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Accelerating & Sustaining the Water Innovation Ecosystem:

What's next?

Authors:

Janelle Heslop, Advisory Associate
Amanda Faulkner, Senior Research Analyst

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Introduction

In September 2013, Cleantech Group hosted its second annual Water Innovation Summit. Leaders from across the water sector—including venture capital firms, corporates, startups, and municipalities—gathered to discuss the technological, financial, and social challenges related to water innovation.

At Cleantech Group, we define water innovation as the technologies, business models, and partnerships that increase water supply and decrease demand throughout the water delivery and use cycle. As such we spent the two-day Summit examining opportunities for maximizing efficiency at each step. While this approach proved for a fruitful conversation, our greatest learning was that innovation will require rethinking of our often linear and sometimes cyclical approach to water distribution and use. At the core of innovation needs in this sector lie fundamental issues such as data transparency, financing, and infrastructure adaptation. These hurdles affect all parts of the sector and tackling them will require considering the challenges not as a cycle with upstream and downstream players responsible for their “phase”, but rather as a network of opportunities with each player interdependent upon the other to find solutions and develop approaches, leading to exponential efficiency gains.



The following sections capture our insights around challenges and opportunities for innovation at each step of the water delivery and use cycle. We then highlight a few markets that are prime for increased innovation and collaboration and review some of the financing challenges within the water sector. Lastly, we explore opportunities to accelerate innovation through a refreshed approach to collaboration as a sector.

Figure 1. *The Water Distribution and Use Cycle*



Opportunities for Innovation Across the Water Use Cycle

In the following sections, we examine the core challenges and opportunities for innovation throughout the water distribution and use cycle, with the first section focusing on supply.

Supply-side innovation: Envisioning a digital-age grid

Quality, access, and distribution can most easily define the supply challenges that are faced by both municipal and industrial users. While quality and access are of equally high importance, the imminent need to increase the efficiency of distribution systems makes it a huge opportunity for innovation. For many municipalities, aging infrastructure results in major water losses. As one of the Summit participants noted, the cost of fixing old pipes in the U.S.—over 25 percent of which are more than 20 years old—could cost upwards of \$30 trillion. Beyond just fixing old pipes, the core of the opportunity is in rethinking our water distribution system and infrastructure as a part of a new digital age.

100 innovator, **TaKaDu**, is leading the charge with its web-based platform that provides real-time alerts on inefficiencies, water loss, faults and other network problems. Other more comprehensive solutions not only identify inefficiencies but also deploy curing technologies to address them. If done at minimal cost, these all-in-one systems can help to address the challenge of both detection and repair with minimal disruption to the environment and infrastructure. **Curapipe**, for example, provides a comprehensive leak detection, sealing, and long-term curing system that results in trenchless intervention for infrastructure repair. More precocious ideas on this front explored at the Summit included deploying drones and robots to immediately detect and fix leakages!

Water Innovation Summit Sponsor



Provider of advanced pump solutions for water and wastewater treatment.

Innovation is needed to enable a more efficient infrastructure through digitized, automated, and data-centric approaches, reducing the price tag associated with fixing underperforming infrastructures. Leading innovators in this space are tackling the challenge associated with condition assessments, leak detection, and automated repair through digital platforms that bring hardware on line for real-time monitoring of water distribution networks. Cleantech

While increased interconnectivity of the entire distribution system is critical, innovation in this phase of the cycle will also require a new approach to hardware itself (e.g., pumps, valves, and pipes). **Grundfos**, global manufacturer of pumps for water supply and sewage, is leading the charge in the development of 'smarter' physical equipment noting that,

"...there are major opportunities in smart water. Upgrading legacy equipment with data enabling devices which in return provide real-time feedback on flow, pressure, temperature, etc. and further down the road real-time information on perhaps water quality is all very exciting."

*- Henrik Laursen, Director,
Grundfos Silicon Valley*



Consider, for example, how Grundfos is tackling the challenge of water pumping: over 85 percent of pump energy is wasted because pumps are often operated at a single speed; however, by integrating sensors and controls and variable speed drives, Grundfos has created innovative smart pumps that change speed based on flow rates and also alter pressure depending on demand in the piping system. In addition companies such as **Itron**, **ENBALA Power Networks**, and **Sensus** are enhancing asset management, metering, and grid reliability by connecting the individual components of a the water grid to enable more communication and ‘smarter’ interactions.

Data is a critical piece in a ‘smarter’ network. It allows suppliers to understand where water is being

Innovation Spotlight

curapipe

Israel

Developer of a leak curing solution for buried pipelines, primarily within urban water distribution networks that constantly leak

Paid-in-Capital: \$0.7 million

lost and how to manage these losses; this is the essence of a ‘smarter’ water grid. However, while bringing assets online and deploying more controls and monitoring software can help to enhance water management, there is a need to innovate collaboratively to ensure that data is truly usable

and of high-quality. As many Summit attendees noted, extracting more data from the grid must be coupled with finding new ways to unlock the value of that data. In other words, information needs to be standardized and interpretable for all parties. For example, data collected from TaKaDu’s web-based platform for detecting inefficiency must be able to communicate with data collected from Sensus’ utility metering products and solutions—otherwise data’s value is lost in its overabundance.

Demand-side innovation: Incentivizing customers & making the business case for efficiency

On the other end of the pipe is demand from both big and small consumers. Both municipal and industrial users want reliable, clean water and, more importantly, don’t want to pay much for it. The challenge for technology companies in this area is to provide solutions that decrease usage without affecting lifestyles or business operations. In addition, efficiency must not come at the cost of comfort or at the expense to the bottom line.



As one Water Innovation Summit participant commented, no user wants a technology that results in ‘cold showers and warm beers’.

Many of the most interesting demand-side technologies for residential and commercial use focus on enabling behavioral change. In the energy sector, companies like Opower and Tendril have dramatically reshaped how consumers engage with utilities by enabling consumers to make

informed decisions about how to reduce usage through increased data accessibility. In the same way, companies such as **WaterSmart**, a California-based provider of software that helps residential users track and modify their household water usage, are finding ways to help consumers understand and interpret data, leading to water conservation. For commercial users, enhanced data transparency can help to uncover opportunities to increase the bottom line by unlocking opportunities to reduce water use at mass scale. **Banyan Water**, for example, provides software solutions that use predictive and real-time intelligence and data analysis to manage water systems. Banyan operates under the fundamental idea that if property owners truly understood the scale of their water use, they would have more incentive to invest in water efficient-technology. In many ways, the key to innovation

Innovation Spotlight



California

Provider of water meter monitor and Internet-based water use efficiency solutions to monitor and compare water use

Investors: Clean Pacific Ventures, Grundfos

Paid-in-Capital: \$1.0 million

Aquacue was acquired by Badger Meter for \$14 million in 2013

on the demand-side is in creating awareness and many innovators are placing bets on data visibility as a way forward.

The main issue for industrial users remains the 'business case' for water use reduction. Physical (i.e., supply chain impacts) and the reputational risks are becoming an increasingly more important issue for businesses and as a result

industrial users have started to treat responsible water consumption as a license to operate, especially for consumer-facing companies like Coca-Cola and Nestlé. If a farmer doesn't have a reliable source of water, he or she can't produce crops. If oil extraction is happening in an area without a dependable source of water, extraction companies need to find such suppliers in order to be successful and—at times of equal, if not greater, importance—maintain good standing with local communities.

End of life innovation: Creating value from the sludge

While reuse and resource recovery technologies gain traction, core questions around how to capture the wastewater opportunity persist. These include a lack of understanding around scale, decentralized vs. centralized models, and the types of waters that can be used for reuse (e.g., "how dirty is too dirty for reuse?") just to name a few. As many attendees noted, given the complexity of the wastewater issue, this area of innovation is ripe for collaboration and partnership. While the technologies may not be analogous across industries or regions since wastewater effluent streams vary dramatically,

industry leaders noted that partnerships could clarify the most successful approaches, particularly in how to transform wastewater from an issue of risk management to a source of value.

Creating potable water of wastewater is likely the biggest hurdle in this phase of the water journey. While the technologies exist, challenges such as strict regulatory requirements, an effective business model for recovery, infrastructure adaptation, and negative attitudes towards reuse (e.g., the "yuck factor") continue to stifle large-scale efforts.



I. Opportunities for Innovation Across the Water Use Cycle

Overcoming these challenges will require new ways of engaging with consumers around the benefits and costs of reuse water for both grey and blue water uses. There are a few shining examples that can help provide a model for the way forward. The West Basin Municipal District in California has become a recognized leader in recycled water for potable consumption. Responding to a need to dramatically reduce the use of imported water, the District has implemented the largest water recycling facility of its kind in the U.S. and is now providing potable water for tens of thousands of residents. The key to their success has been in educating the public with a particular emphasis on communicating the benefits of reliability while also offering rebates and incentives for residential and industrial users to upgrade to more efficient systems as a part of the larger conservation effort.

Industrial users in particular are increasingly exploring reuse solutions as stringent effluent quality limitations force companies to invest in advance technologies. For example, innovators such as **Clean Runner** and **Oasys Water** are helping the Oil & Gas industry develop solutions for desalinating and

reusing produced waters from fracking processes, reducing the cost and risks of operating in water-scarce regions. However, innovation in the industrial sector can be more than just risk management and resource efficiency; many innovators are finding ways to provide technologies that convert wastewater into value, capturing additional value from industrial processes. These technologies range from **Fogbusters'** process for capturing biodiesel from fat and grease in food-based wastewater streams to **Pasteurization Technology Group's** process for combining wastewater disinfection and renewable energy generation for a number of industries.



Water innovation opportunities can often be stifled by the complexity and fragmentation of this diverse market. Manufacturing, agriculture, oil & gas, municipalities and power generation all have different water supply and technology needs. Each market, with its unique challenges, will require specialized solutions. Oil & gas has plenty of cash to spend on new technologies but is pushing the technological limits in new geographies and non-traditional sources. On the other hand, municipalities have fairly straightforward technology needs, but have major challenges financing infrastructure upgrades and modifying user behavior. By examining some of the largest markets prime for water innovation, we can better identify the major challenges and opportunities to overcome as a sector.

Oil & Gas

The Oil & Gas industry has long since used water throughout its value chain but as demand increases and unconventional fuel supplies are being unlocked there is an increasing scrutiny on the amount of water being extracted and quality of water being returned. Oil & Gas operators know that water provides a reputational risk if not addressed properly. And the magnitude of problem is enormous: according to Global Water Intelligence, eight barrels of saline and contaminated water are produced for every barrel of oil in North American onshore oil operations. Although regulation provides incentives to use water efficiently and not discharge improperly treated wastewater, the social license to operate is likely top of mind. However, each geographic area presents a different set of localized risks and regulations, making it difficult for these global companies to develop across-the-board solutions.

Innovative water startups have jumped into the Oil & Gas space wholeheartedly, developing new technologies for the sector, as well as modifying existing technologies to address this market. These technologies include water treatment and desalination for reinjection, enhanced oil recovery, fracking, and oil sands. Desalination is a particularly interesting area as developments in this space targeted for Oil & Gas markets can still contribute to the improvement of desalination technologies for

municipalities as well. Companies such as **Energy Recovery**, **Saltworks Technologies**, and **Desalitech** are working to improve desalination technologies, and more importantly, to bring down their costs. In addition to treating the salinity of produced water, Oil & Gas companies are looking for new technologies for removing oil and chemicals from the water in order to reuse or discharge it. **MIOX**, **APTwater**, **Axine Water Technologies**, and **newterra** are all addressing this market. Many of the companies in this area are targeting both municipal and industrial customers but find that Oil & Gas customers tend to have less risk aversion and more money to try new technologies.

Water Innovation Summit Sponsor

Energy Recovery - California



energy recovery™

Energy Recovery is a provider of solutions for desalination and for transforming industrial fluid flows and pressure cycles into reusable energy for the water, oil & gas, and chemical industries.

Agriculture

The agricultural sector is one of the largest users of water in the world and therefore is ripe for new innovative technologies and business models to increase efficiency. As one Water Innovation Summit attendee commented, “if agriculture diverts 70 percent of water in the U.S., then why are we talking about an app for home water conservation?”

The agricultural sector, however, is fragmented, with varying needs and regulations around the globe. Additionally, many of the innovative companies that focused on agriculture are not in the position to provide the venture returns that VC investors seek—they are more often hundred-year companies, not three-year quick investment exits.

Even if an agtech startup finds a need to address and develops an appropriate technology, growers tend to be risk-averse due to bad experiences with new technologies in the past. However, large buyers of agricultural commodities, such as Nestlé, are beginning to require sustainability and transparency from farmers, incentivizing farmers to try new technology solutions. In addition, organizations such as BlueTechValley of the San Joaquin Valley are bringing together growers, entrepreneurs, investors, and corporates to make significant headway in brokering new collaborations and approaches for water conservation in this fragmented market.

Another major challenge in the ag-water space is the issue of water rights. U.S. water rights were issued years ago and don’t necessarily reflect the needs or reality of today. In some cases, it is more lucrative for farmers to sell their water rights to municipalities and leave farming altogether. However, these perverse

Innovation Spotlight

PureSense
Irrigate with Confidence

California

Provider of software as a service to growers to manage irrigation and crop growth in real time and produce higher, healthier yields at lower total costs

Investor: One Earth Capital

Paid-in-Capital: \$10.3 million

incentives mean fewer farmers and potentially significant effects on food prices. Some of the investors present at the Water Innovation Summit mentioned the arbitrage opportunities present if farmers were better able to connect to one another, circumventing the volatility of water prices within a small region. Given the low

likelihood for revised water rights that reflect current realities, such an arbitrage scheme could improve the efficiency of this complicated system.

In addition to arbitrage of water prices, the agriculture sector presents a number of opportunities for water companies to innovate. Precision agriculture is a hot area, with a number of companies, such as **AquaSpy**, **HydroPoint Data Systems** and **OnFarm**, developing a system of sensors and software to make planting, chemical inputs, and irrigation more accurate. The technologies make farmers’ lives easier while saving water. Given the complexity of water rights and policy in this area, technology that makes a farmer’s life easier with a short payback period is going to be a success. And given the sheer amount of water that the agriculture sector diverts, these technologies could make a major impact in overall water usage.



Municipalities & Operators



Municipalities and operators possibly have the worst reputation as obstructions to innovation in this ecosystem. As large-scale suppliers of water to communities, their willingness and ability to implement new technologies, experiment with new business models, and explore innovative financing models are a major stage gate to mass adoption of disruptive technologies. However, the hurdles that municipalities and private operators face are unique and compounded. These include heavy regulations, inability to make compelling business cases for new or upgraded equipment given inadequate revenue models, lack of diverse methods for financing, limited methods for accessing innovation and understanding of innovation available to them.

There is an immense opportunity in connecting innovation ecosystems with water utilities. Doing

so could expose water utilities to new forms of innovation and provide a real-world environment to test new technologies and business and financing models. Consider the example of the Southern Nevada Water Authority (SNWA), which provides the nation's largest water conservation incentive programs. In addition to water conservation incentives and training programs, SNWA has found several ways to stay connected with innovation ecosystems that enable partnership opportunities and early access to new technologies. For example, SNWA hosts WaterSmart Innovations (WSI) to bring together the world's experts on water efficiency—a unique opportunity for SNWA to connect directly with water innovators right in their backyard. SNWA is also working with local organizations to develop programs that serve as incubators to connect the utility to promising regional innovation, and will accelerate the adoption of conservation-oriented devices.

In addition to connecting with startups, municipalities should also more regularly diagnose their innovation needs and collaborate through pilots and other mechanisms to understand how to better meet them.

In 2012, the California Water Fund helped to fund a one-year pilot with the East Bay Municipal Utility District to understand how WaterSmart Software, including customer usage reports and consumer education, could reduce residential water use. Pilots and programs such as these are also made possible by a cultural willingness to drive towards solutions and a bureaucratic structure that encourages and incentivizes utilities to 'experiment' with new things.

Innovation Spotlight



WaterSmart
SOFTWARE, INC.

California

Provider of software as a service to help residential users track household water usage

Investors: Draper Fisher Jurvetson (DFJ), Physic Ventures, The Westly Group, Apsara Capital, Menlo Incubator Partners, Sand Hill Angels

Paid-in-Capital: \$6.4 million



One theme that dominated the Water Summit conversation is the challenge of financing. Trillions of dollars will be needed to update aging infrastructure, install smart meters, and adapt to climate change; billions are also needed to fund innovation into new technologies and business models.

Financing needs are not hard to identify but can be tricky to fulfill.

Municipalities often struggle to invest in new infrastructure due to slashed budgets and the long payoff time for such investment. Likewise, venture capitalists have expressed interest in the water sector but only in companies that have a disruptive technology that could provide quicker venture returns. However, many water startups provide incremental improvements that are still extremely important. Given these challenges, what are some of the innovative, new financing models that are promising for this sector?

One important player focused on the emerging markets and large infrastructure challenges is the **International Finance Corporation (IFC)**, which provides investment, advisory and asset management services to encourage private sector development in developing countries. The organization provides investment, ranging from hundreds of thousands to hundreds of millions of dollars, to companies and projects across a number of sectors, including water. IFC investments in water include **dloHaiti**, a for-profit venture providing safe drinking water in underserved areas of Haiti; **Organica Water**, a Hungary-based provider of fixed-bed biofilm activated sludge wastewater treatment plants for urban and residential population centers; and **Waterhealth India**, a provider of decentralized water purification and disinfection systems that

Innovation Spotlight



Provider of Fixed-Bed Biofilm Activated Sludge (FBAS) wastewater treatment plants in urban and residential population centers

Investors: Gamma Capital Partners, International Finance Corporation (IFC), RNK CAPITAL, WLR China Energy Infrastructure Fund

Paid-in-Capital: \$17.6 million

Hungary

provide potable water solutions to underserved communities. The IFC's focus on innovations for underserved global populations provides a balance to the purely financial drive of the venture capital firms investing in the space.

However, the financial ambitions of venture capitalists can play a critical role in challenging

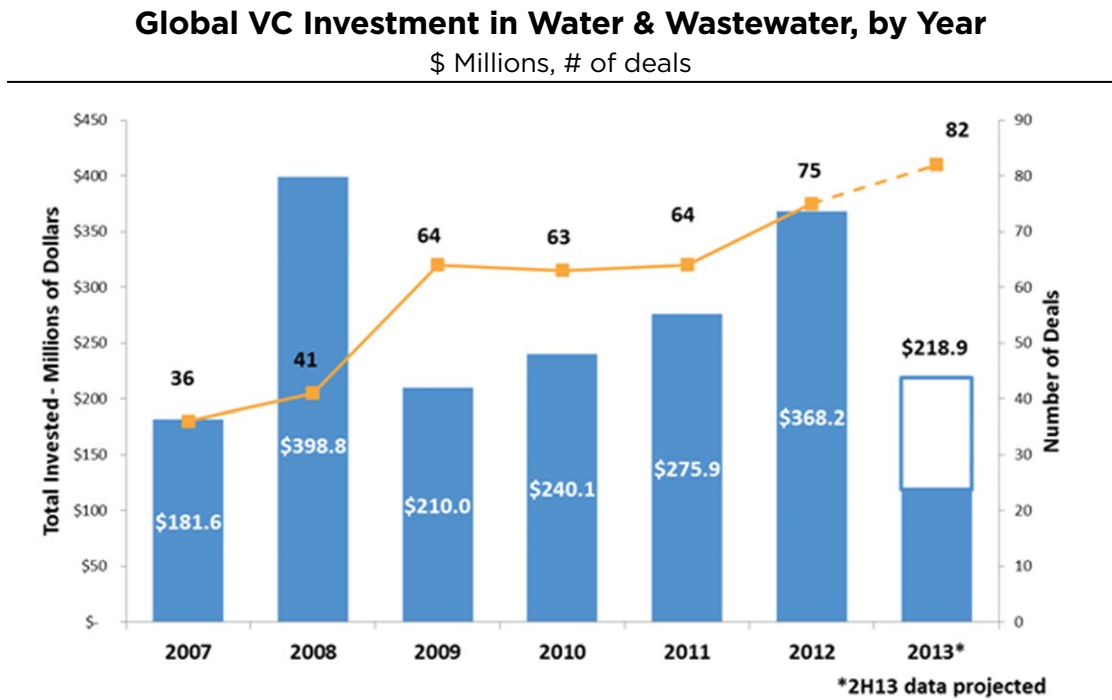
innovators to be disruptive within this sector. Venture capitalists are interested in companies that skip incremental improvement and go straight for ground-breaking; in this sector, which has long since focused on incremental efficiency improvements, those type of technologies can be challenging to find. The most active VC in the space is **XPV**, a Toronto-based firm that focuses on investments in emerging water companies, including **FilterBoxx**, **newterra** and **Global Water FATHOM**. In addition to XPV, a number of prominent VC firms have made investments in the space. However, as one VC partner commented during the Water Innovation Summit, most VCs don't look for water companies; they look for investment opportunities with potentially high returns and are happy to invest in water companies if they fit that criteria. **Khosla Ventures**, **Chrysalix Energy Venture Capital**, **Draper Fisher Jurvetson**, and **Kleiner Perkins Caufield & Byers** all have water companies in their portfolios. However, the lower risk, lower return bucket that water companies tend to fall into isn't exactly VCs' specialty. The lack of successful exits has also likely scared some VC investors away. There are some positive examples, such as Aquacue, but overall, the track record is less than compelling.

Despite the lack of exits, there has been a consistent flow of investment into this space. The number of

investments has risen steadily since 2007, with yearly VC totals of \$150 million or more. However, the projected dollar count in 2013 looks to be lower than that of the past few years. Across VC investing,

there has been a move to less capital-intensive companies, which is reflected in water given the increase in projected number of investments and decline in investment dollars.

Figure 2. Investment Trends in Water



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In the coming years, corporates will likely be a larger player in water investment. Corporates such as **Total**, **ABB**, **Unilever**, **Dow Chemical**, and **BASF** have all made significant investments in the water space. These companies have a more holistic view of partnering with water companies, looking at both the financial, strategic, and technological

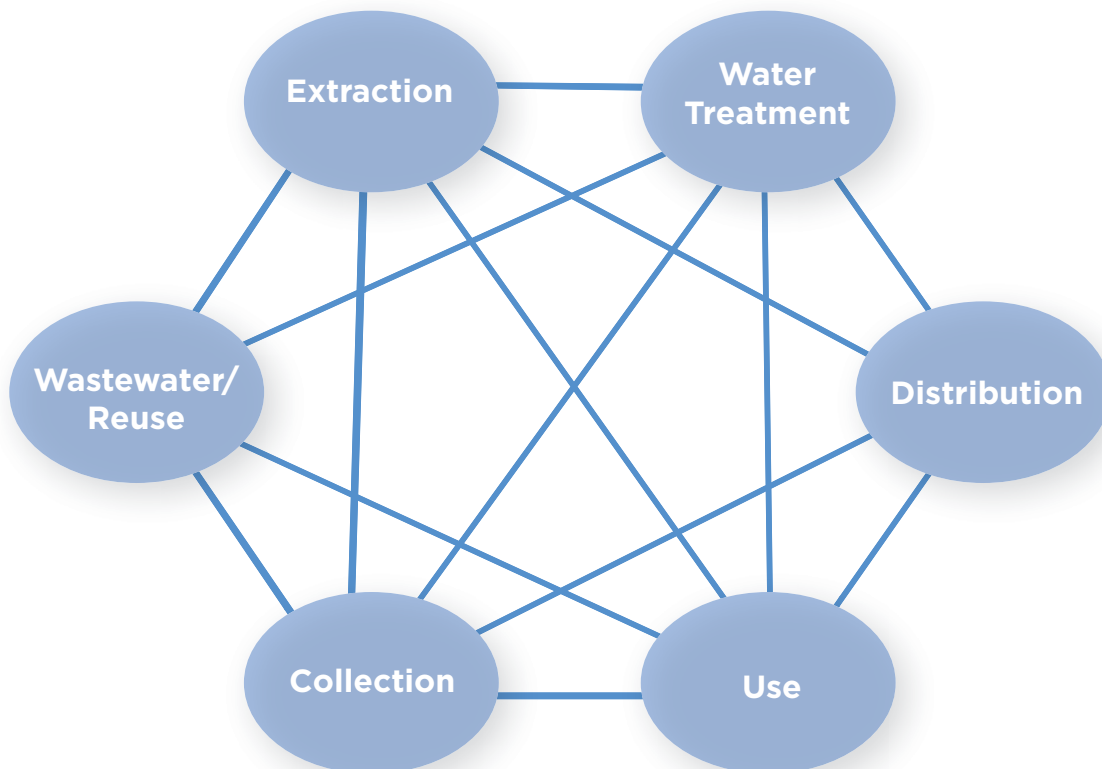
upside to investments. They see investing in water innovation as central to their ability to operate, rather than a purely financial decision. Incremental improvements in operations can actually be quite valuable to corporates, in contrast to VCs interested in only disruptive technologies.

IV. Accelerating Innovation by Collaborating in New Ways

While there are many innovators tackling specific issues, underlying challenges such as data accessibility and repairing and scaling infrastructure will require a new model of collaboration for innovation. Given the complexity of the industry across sectors and regions, there is an imminent need to begin solving challenges as integrated inputs. For example, when thinking about a 'smarter' water

infrastructure, we must consider the fragmented wastewater infrastructure as a critical piece—this was noted as a particular challenge by municipal operators working on integrating recycled water into current systems. This will require rethinking the current linear/cyclical process as an interconnected ecosystem of players who must innovate together.

Figure 3. Rethinking innovation along the entire water supply chain.



In practice, a network of innovation could result in an entirely new approach to how water is delivered to users and should start with diversified partnerships and intensified collaborations outside

of immediate focus areas. An early outcome will be technologies, business models, and collaborations that defragment current approaches while multiplying efficiency gains for the whole system.



In addition, the sector should consider a few of the following ideas as it recalibrates its approach to accelerating innovation:

■ Convene diverse forums to tackle complex issues.

It is not often that you find stakeholders, who include venture capital firms such as **XPV Capital**, Cleantech 100 innovators like **Ostara Nutrient Recovery**, Fortune 100 corporates such as **Dow Chemical** and **Chevron**, and federal regulators from the EPA working together to solve water challenges in the same room. While events like Cleantech Group's Water Innovation Summit are great for sparking dialogue, if these forums are not followed by frequent and productive forums for tackling fundamental issues, innovation in this sector will continue to happen in silos. The hurdles faced by the venture capitalist interested in investing in water innovation and the municipal utility operator working on operational excellence are dramatically different and need to be understood by each party through head on dialogue.

■ Integrate water challenges with other resources.

Water innovation should be integrated more broadly with other resource constraints. At the Summit, this challenge was acknowledged by energy-consumptive corporates, such as **Google**, that cannot afford to view these issues in isolation. Innovators solving for integrated challenges, such as Energy Recovery and Grundfos, who are considering energy and water efficiency gains in its technology development will be ahead of the curve. Innovators that can create value for users across multiple resources such as **Pasteurization Technology Group**, whose technology disinfects wastewater while creating renewable energy, will have the most success.

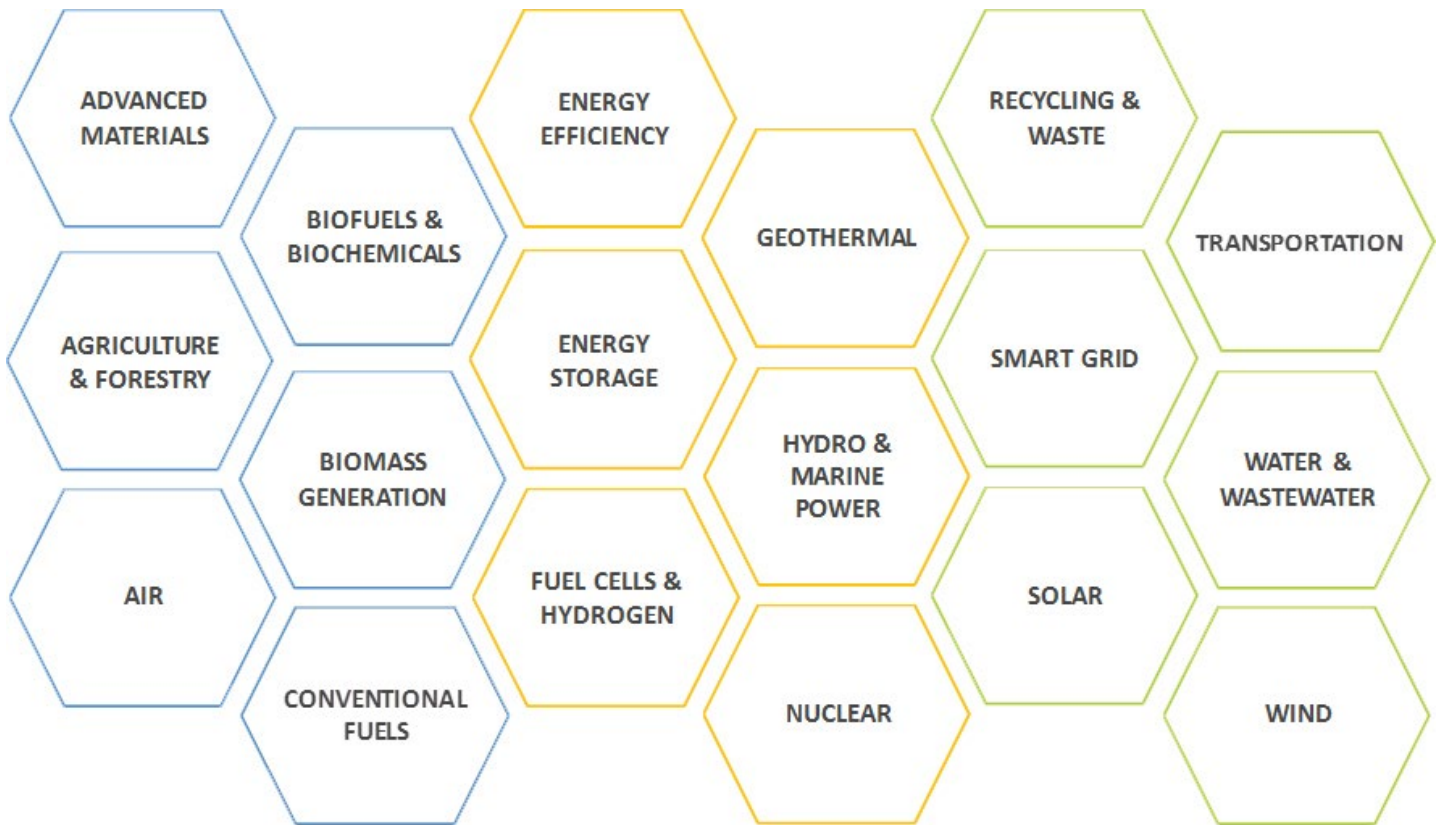
■ Accelerate innovation across borders.

Water is very often cited as a regional issue; and while it is, there is a massive opportunity to look for solutions beyond our borders. For example, as China rapidly scales up its water infrastructure, there should be significant knowledge and technology transfer and dialogue on the best approaches for this new innovation ecosystem to collaborate with other regions. Similarly, consider the opportunities to take innovations created to address the needs in developing nations and cross-transfer these innovations to do things better in developed nations. While there are clear challenges to making this happen (e.g., direct technology transfer is difficult, local content requirements or regulations act as borders), a global dialogue around water innovation will help to breakdown hurdles that can more quickly move towards solutions.

These approaches are difficult and will require collaboration and systems-thinking. However, the challenges faced by the water sector will only increase with aging infrastructure, security threats, increasing populations and changing climates. A network of innovation that uses increased communication between stakeholders, integrated solutions, and global approaches will provide the strength and flexibility needed to address these problems.



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About Energy Recovery



Energy Recovery Inc. (NASDAQ: ERII) technology harvests power from high-pressure fluid flows and pressure cycles. Through collaboration with industry, Energy Recovery helps make industrial processes within water, oil & gas, and other industries more profitable and environmentally sustainable. With over 15,000 energy recovery devices installed worldwide, Energy Recovery sets the standard for engineering excellence, cost savings, and technical services to clients across the globe. Year after year, the company's clean technologies save clients over \$1.4 Billion (USD) in energy costs. Headquartered in the San Francisco Bay Area, Energy Recovery has offices in Madrid, Shanghai, and Dubai. www.energyrecovery.com

About Grundfos



With an annual production of more than 16 million pumps, Grundfos is the global leader in advanced pump solutions and a trendsetter in water technology, specializing in circulator pumps for heating and air conditioning as well as centrifugal pumps for industrial applications, fire protection, water supply, wastewater and water treatment. In addition to pumps, Grundfos produces standard and submersible motors as well as state-of-the-art electronics for monitoring and controlling pumps. Since its inception in 1945, the company has flourished from one small factory in Bjerringbro, Denmark to a global corporation comprising more than 80 companies and over 18,000 employees. In 2012, Grundfos reported net revenues totaling \$4 billion.

In North America, Grundfos employs more than 1,600 people – and is continually expanding its regional expertise. In Canada, Grundfos has a sales facility in Oakville, Ontario.

High on the company's corporate agenda is an active commitment to improving the environment. Grundfos contributes to global sustainability by pioneering technologies that improve quality of life for people and care for the planet. For more information, visit www.grundfos.com