Management software, which provides municipalities with the data monitoring and analytics needed to manage water flow, system pressure, and water loss – ultimately promoting more informed decision-making.¹¹

Water reuse / Energy efficient water:

Given increasing supply constraints, companies are turning to technologies that can enable wastewater to become a resource. These recycle and reuse solutions can meet water demand needs for non-potable water intensive sectors such as power generation. Technology solutions are also addressing the energy intensity associated with water delivery and treatment. One example mentioned by Heiner Markoff (GE) is membrane bioreactor technologies (MBR), which filter water, recover byproducts, and treat wastewater for recycling. GE's MBR technology is 30% more energy efficient than conventional water treatment technologies. Another example is a technology where the complete elimination of liquid discharge from an industrial manufacturing process can reduce both the waste and energy typically required for wastewater treatment. This process recovers distilled water for reuse while simultaneously creating beneficial salt byproducts, which can be used for de-icing roads or softening grey water.

Decentralization / Distributed systems:

Decentralized wastewater systems can also reduce the energy intensity of large concentrated water systems, which require significant energy to deliver water to points of consumption. Urban systems rely on pressurized water tanks that pump water into a tower and allow gravity to maintain a constant system pressure as water is

⁹ USA Today analysis: Water Costs Gush Higher

¹⁰ Organization for Economic Cooperation and Development (OECD)

¹¹ Netbase Software is owned by Crowder Consulting



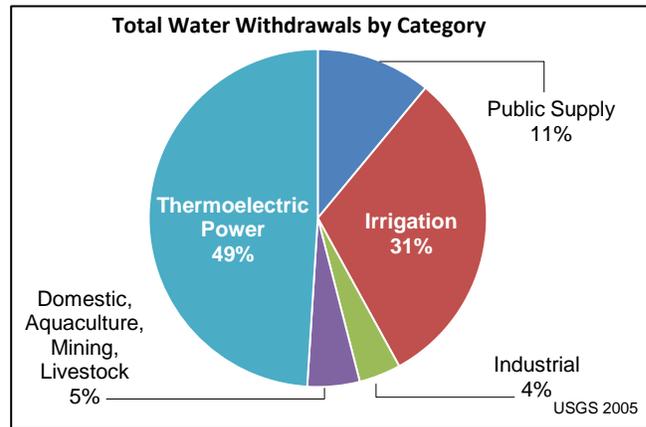
forced through the pipes. Decentralized water networks are adopted in developing countries where legacy infrastructure is absent. Regulations in many developing countries also facilitate the distributed water model. Colin Sabol (Xylem) discussed how, in China, new buildings with more than 100 inhabitants are required to have self-contained wastewater networks. In the U.S., this is challenging given existing infrastructure, but there are opportunities for technology to provide more modular on-site systems particularly to address industrial needs. For example, wastewater plants are addressing some of the water needs in the Pacific Southwest as much of the reusable water in large quantities can be redirected toward commercial purposes such as cooling water for power plants.¹²

The Role of Water in Energy

There is an inextricable relationship between water and energy – each is exceedingly dependent on the other. Approximately 50% of water withdrawal is from the power generation sector, resulting in extreme susceptibility to constraints in water availability.¹³ The vast majority of water used in the energy sector is for cooling at thermal power plants.

Power Generation:

The prolonged drought in Texas has made the energy sector's dependency on water much more acute – were it not for Texas' supply of wind power, which provides around 15% of the power requirements, the state would have faced widespread blackouts. Paul Faeth (CNA) pointed out how carbon pricing can play a role in incentivizing less carbon intensive power sources, such as renewables, which tend to be less water demanding. Incentivizing energy efficiency will also help reduce the amount of energy consumed, thus decreasing water needs for power production.



Shale / Hydraulic Fracking:

With the rapid expansion of shale exploration in the U.S., it is proving critical to develop technologies which address water and wastewater management in hydraulic fracturing (“fracking”). Though with greater use of natural gas for power generation, there have been benefits of both lower greenhouse gas emissions and lower water use relative to coal fired power generation, upstream fracking uses significant amounts of water and produces wastewater with fracking chemicals and high salinity.

According to the Shale Gas Information Platform (SHIP), drilling and fracturing a typical horizontal shale gas well requires roughly ten to thirty million liters of water, equal to eight times the volume of an Olympic-size swimming pool. Each well can also result in 20% of the water flowing back within the first 60 days. Technologies are helping to address the water challenge by enabling return water, also known as brine, to be recycled and reused.

The scale-up of exploration and production efforts have resulted in multiple companies often leasing and drilling wells in the same area. Sandy Stash (Talisman Energy) made a compelling case for optimizing cooperation among oil and gas operators to pool water needs and facilitate local wastewater treatment and reclamation opportunities.

How Much Water does it take to make electricity?

Fuel Source	Efficiency (liters / 1,000 kWh)
Natural Gas	38
SynFuel: coal gasification	144 – 340
Tar Sands	190 - 490
Oil Shale	260 - 640
Synfuel: Fisher-Tropsch	530 - 775
Coal	530 - 2100
Hydrogen	1850 - 3100
Liquid Natural Gas	1,875
Petroleum/Oil-Electric Sector	15,500 - 31,200
Fuel Ethanol	32,400 - 375,900
Biodiesel	180,900 - 969,000

Source: IEEE Spectrum

¹² EPA Water Recycling and Reuse: The Environmental Benefits

¹³ USGS Water Use in the United States (<http://ga.water.usgs.gov/edu/wateruse-total.html>)



She also cited how industry can partner with local water authorities in meeting mutual water needs.

Virginia Grebbien (Parsons) discussed how industry can help the public sector by better understanding project risks. For example, she cited that California doesn't have distributed recycled water projects for the energy sector because the state is concerned about who will operate and regulate them to ensure reliable and high quality water. The private sector can address this by coordinating with regulatory authorities and providing operational efficiency and safeguards.

Emerging Best Practices and New Models

Water challenges are very much local and there isn't a one-size-fits-all approach. Despite facing unique obstacles, a common theme among both municipal water utilities and local government representatives was the impact of severe weather on water infrastructure needs and the requirement to adapt to changing climate conditions. Diverse portfolios of solutions are needed, including conservation, efficiency, recycling, and additional conveyance and storage systems. Cities also are looking at integrating green infrastructure as a means for meeting needs more economically and increasing infrastructure resiliency.

Industry and Municipal Partnership

Shell and the City of Dawson Creek, British Columbia, partnered on a reclaimed water project, which will virtually eliminate Shell's need to draw on local fresh water for its Groundbirch natural gas venture. Shell's wastewater treatment facility will also provide additional water for industrial and municipal users, helping to alleviate the water shortage from one of the worst droughts in the City. Through a pipeline, which transports water from the treatment plant to the Groundbirch area, it is also anticipated to eliminate 3 million kilometers per year in truck trips over the course of the full gas field development.

Southern Nevada:

Pat Mulroy (Southern Nevada Water Authority) spoke about Las Vegas, the single driest city in the U.S., which depends on the Colorado River for nearly all of its water supply. Ninety-three percent of all Las Vegas water is recycled. The city has adapted to changing climate conditions by controlling system-wide water loss ratios to less than 1%. In addition, it has implemented an innovative four-tiered pricing scheme, which has incentivized conservation. Despite these measures, unprecedented low levels at Lake Mead in the wake of climate change have spurred additional investment requirements in the magnitude of \$3.5 billion, which will be borne by the community in order to build a new conveyance system to secure additional water supply.

New York:

New York City serves water to nine million customers, who consume one billion gallons each day, and processes 1.3 billion gallons of wastewater per day. Cas Holloway (New York City Deputy Mayor for Operations) described how New York's land conservation and watershed management program has provided an abundant supply of freshwater without the need for filtration. Filtration avoidance has provided significant cost savings in the range of \$10 and \$30 billion. Despite the high water quality, severe storms have increased occasions of turbidity (a measure of opacity in the water system), which can require shutting down water sources. Storm water also generates combined sewer overflow issues. Philadelphia and New York are among the cities looking at green infrastructure (distributed green roofs, rain gardens, and more permeable surfaces that can absorb rainwater) to reduce grey storm water infrastructure requirements while enhancing flood mitigation, air quality, and greener urban landscapes.

Southern California:

The Metropolitan Water District of Southern California ("Met") is a water wholesaler that represents a consortium of 26 member agencies serving 19 million customers. The water system is extremely susceptible to many of the issues highlighted in the wake of climate change and aging infrastructure.

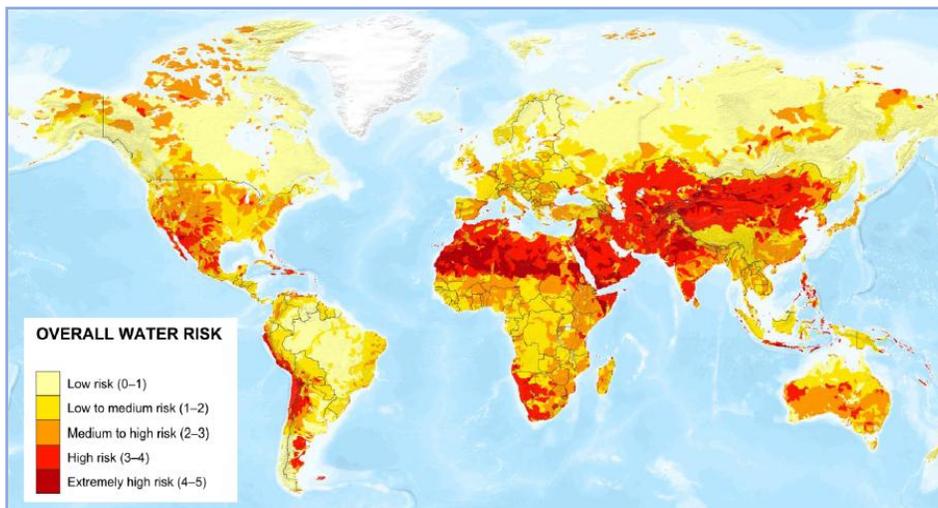
According to Jeff Kightlinger (Metropolitan Water District of Southern California), traditionally Met has relied on the snow-covered Sierra Mountains as a natural water storage mechanism; however, with warming climate conditions that have reduced snow fall and accumulation, they are now required to invest in significant infrastructure to capture, store, and transport water over long distances. Smart and adaptable infrastructure that adds water storage capacity to store water when available will help address the increasingly volatile water supply needs of this arid region.



The Aqueduct Partnership

The summit builds upon the ongoing partnership between GS, GE, and WRI. Goldman Sachs and GE are the founding members of the WRI Aqueduct Alliance, a partnership which brings together a number of leading companies to better address water risk through a global water risk mapping tool. The latest version of the [Aqueduct Water Risk Atlas](#) was revealed at the summit by WRI's President and CEO, Andrew Steer.

Aqueduct Water Risk Tool



Aqueduct's Global Water Risk Maps rely on 12 key indicators to assess physical quality and quantity risks along with regulatory and reputational risks.

Aqueduct will assist companies and investors to think about water risks related to supply chain, manufacturing, and investment. It will also highlight trends and opportunities to guide public sector leaders in achieving sustainable water resources management.

To view the thought leadership videos of speakers from the summit, please [click here](#).