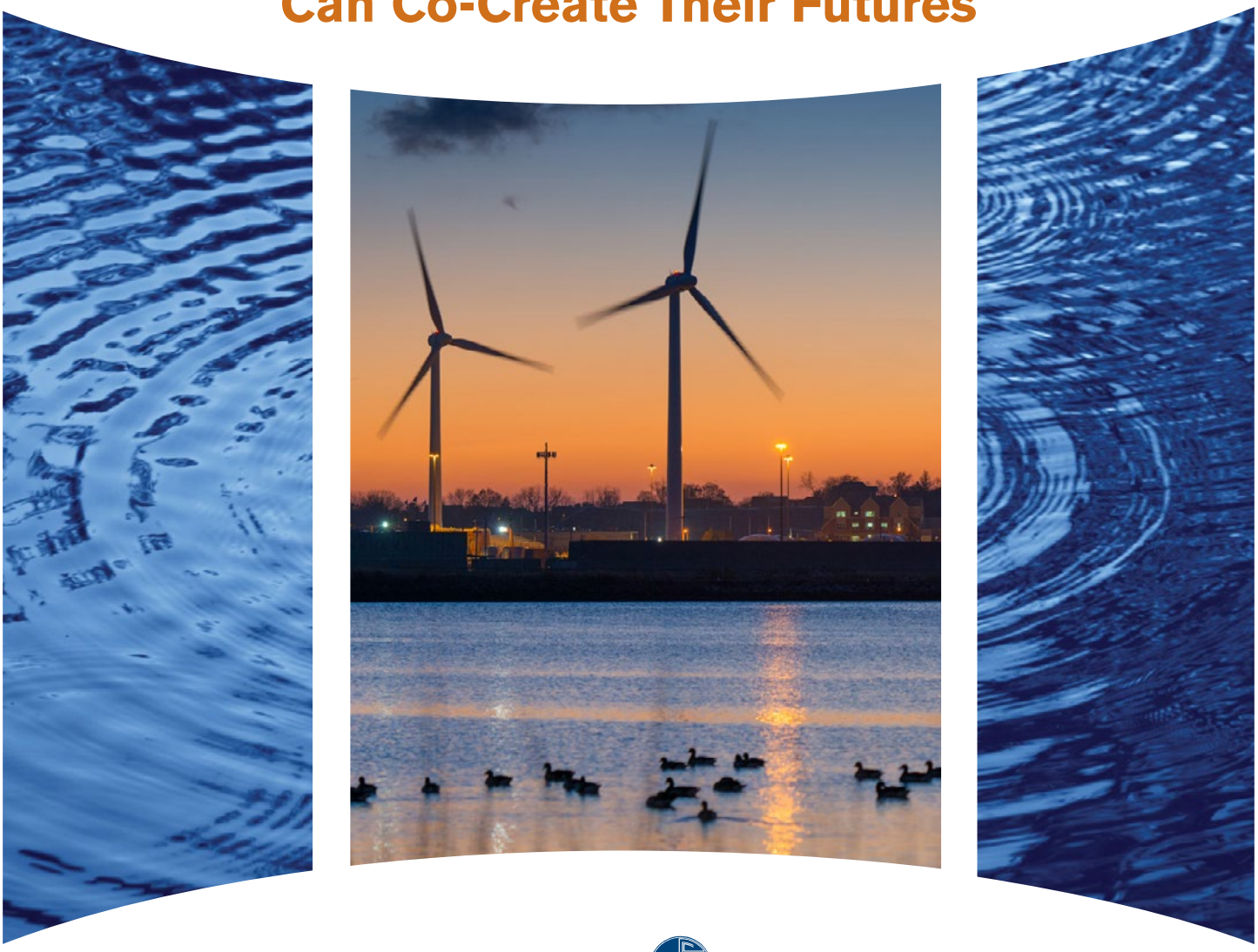
November 2013

Charting New Waters

# Building Resilient Utilities

## How Water and Electric Utilities Can Co-Create Their Futures



The Johnson Foundation AT WINGSPREAD

### *About The Johnson Foundation at Wingspread*

The Johnson Foundation at Wingspread, based in Racine, Wisconsin, is dedicated to serving as a catalyst for change by bringing together leading thinkers and inspiring new solutions on major environmental and regional issues. Over the course of 50 years, The Johnson Foundation at Wingspread has inspired consensus and action on a range of public policy issues. Several organizations have roots at Wingspread, including the National Endowment for the Arts, National Public Radio, the International Criminal Court and the Presidential Climate Action Plan. Building on this legacy, The Johnson Foundation at Wingspread has set a new, strategic mission designed to achieve greater, more sustained impact on critical environmental issues. Launched as part of this new direction is Charting New Waters, an alliance of leading organizations calling for action to avert the looming U.S. freshwater crisis.

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# Building Resilient Utilities

## How Water and Electric Utilities Can Co-Create Their Futures

### Convening Report

**Meeting Convened by**
**The Johnson Foundation at Wingspread**
**August 21–23, 2013**

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# Letter from the Director

***How can water utilities and electric utilities help each other reduce costs, stretch their resources and respond to climate change?*** As part of Charting New Waters, a multi-year effort to address growing concerns about U.S. water sustainability, The Johnson Foundation at Wingspread invited a diverse array of stakeholders to come together in August 2013 to explore this question.

This latest report in our Charting New Waters series, *Building Resilient Utilities: How Water and Electric Utilities Can Co-Create Their Futures*, reflects the discussions from the August 2013 gathering. Together, the participants began to talk about a "utility of the future" and a "customer of the future." As we move toward more resilient and sustainable service delivery, the traditional lines between electric, water supply and wastewater utilities begin to blur.

Water utilities need energy, and energy utilities need water. Lots of it. At the same time, a growing number of water utilities are generating electricity and transportation fuels. And many electric utilities have a use for wastewater to cool their facilities. Utilities of all types are feeling the impacts of a changing climate, yet few have explored ways to work together to either mitigate or adapt to those impacts. This report captures the outcomes of the August meeting in four main sections:

- ***Opportunities*** at the water–energy nexus,
- ***Hurdles*** to cross-sector collaboration,
- ***Recommended strategies*** for catalyzing cross-sector collaboration, and
- ***Envisioning*** the integrated utility of the future.

We are committed to keeping the conversation going outside the walls of Wingspread. Alongside the report, we invited four participants to contribute additional thoughts to our new online dialogue, Inspiring Solutions. I encourage you to take some time to read this report and to visit Inspiring Solutions to gain additional perspective on how we can co-create the utility of the future.

We know that this report, and the conversations that underpin it, are a beginning rather than an end. There was wide recognition among the participants that additional perspectives, especially from the electricity side of the equation, will strengthen the opportunities moving forward.

We have learned throughout Charting New Waters that by bringing together partners like you – partners with different experiences and perspectives – new ideas emerge. I can't help but be optimistic when I see and hear the hunger for change and the ideas for how we can shift to a framework for long-term sustainability and resilience.

As always, I am grateful to those who participated in this meeting and its report, and to all those who have joined us on this journey.

Thank you for your continued partnership,

Lynn Broaddus
Director, Environment Programs
The Johnson Foundation at Wingspread

# Introduction

***Electricity. Water. Wastewater treatment.***
Three essential services that underpin our 21st century American way of life. Three arteries that support commerce, recreation, households, hospitals and schools in communities large and small across the United States. Without electricity we do not have drinking water and wastewater treatment, and without clean drinking water and wastewater treatment public health is put at risk.[1]

These essential services and systems were traditionally planned, designed and operated with an assumption that water and energy were, and would continue to be, inexpensive and plentiful, and that there would be no constraints on carbon dioxide or other greenhouse gas (GHG) emissions.

But conditions have changed. Today's water and power sectors – historically focused on providing safe, reliable and available resources at the turn of a tap or the flip of a switch – must now navigate a transition to a new paradigm in which sustainability (environmental, economic and social) and resilience (to acute disasters, chronic challenges, peak demand and other global trends) must become core values.

Climate change is increasingly exacerbating crises that put these essential services at risk – from destructive storms like Hurricane Katrina and Superstorm Sandy to drought that has afflicted large swaths of the western United States. In the face of an uncertain future, U.S. water and electric power utilities are working to strengthen their resilience to extreme events, while many are also seeking ways to mitigate climate change.

### Charting New Waters

The latest phase of Charting New Waters is focusing on water infrastructure. Specifically, this work aims to catalyze the widespread adoption of more sustainable and resilient water infrastructure systems in the United States. It is focused on synthesizing and disseminating information that helps local, state and national leaders set a course for and navigate decisions regarding the construction, financing, management and maintenance of sustainable and resilient water infrastructure for the future.

The Johnson Foundation AT WINGSPREAD

*Conferences that Inspire Solutions*

Water and wastewater utilities are among the largest consumers of energy in communities across the United States.[2] At the same time, electric utilities are facing an increased risk of curtailed operations and temporary shutdowns at thermoelectric power plants (i.e., those that run on coal, natural gas or nuclear power) because of decreased water availability for cooling.[3] In the water sector, technological innovations and enhanced energy efficiency offer opportunities for utilities to significantly reduce or eliminate their net energy use while also achieving greater nutrient recovery and more efficient use of water itself. Recognizing the interplay among these resources, wastewater utilities have come together to set a vision for a "water resources utility of the future."[4] Water supply utilities are also examining opportunities to innovate and increase efficiency. Electric utilities are undergoing their own transformational process, as they seek to reduce water use, curb GHG emissions, address air quality issues and cope with increasing energy efficiency and integrating renewable energy resources into their portfolios.[5] Yet despite the inextricable link between the water and electric power sectors and the major potential to leverage investment in both infrastructure systems as they transition to the future, advancements in these sectors are largely occurring independently of one another.[6] (Note: For the purposes of this report, *water sector* and *water utility* both encompass wastewater and water supply, unless otherwise distinguished.)

In August 2013, The Johnson Foundation at Wingspread convened a group of water and energy experts and asked them to explore how the water and electric power sectors can co-create their futures.[7] Can they be more successful and more readily achieve, or even surpass, their goals if they work together? Discussions centered on how to cultivate greater collaboration between the water and electric power sectors to facilitate resource management solutions that generate multiple benefits. Participants framed key opportunities for greater cross-sector collaboration and identified hurdles that inhibit water and electric utility synergies. In particular, the group explored synergies, efficiencies and mutual benefits in water and energy use that can come from collaborative planning and integrated facility design, siting and management. This report presents The Johnson Foundation's synthesis of the information, insights and ideas shared during this thought-provoking conference.

*Technological innovations and enhanced energy efficiency offer opportunities for utilities to significantly reduce or eliminate their net energy use while also achieving more efficient use of water itself.*

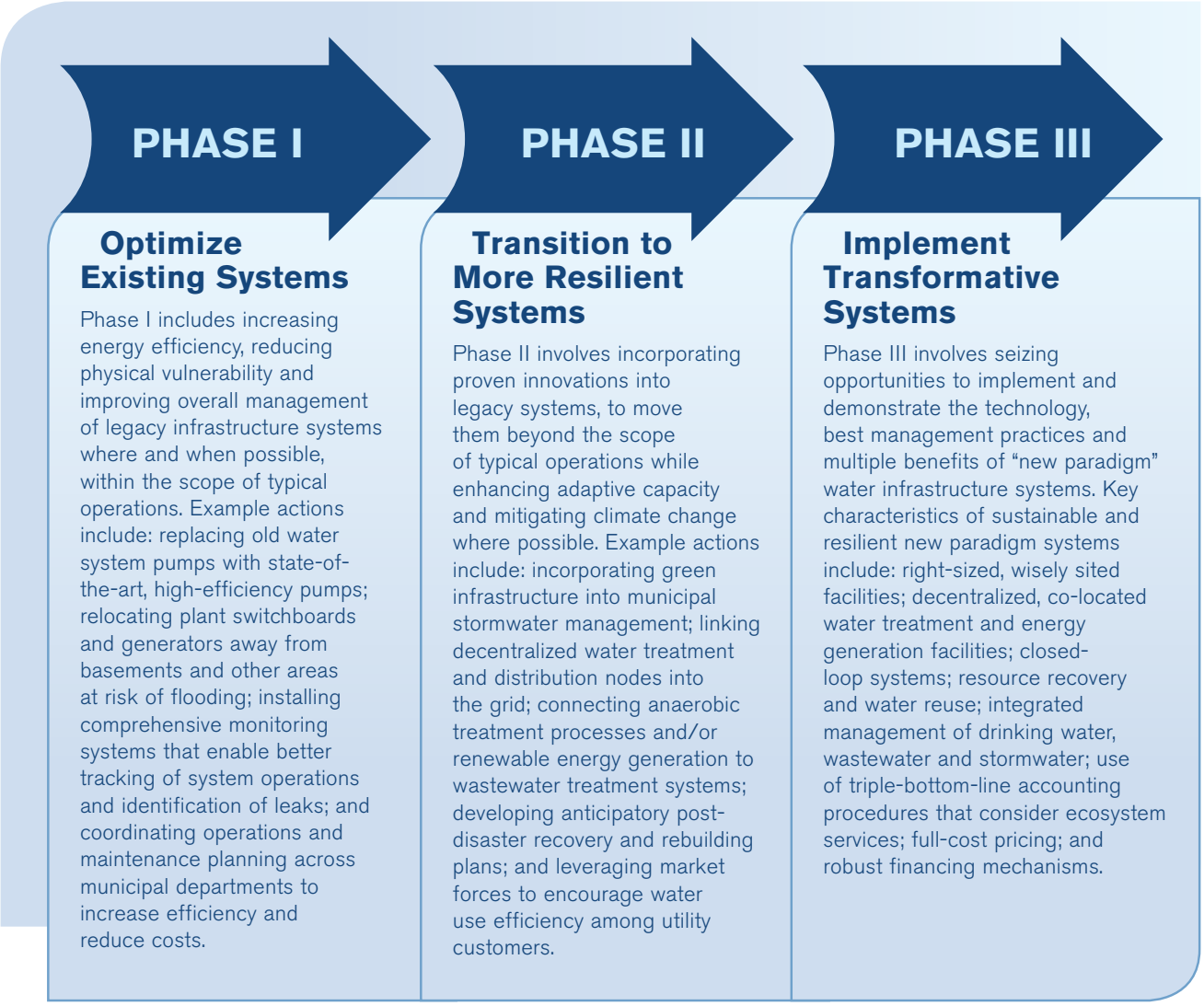
Image courtesy of The Johnson Foundation at Wingspread

Living Room in The House, The Johnson Foundation at Wingspread, August 22, 2013

## Navigating Toward the Infrastructure of the Future: Integrating Water and Electricity

The July 2013 Charting New Waters report, *Catalyzing the Transformation of U.S. Water Infrastructure*, presented a "Framework for Change" aimed at catalyzing movement toward the water infrastructure of the future.[8] This framework reflects a continuum of change – from optimizing legacy systems to implementing new, transformative systems – and the reality that change most often occurs incrementally, but not always in a linear fashion. Figure 1 depicts the Framework as presented in our July 2013 report, while Figure 2 reflects refinements and water–energy examples from the August 2013 conference. The Johnson Foundation will continue to vet, refine and build out this Framework for Change throughout the current phase of Charting New Waters, with the ultimate goal of creating a graphic that synthesizes the range of ideas captured during this phase of work.

## Figure 1: Framework for Change *July 2013*



# Figure 2: Framework for Change: Water–Energy Examples

PHASE 3

## Fully Transform Systems

**Example:** Build an integrated resource management facility that receives and treats wastewater to direct potable reuse quality, recovers nutrients for fertilizer production and is a net energy producer utilizing organic waste and/or other renewable energy sources.

PHASE 2

## Transition to More Resilient Systems

**Example:** Harvest methane-rich biogas from anaerobic digesters at a wastewater treatment plant to power turbines and generate a portion of the plant's electricity.

PHASE 1

## Optimize Legacy Systems

**Example:** Conduct an energy audit of an existing water infrastructure system and implement measures to increase efficiency and improve overall energy management.

Phase #1 image courtesy of *Water System Operator* magazine
Phase #2 image courtesy of East Bay Municipal Utility District
Phase #3 image courtesy of Natural Systems Utilities

# Opportunities at the Water–Energy Nexus

The utilities that provide water services and electricity in the United States are navigating a transition from the systems and assumptions upon which they were built in the 20th century to a new paradigm in which sustainability and resilience are becoming core values. These utilities were planned and designed under the assumption that water and energy would always be cheap and plentiful, and well before the effects of carbon dioxide on climate were widely known. But today, conditions have changed, and the time is ripe to catalyze greater understanding, stronger coordination and a shared vision between the water and electric power sectors. The group convened by The Johnson Foundation in August 2013 identified the following areas of opportunity for these sectors to collaborate and lead the way toward the infrastructure of the future together:

*The time is ripe to catalyze greater understanding, stronger coordination and a shared vision between the water and electric power sectors.*

- Proactively manage electricity demand,
- Enhance energy efficiency and bolster alternative generation,
- Shift to clean power sources,
- Leverage resource recovery opportunities,
- Shape federal and state policy, and
- Engage in community development and resilience planning.

## Proactively Manage Electricity Demand

Water and wastewater utilities account for approximately 5.5 percent of all electricity used in the United States, not including additional building-level energy inputs for pumping and heating.[9] Therefore, energy management strategies in the water sector can have significant implications for the power sector. Most water utility managers have flexibility regarding when and how they treat and pump water, which means they can alter the timing of certain energy-intensive processes to align with the periods of greatest electricity availability. This would generally be of great value for electric utilities, which have multiple reasons for wanting to shift peak electricity demand to times when lower-cost electricity is bring produced. For instance, peaks are the point at which the electric grid is at the most risk of failure. Meeting peak demand also frequently requires large capital investments to increase electrical grid capacity to meet demand for short episodes with high marginal cost. For most traditional thermoelectric power plants, the greatest availability of electricity (and hence the lowest-cost electricity) is during nights and weekends. But for renewable sources of power, the greatest availability may be at other times of the day, week or season. For example, providers that rely heavily on photovoltaic generation may find it advantageous for water utilities to concentrate energy-intensive operations during daylight hours when solar power is plentiful.

Potential ways to catalyze proactive demand management by water utilities include offering reduced rates for shifting electric use to the times when there is the greatest gap between electricity

production and demand. This needs to be coupled with reliable information regarding when the off-peak times are likely to occur. Third-party companies such as EnergyConnect by Johnson Controls are providing demand response services that facilitate the transmission of real-time information between grid operators and electricity consumers (including water utilities such as that in the Hampton Roads Sanitation District in Virginia), creating better alignment between grid capacity and energy use.[10] Numerous opportunities exist to create additional win-wins like this across the sectors. The prospect of the water sector shifting its electricity demand to align better with availability should be particularly appealing to electric utilities whose system capacity is already stretched thin, as they face a future in which climate-change-related temperature increases and population growth are expected to drive peak electricity loads ever higher.[11]

## Enhance Energy Efficiency and Bolster Alternative Generation

Many water utilities are actively working to reduce the energy and GHG footprints of their facilities and ease the load on the existing power grid by increasing efficiency and generating energy on-site.[12] Wastewater treatment plants can optimize the energy efficiency of their core equipment by using variable frequency devices, implementing energy-saving automation schemes and right-sizing impellers. In addition to developing traditional hydropower projects, water utilities are beginning to explore the potential to generate energy by retrofitting water collection and delivery conduits with in-line hydro turbines.

Distributed energy generation technologies already in use at treatment plants include solar arrays, wind turbines and biogas-powered combined heat and power (CHP) systems. In 2012, the wastewater treatment plant operated by the East Bay Municipal Utility District in Oakland, California, became the first net-positive, energy-generating wastewater plant in the United States; it uses biogas (from anaerobic digesters that process sewage and

### Mining Sewers for District-Scale Electricity: The Village on False Creek

Image courtesy of Ausenco Sandwell

The Neighbourhood Energy Utility (NEU) serving the Southeast False Creek community in Vancouver, British Columbia, was the first utility in North America to use waste heat recovery from untreated urban wastewater. Sewage heat recovery supplies approximately 70 percent of the utility's annual energy demand, with solar panels on buildings in the neighborhood providing the balance of the supply. The NEU has reduced greenhouse gas emissions by more than 50 percent compared to conventional energy sources; stabilized energy costs for customers, compared to more volatile fossil fuel prices; and, as a self-funded utility, provided a return on investment to taxpayers.[13]

other biodegradable waste) to power low-emission gas turbines.[14] Other wastewater facilities, such as the Stevens Point Wastewater Treatment Plant in Wisconsin, are now net exporters of energy in at least some months of the year, while others are working toward it in their future.[15] The Sanitation Districts of Los Angeles County's Joint Water Pollution Control Plant is self-reliant with respect to power generation, and the municipal wastewater plant in Gresham, Oregon, aims to produce all of its own electrical power on-site by 2014 by utilizing a solar array and a CHP system.[16] Extracting thermal energy from sewer lines to power steam turbines is another emerging practice that has the potential to bolster the electrical grid. In New Jersey, the Camden County Municipal Utilities Authority is currently planning a sewer heat recovery demonstration project with a $1 million grant from Public Service Electric and Gas, the local power utility. These and other pioneering wastewater utilities are creating models that can be replicated in communities across the nation.

*Water utilities could also have an impact in shaping the market for clean electricity generation and supply through active engagement with the electric power sector.*

## Shift to Clean Power Sources

While momentum is increasing in the water sector to reduce electric grid loading and GHG emissions and help diversify community energy portfolios, water utilities could also have an impact in shaping the market for clean electricity generation and supply through active engagement with the electric power sector. As large energy consumers, water utilities are in a position to use their purchasing power to encourage electric utilities to reduce their GHG emissions and water consumption by specifying, or even demanding, that their electricity be generated from clean sources. Major companies such as Google and Microsoft, as well as institutions such as colleges and universities, hospitals, municipal governments and U.S. military bases, have set pertinent precedents that water utilities could follow.[17]

## Leverage Resource Recovery Opportunities

Wastewater and electric utilities can share resources in mutually beneficial ways, and many are already doing so. As of 2011, more than 65 electric utilities in the United States were using treated wastewater effluent (i.e., reclaimed water) as cooling water at power generation facilities.[18] Opportunities exist to vastly expand this number in places where plants are located in close enough proximity for resource sharing to be economically viable. This approach provides power plants with a reliable cooling water source while cutting costs and reducing freshwater use and consumption as well as the environmental impacts associated with obtaining an adequate water supply. In another example, waste heat from power plants can be transferred to wastewater treatment facilities, to bring down the heating costs relating to sewage treatment processes and/or desalination. It may also be in the interest of electric utilities to partner with water utilities or agencies to implement "green" infrastructure – that is, infrastructure that reduces the amount of stormwater entering treatment plants for processing (in combined sewer systems) while also sequestering carbon and mitigating the urban heat island effect in warmer months. The benefits of green infrastructure could indirectly reduce peak electricity demand by

reducing wastewater treatment and indoor cooling needs. Incentivizing the water and electric sectors to work together more would undoubtedly generate further site-specific opportunities.

## Shape Federal and State Policy

The opportunities for more efficient resource use, cost savings and community benefits that can be generated by stronger linkages between water and electric power utilities are garnering attention at the federal, state and local levels. At the federal level, the U.S. Department of Energy (DOE) is working to identify strategic energy–water policy and research and development priorities for the Department. At the state level, 29 states have renewable energy portfolio standards (RPSs) through which water utilities can generate credits for their electricity provider by installing on-site renewable generation such as photovoltaics or wind turbines.[19] However, many RPS programs do not provide credits for CHP systems, which are often used at wastewater plants. Some states have forged the path to allow electric utilities to receive alternative energy credits for CHP systems. In 2009, for example, Massachusetts established an Alternative Energy Portfolio Standard, which created incentives for businesses, institutions and governments to install alternative energy systems and included a requirement for energy suppliers to incorporate eligible sources (including CHP) into their portfolios.[20] Working together, the water and electric power sectors may be able to influence future policy decisions that create mutually beneficial opportunities.

## Engage in Community Development and Resilience Planning

At the local level, municipalities that own and operate both their water and electric utilities have perhaps the best opportunity to forge cross-sector relationships and leverage assets, since they have fewer structural hurdles and share built-in social goals. As an example, Austin Energy's Sand Hill Energy Center in Texas uses reclaimed wastewater from Austin Water's nearby South Austin Regional Wastewater Treatment Plant for cooling purposes.[21] This symbiotic relationship conserves potable water for the community and reduces operating costs at the publicly owned power plant, which results in more funding for city services such as fire, police, parks and libraries.[22] The growing national focus on community resilience to disasters presents another opportunity for these essential, interdependent utility services to collaborate, in particular on recovery planning. In addition to bolstering the ability of water and electric utilities to get back online rapidly following a disruption, collaborative efforts can help build relationships that spawn innovative projects. Neighborhood-scale redevelopment and revitalization initiatives also offer opportunities to demonstrate transformative, decentralized systems that generate power and heat from wastewater.[23] Often, however, municipalities that own and operate both their water and electric utilities have planning and management systems that are just as siloed as those under separate authorities.

*The opportunities for more efficient resource use, cost savings and community benefits are garnering attention at the federal, state and local levels.*

## Hurdles to Cross-Sector Collaboration

While many opportunities exist for the water and electric power sectors to help each other become more sustainable and resilient, there are also noteworthy hurdles, including:

- Lack of cross-sector understanding about operational needs and constraints,
- The nonstandardized nature of water sector energy projects,
- Traditional organizational structures,
- Lack of incentives to take risks,
- Financing challenges, and
- Regulatory and policy constraints.

At a fundamental level, there is a lack of understanding between sectors about their respective operational needs and constraints, as well as a lack of broad systems thinking about the interdependencies between them. Furthermore, water and energy utilities often have different goals and reward structures that create conflicting interests. Players in the water sector need to develop a better understanding of how the power sector is regulated and how the electrical grid is managed. While the power sector is quite heterogeneous, there are national reliability standards developed and enforced by the North American Electric Reliability Corporation, according to which all electric utilities must design their systems.[24] The nonstandardized nature of small-scale energy generation projects at wastewater facilities, therefore, is one reason electric utilities find it challenging to incorporate distributed generation sources into their portfolios. In addition, interconnection fees and approval processes, as well as net metering policies, present hurdles to connecting distributed generation from wastewater treatment plants to the electric grid.

*Players in the water sector need to develop a better understanding of how the power sector is regulated and how the electrical grid is managed.*

Existing organizational structures within each industry also perpetuate siloed planning processes and management strategies. Each sector has its own core statutes and regulatory agencies that enforce them. In addition, the workforce training system has not historically emphasized integration across the water–energy nexus. These are some of the underlying reasons why no planning framework exists through which the sectors can coordinate. Moreover, the concept of coordinated planning across the water and electric power sectors begs questions about incentives for the sectors to engage with each other, at what scale to engage, planning time horizons, jurisdictions and authority to operationalize plans.

Water and electric utilities are generally risk-averse institutions, and they manage their operations to meet regulatory standards and requirements. Uncertainty about the reliability of new technologies and the potential application of punitive regulations, as well as uncertainty about long-term operating costs and fluctuating financial markets, are all significant hurdles for stronger coordination between the water and electric power sectors. Existing disincentives must be removed and new incentives are likely necessary to motivate more actors in the sectors to break out of business-as-usual practices and go beyond compliance. Currently, many electric

utilities view distributed generation, including the renewable energy offered by water utilities, as a threat to their financial model and a nuisance to their operational procedures.

Obtaining financing for capital expenditures is also a significant concern for utilities, especially in the water sector. Existing pricing and rate structures are not generating revenues congruent with the investments needed to upgrade and transform water infrastructure, and in some cases to even effectively maintain existing systems.[25] Managers are often faced with budgets sufficient only to cover the cost of maintaining critical assets that represent sunk capital, with little if any funds allocated for discretionary spending on innovative new infrastructure projects. Without the right policies and incentives, these managers are unlikely or unable to take on the financial risk to implement new systems. Moreover, financial institutions do not necessarily possess adequate understanding of the risks (or lack thereof) associated with emerging technologies, making it more difficult for utilities to secure capital for new projects if and when they decide to pursue them.

The nation's regulatory and policy landscape also presents a range of hurdles to integration between the sectors. The existing regulatory paradigms for water (e.g., the Clean Water Act) and air (e.g., the Clean Air Act) are significant deterrents to innovation because of their punitive and sometimes conflicting natures. This reality hinders holistic consideration of environmental problems and the benefits of integrated solutions. In the District of Columbia, for instance, DC Water is developing new processes that will allow it to achieve higher nutrient recovery on a large scale while also reducing energy use, but concerns about short-term National Pollutant Discharge Elimination System permit exceedances while the process is brought on-line are hampering the utility's adoption of this technology.[26] There is a great need for regulatory flexibility at the federal and state levels, to allow for the demonstration and validation of new technologies while still meeting environmental protection requirements. In addition, outdated electric sector regulations prevent some utilities from making connections between water and energy infrastructure that could be realized today. For example, the Gloversville-Johnstown Joint Wastewater Facilities in New York State is prevented by existing regulations from exporting excess energy to the grid.[27]

As wastewater treatment plants turn to biogas-fueled energy generation, they may find themselves subject to the Clean Air Act in new ways. For example, any water or electric utility interested in developing a

Image courtesy of City of Gresham, SunEdison and REC Solar

City of Gresham, Oregon, wastewater treatment plant with on-site solar array

new energy generation source that would combust wastewater biogas or conventional fuels must first demonstrate that it would pass Clean Air Act air pollution dispersion modeling rules, which can be expensive and challenging, especially for utilities unfamiliar with these permits.[28] In fact, some wastewater utilities have had difficulty obtaining Clean Air Act Title V permits for biogas-fueled combined heat and power systems, despite the fact that CHP systems have lower pollutant and GHG emissions compared to the fossil-fuel-fired sources they are likely offsetting.[29] To work around such complications, DC Water has negotiated an agreement with Pepco Energy Services, the local electric provider, for Pepco to design, build and operate a biogas-fueled CHP plant on-site at DC Water's Blue Plains Advanced Wastewater Treatment facility.[30] Other wastewater utilities, such as the Janesville Water Utility in Wisconsin, are choosing to convert biogas into transportation fuel for compressed natural gas vehicles.[31] For the U.S. to take full advantage of the potential for biogas energy generation at wastewater treatment plants while meeting the goals of the Clean Air Act, it may be necessary for the water sector to forge new partnerships or find new ways to facilitate the task of regulatory compliance.

*For the U.S. to take full advantage of the potential for biogas energy generation at wastewater treatment plants, it may be necessary for the water sector to forge new partnerships or find new ways to facilitate the task of regulatory compliance.*

# Recommended Strategies for Catalyzing Cross-Sector Collaboration

The hurdles outlined above illuminate why most water and electric power utilities continue to build and operate conventional infrastructure and employ traditional planning and management approaches despite the potential benefits of greater collaboration. Recognizing that the United States' aging water infrastructure and shifting energy portfolio present an array of opportunities to redesign the nation's water and energy infrastructure, participants at the August 2013 Charting New Waters conference outlined practical ideas aimed at overcoming hurdles to collaboration between the water and electric power sectors. The strategies suggested include the following:

- Stimulate cross-sector communication,
- Partner on education and outreach,
- Engage in collaborative planning,
- Reduce disincentives and risks, and
- Identify regulatory constraints and opportunities.

## Stimulate Cross-Sector Communication

Improving communication and building relationships across the water and electric sectors is fundamental to reaching greater cross-sector understanding about the constraints they face, the opportunities that exist and how to break down barriers to integration. One option for fostering communication would be to establish a cross-sector task force to spearhead projects that benefit both sectors. Such a group could be jointly sponsored by the DOE, the U.S. Environmental Protection Agency (EPA) and/or water and energy sector associations. It could take on a variety of potential activities,

including: developing outreach resources to increase the understanding of planners, managers and oversight bodies about water–energy connections and opportunities; fostering the uptake of existing tools for utility managers; bringing together leading innovators to exchange ideas; and identifying additional practical pathways to bridge the water and electric power sectors. Such collaboration would also help build a community of practice that bridges the sectors. The Leaders Innovation Forum for Technology, jointly sponsored by the Water Environment Research Foundation and the Water Environment Federation, may offer a starting point for this kind of effort.[32]

## Cross-Sector Conversation Starters: Key Questions and Messages

Participants in the August 2013 Charting New Waters conference quickly recognized that the lack of cross-sector understanding was one of the key barriers to even considering collaboration, much less engaging in it. In the interest of initiating productive conversations between the water and electric power sectors, participants representing the water sector generated questions they would pose to power sector leaders, and power sector participants developed messages to help guide water sector leaders' approach to engagement.

### *Water Sector Questions for the Electric Power Sector*

Which stakeholders in your sector are essential to facilitating cross-sector integration?

How and to what extent is water factored into your long-term planning?

How can we help you address the water challenges you face?

What challenges does distributed generation pose to your business model?

How can interconnection and rate-setting processes be streamlined?

What would it take to achieve the co-location of water and power generation facilities?

How can we coordinate to minimize deleterious impacts to air, water and land resources?

How can we work together to eliminate the flaring of usable gas?

### *Electric Power Sector Messages for the Water Sector*

The electric power sector is extremely complex and must be understood locally, regionally and nationally, particularly in terms of its regulation by the Federal Energy Regulatory Commission.

Use caution in emulating rate structures from the power sector, and only adopt proven methods.

There is real potential for the water sector to help shave peak electricity demand.

There is significant unmet potential for the use of reclaimed water for thermoelectric power plant cooling.

Power plant waste heat could be a useful resource for wastewater treatment plants.

Conduct careful analysis of the economies of scale for distributed energy generation.

A coordinated cross-sector research and development agenda could help prevent unintended consequences.

## Partner on Education and Outreach

The water and electric sectors share a common challenge relating to education and outreach to ratepayers and elected officials. In particular, both face challenges explaining issues such as the rationale for conservation, the need for capital improvements and the long-term benefits those improvements promise. Therefore, water and power utilities whose service areas overlap could develop unified messaging that highlights the links between water and energy and underscores the importance of conservation, efficiency and infrastructure investment. They could also conduct joint market research to understand customers' willingness to test new technologies, services and products, and obtain feedback that could help bring successful demonstrations to broad-scale deployment. Together, the sectors can deliver a more powerful message and help build political support for innovative projects within and across the sectors.[33]

## Engage in Collaborative Planning

While it is unlikely that a widely accepted, shared planning framework will emerge in the near future, it is possible for water and electric utilities to begin engaging in joint planning activities. For example, neighboring water and electric utilities could conduct audits of one another's systems and identify ways

Image courtesy of City of Medford, Oregon Regional Water Reclamation Facility, photo by Walt Meyer

### Disseminating Best Practices for Energy Management at Wastewater Treatment Plants

The growing focus on energy management at water facilities has spawned program models and tools that water utilities seeking to optimize energy management and efficiency at their facilities can use. In 2010 and 2011, the Oregon Association of Clean Water Agencies delivered a 13-month energy management training program for water utility managers. Cosponsored by the Bonneville Power Administration, the EPA and the Energy Trust of Oregon, the program trained personnel from 13 Oregon, Washington and Idaho wastewater utilities on sustainable energy management. The training has led to substantial energy and cost savings for all of the participating utilities and continues to be offered.[34] In 2013, the Water Environment Federation published *The Energy Roadmap: A Water and Wastewater Utility Guide to More Sustainable Energy Management*, which serves as a guide for utilities of all sizes to pursue a path to sustainable energy management.[35] Broader dissemination and adoption of existing program models and tools like these could have a significant impact on how U.S. water utilities manage energy.

to enhance the efficiency of water and energy use, respectively. Utilities serving common geographic areas could also collaborate on scenario planning, with an emphasis on ensuring the resilience of their interdependent systems during various acute and chronic disruptions. At a national level, analysts from the two sectors could conduct joint studies of which power and wastewater plants across the nation are going offline or are planned to be built, and identify opportunities to design and construct cutting-edge, integrated infrastructure in the near term rather than continuing to invest in 20th century technologies for decades to come.[36] Such analyses may help identify opportunities for the sectors to pursue joint pilot projects and potentially lead to the physical co-location of some facilities. Such work could also help determine the potential benefits of new state-level regulations that require new and refurbished power plants to use reclaimed water for cooling.

Collaborative planning might also address issues relating to capital improvement financing, which is a challenge that many water utilities face. For example, 30 years is too long of an investment time horizon for many wastewater utilities interested in on-site energy projects. Given the right incentives, electric utilities may find it beneficial to offset the initial capital costs of wastewater facility energy projects in return for additional supply that will bolster their renewable portfolios over the long term. Water utilities, virtually all of which are facing expensive climate change impacts, have an inherent interest in broad-scale reductions in GHG emissions and the shift to renewable energy. Water utilities that are seeking to reduce their GHG emissions but are unable to develop on-site, low-emission energy generation to meet all of their needs may choose to demand that their electric power provider supply them with electricity generated from renewable sources. This is another arrangement that could be negotiated through joint cross-sector planning.

## Reduce Disincentives and Risks

Achieving a deeper level of cross-sector coordination and integration, however, will require incentives that reduce the risk of unconventional projects. New policies are needed to build the confidence of leaders in the water and electric power sectors and motivate them to go beyond compliance. One potential measure would be for states to implement alternative energy incentives similar to those in Massachusetts that incentivize wastewater plants to install energy projects (e.g., biogas or in-line hydro) and give credits to electric utilities for incorporating those generation sources into their portfolios. To incentivize the power sector's participation, the eligibility of investor-owned utilities for energy credits could be tied to the provision of fair electricity rates or direct investment in treatment plant energy projects. Simplifying policies regarding distributed energy generation (e.g., feed-in tariffs, interconnection agreements) may also catalyze more proactive coordination between the sectors.

*Collaborative planning might also address issues relating to capital improvement financing, which is a challenge that many water utilities face.*

### Identify Regulatory Constraints and Opportunities

To begin addressing difficult technical and regulatory issues, representatives from the two sectors could conduct a joint review of key statutes (e.g., the Clean Water Act, Safe Drinking Water Act and Clean Air Act) to identify stipulations that inhibit integration. Potential participants in such a review could include the EPA, the DOE, the Federal Energy Regulatory Commission, water and power industry associations and other key stakeholders. Such collaboration could generate recommendations regarding appropriate circumstances in which to allow the regulatory flexibility necessary to test and validate innovative technologies that bridge the sectors. For example, a utility in compliance for a certain amount of time might be granted a time-limited waiver to allow for an experimental project, or be granted extra time to implement an emerging technology that promises to be a wiser long-term investment for achieving regulatory compliance. A high-level collaborative group could also work toward standardizing and rationalizing approaches to the installation and regulation of distributed energy generation projects at wastewater treatment plants. Such collaboration might entail recommending standard performance measures, as well as outlining a cross-sector research agenda to jointly resolve difficult issues. Aligning regulations in this manner could greatly reduce the risk and uncertainty associated with cross-sector integration, particularly from the electric power sector's standpoint.

Image courtesy of The Johnson Foundation at Wingspread

Veranda of The House, The Johnson Foundation at Wingspread, August 22, 2013

## Envisioning the Integrated Utility of the Future

During the August 2013 conference, participants spent time engaging in "blue sky" thinking about the future possibilities for utility sector integration, resource recovery and enhanced efficiency. Setting today's constraints aside, the group developed a vision for an "integrated resources management utility," including foundational principles, core business practices and a customer outreach philosophy.

The envisioned integrated resources utility of the future would be designed according to several key principles centered on achieving unprecedented levels of sustainability and resilience. It would provide water delivery, wastewater treatment, energy generation and solid waste management services. The utility would embrace systems thinking and the precautionary principle (i.e., "do no harm"), and exceeding regulatory compliance would be the status quo. Triple-bottom-line analysis would be applied in decision making regarding all aspects of the facility, including design, construction, operations

and maintenance. All facilities would limit freshwater use, water consumption and GHG emissions to the lowest attainable levels, in some cases achieving better than net zero emissions. Performance measurements would be value-based, focusing on success implementing water–energy and climate mitigation solutions rather than volumetric measurements.

These facilities of the future would be right-sized to meet the needs of populations inhabiting the watersheds and airsheds they serve as efficiently as possible. Policies guiding the development of the integrated utility would allow for both more centralized plants as well as small-scale facilities that may or may not be managed centrally. Federal financing vehicles would reflect the integration between sectors, with the EPA and DOE offering joint funding programs geared toward innovative utilities and State Revolving Fund programs encompassing energy efficiency projects. Public–private partnerships would be a widespread mode of infrastructure financing, and the financial markets would drive the implementation of best practices through novel credit assessment methods. Some district-scale facilities would be controlled by the local community through a co-op business model that supports community values and generates a variety of direct community benefits.

The integrated resources utility of the future would serve "customers of the future" who are educated and actively engaged in how the utility is managed. Customers would have a thorough understanding of where their water and electricity comes from and how to effectively conserve both resources. They would regularly receive sustainability reports and other information about the value the utility is providing through its integrated services. Because of the transparency and quality information provided by the utility through outreach and smart resource management technologies, customers would contribute to the utility's risk management through their personal resource use choices.

### Principles of the Integrated Utility of the Future

The utility of the future will provide water delivery, wastewater treatment, energy generation and solid waste management services in an integrated way that optimizes the use of all resources and eliminates waste. Key principles include the following:

- Apply systems thinking and triple-bottom-line analysis to all management decisions, including design, construction, operations and maintenance.
- Do no harm, and go beyond compliance.
- Measure success based on environmental, climate and other nonfinancial performance criteria.
- Right-size facilities and operations for the customer base, and allow for future flexibility.
- Leverage diverse sources of financing.
- Engage customers as resource management partners.

# Conclusion: Co-Creating the Future

To attain the ultimate vision of an integrated resources management utility, we must start with practical, incremental steps that build relationships among leaders in the water, wastewater and electric power sectors. To co-create their futures, leaders must collaborate to advance technology research and development, as well as to catalyze changes in planning, policy, regulations, financing and other governance hurdles that inhibit closer coordination and shared incentives among water, wastewater and electric power utilities. Key challenges include improving cross-sector communication, fostering collaborative planning, and creating incentives and appropriate regulatory flexibility that give utility decision makers enough confidence to take risks they would have avoided historically.

*To help catalyze widespread movement along the continuum of transformation, Charting New Waters is dedicated to raising the visibility of pioneering utilities that are creating innovative models that others can replicate across the nation.*

A core focus of the latest phase of Charting New Waters is building out the Framework for Change that emerged during our April 2013 convening, and which the August 2013 group further developed. The Framework presents goals for which water and wastewater utilities can strive as they plan for and invest in the future. To help catalyze widespread movement along the continuum of transformation, Charting New Waters is dedicated to raising the visibility of pioneering utilities that are creating innovative models that others can replicate across the nation.

The hurdles and suggestions illuminated during the August 2013 convening suggest additional work, summarized in the following questions:

- How can the water sector leverage its position as a major electricity customer to shift the electricity market toward higher reliance on renewable energy and lower greenhouse gas emissions?
- What public policy changes are needed to enhance the resilience of urban water supplies in regions of the nation facing chronic or episodic water shortages?
- What are the potential benefits of greater integration between the wastewater and solid waste management sectors?
- What are the key elements of sustainable business models for the water and wastewater utilities of the future?
- What are the key environmental justice factors associated with the water infrastructure of the future, and how can they be addressed in a fair manner?
- What can be done to develop “customers of the future” who value and demand sustainability and have the knowledge and tools to act accordingly?

The August 2013 Charting New Waters convening revealed a tremendous need to bring the nation’s water and electric utility sectors together to leverage opportunities at the water–energy nexus that cannot be fully realized independently. The United States plays a critical role in forging the path toward global sustainability. Water and electric utilities, and the professional associations, regulatory bodies and private firms that work with them, must reach beyond their existing paradigms to achieve the transformation we know is technologically possible. The future demands nothing less.

# Appendix: Meeting Participants

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# Endnotes

[1] For a comprehensive overview of the water–energy nexus, see *Water and Energy Nexus: A Literature Review, Water in the West*, August 2013. Available online at: http://waterinthewest.stanford.edu/sites/default/files/Water–Energy_Lit_Review.pdf.

[2] See *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water*, U.S. Department of Energy, December 2006, pp. 25-26. Available online at: http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf.

[3] See *U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather*, U.S. Department of Energy, July 2013, p. i. Available online at: http://energy.gov/sites/prod/files/2013/07/f2/20130716-Energy%20Sector%20Vulnerabilities%20Report.pdf.

[4] See *The Water Resources Utility of the Future: A Blueprint for Action*, National Association of Clean Water Agencies, Water Environment Research Foundation, and Water Environment Federation, 2013. Available online at: http://www.nacwa.org/images/stories/public/2013-01-31waterresourcesutilityofthefuture-final.pdf.

[5] See http://utilityofthefuturecenter.org/center for more information about drivers of change facing the U.S. electricity sector.

[6] See *Water-Smart Power: Strengthening the U.S. Electricity System in a Warming World*, Union of Concerned Scientists, July 2013. Available online at: http://www.ucsusa.org/assets/documents/clean_energy/Water-Smart-Power-Full-Report.pdf.

[7] A list of participants who attended the August 21-23, 2013, conference is included in the Appendix on p. 19.

[8] See *Catalyzing the Transformation of U.S. Water Infrastructure*, The Johnson Foundation at Wingspread, July 2013. Available online at: http://www.johnsonfdn.org/sites/default/files/reports_publications/CNW_ConveningReport.pdf.

[9] See K.T. Sanders and M.E. Webber, "Evaluating the energy consumed for water use in the United States," *Environmental Research Letters*, IOPScience, September 2012. Based on information in the conclusion of that report, 5.4 quads of energy are estimated to generate electricity for pumping, treating, heating, cooling and pressurizing water in the United States. That translates to 5.5 percent of all electricity used in the United States. Available online at: http://iopscience.iop.org/1748-9326/7/3/034034.

[10] See http://www.energyconnectinc.com/ for more information about the services offered by EnergyConnect, Inc.

[11] See *U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather*, U.S. Department of Energy, July 2013, pp. 15-16. Available online at: http://energy.gov/sites/prod/files/2013/07/f2/20130716-Energy%20Sector%20Vulnerabilities%20Report.pdf.

[12] Participants at the August 2013 Charting New Waters conference recognized the potential for energy generation by water supply utilities, for example via in-line hydropower projects, but the focus of the discussion was on opportunities at wastewater treatment facilities.

[13] See http://vancouver.ca/docs/planning/renewable-energy-neighbourhood-utility-factsheet.pdf for more information about the Neighbourhood Energy Utility at the Village on False Creek.

[14] See http://www.ebmud.com/environment/sustainability for more information about the East Bay Municipal Utility District's energy program.

[15] See http://stevenspoint.com/index.aspx?NID=264 for more information about the Stevens Point Wastewater Treatment Plant.

[16] See http://www.lacsd.org/wastewater/wwfacilities/jwpcp/power_generation.asp for more information about the Sanitation District of Los Angeles County's Joint Water Pollution Control Plant and http://greshamoregon.gov/city/city-departments/environmental-services/wastewater-division/template.aspx?id=4330 for more information about the energy goals for the city of Gresham's wastewater treatment plant.

[17] See http://americaspowerplan.com/ for a comprehensive assessment of market forces driving the transition to clean energy in the U.S. power sector and related policy recommendations.

[18] See *Use of Reclaimed Water for Power Plant Cooling*, Argonne National Laboratory, August 2007, Appendix A. Available online at: http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/reclaimed%20water.pdf. After additional research using the Energy Information Agency's 2009 EIA-860 data and cross-referencing with monthly EIA updates from 2010 and 2011, the Natural Resources Defense Council identified 14 additional facilities in addition to those listed in the 2007 report. Meanwhile, some plants listed in the original report were proposed but never completed.

[19] See http://www.dsireusa.org for more information about state incentives for renewable energy and energy efficiency in the United States.

[20] See http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/rps-aps/rps-and-aps-program-summaries.html for more information about Massachusetts' Alternative Energy Portfolio Standard.

[21] See http://www.austinenergy.com/about%20us/environmental%20initiatives/Sand%20Hill/index.htm for more information about Austin Energy's Sand Hill Energy Center.

[22] See http://www.austinenergy.com/about%20us/Company%20Profile/index.htm for more information about the company profile of Austin Energy.

[23] See http://ecodistricts.org/ for information about the EcoDistricts framework for district-scale redevelopment and revitalization.

[24] See http://www.nerc.com for more information about the North American Electric Reliability Corporation (NERC). In the United States, NERC is subject to the oversight of the Federal Energy Regulatory Commission.

[25] See http://growingblue.com/wp-content/uploads/2013/10/Aquanauts_Study_Data.pdf for a comprehensive analysis of the driving factors behind variability in water rates across the United States.

[26] Personal communication with Chris Peot, Resource Recovery Manager, DC Water, August 22, 2013.

[27] See http://www.g-jwastewater.com/energy.html for more information about energy recovery at the Gloversville-Johnstown plant.

[28] See http://www.epa.gov/oaqps001/permits/ for more information about Clean Air Act permitting. And see http://www.epa.gov/airquality/peg_caa/index.html for *The Plain English Guide to the Clean Air Act*, developed by the EPA.

[29] See *Barriers to Biogas Use for Renewable Energy*, Water Environment Research Foundation/New York State Energy Research and Development Authority, 2012. Available online at www.werf.org/c/_FinalReportPDFs/OWSO/OWSO11C10.aspx.

[30] See http://www.pepcoenergy.com/Pages/PR-20120306.aspx for more information about the combined heat and power plant agreement between DC Water and Pepco Energy Services.

[31] See http://www.stateenergyoffice.wi.gov/sublink.asp?linksubcat2id=2594&linksubcatid=3557&linkcatid=3692&linkid=1462 and http://www.ci.janesville.wi.us/index.aspx?page=148 for information about the use of biogas for transportation fuel in Janesville, Wisconsin.

[32] See http://www.werf.org/lift for more information about the Leaders Innovation Forum for Technology.

[33] On September 11, 2013, the National Renewable Energy Laboratory offered a webcast as part of the DOE's Technology Assistance Program entitled *The Energy–Water Nexus: State and Local Roles in Efficiency and Water and Wastewater Treatment Plants*. The presentation targeted state energy officers and featured presentations from the Water Environment Federation (WEF) and WEF members, Johnson Controls and Fort Worth Water/Wastewater Utility, which were arranged based on connections made during the August 2013 Charting New Waters conference at Wingspread. The archived webcast is available online at: http://www1.eere.energy.gov/wip/solutioncenter/webinar_archives.html.

[34] See http://www.oracwa.org/pdf/acwa-energy-yields-savings_6-11.pdf for more information about the training program developed by the Oregon Association of Clean Water Agencies.

[35] See http://www.e-wef.org/Default.aspx?TabId=192&ProductId=20487783 for more information about *The Energy Roadmap* published by the Water Environment Federation. An overview of the project is also available at: http://wef.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=12884902042&libID=12884902042.

[36] See *Water-Smart Power: Strengthening the U.S. Electricity System in a Warming World*, Union of Concerned Scientists, pp. 13-18, July 2013. Available online at: http://www.ucsusa.org/assets/documents/clean_energy/Water-Smart-Power-Full-Report.pdf.

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