Partnership on Technology Innovation and the Environment

Expert Workshop on Water Technologies

Summary Report

June 27, 2014

Prepared by:

Center for Environmental Policy
American University

CENTER FOR ENVIRONMENTAL POLICY
SCHOOL *of* PUBLIC AFFAIRS

This report summarizes the results of the Expert Workshop on Water Technologies and does not reflect the positions of the PTIE Partners

EXECUTIVE SUMMARY

Despite its critical importance, water resources are often undervalued, thus providing limited incentive for technology innovation or adoption that could improve water quality and use. The Partnership on Technology Innovation and the Environment is taking a multi-sectoral approach to addressing barriers and capitalizing on opportunities to scaling up water technologies. On June 27, 2014, the Partnership convened the Expert Workshop on Water Technologies to advance discussions on accelerating the implementation of water technologies in two issue areas – monitoring non-point source nutrient pollution and wastewater treatment. Experts examined opportunities and barriers, and then extended the discussions to look at options to move forward and, where appropriate, for the Partnership to add value to existing efforts. The issue areas included:

Challenging Nutrients: Technology Innovation for Better Water Quality – The ability to reduce nutrient pollution and improve water quality is hindered by an overall lack of monitoring and the high costs of collecting such data. Based on the model of a *market stimulation challenge*, the goal of this project is, within the next three years, to achieve an 80-90% reduction in the cost of nutrient monitoring technology while maintaining or improving sensor quality and reliability. The Partnership is promoting this goal by assessing user requirements for nutrient sensors and evaluating market-driven mechanisms to expand the use of sensor technologies. During the Expert Workshop, participants concluded that less expensive nutrient sensors could help increase data availability and offer benefits in terms of better water quality, more focused priority-setting, and effective applications of effluent trading, among others. Among the many financial and policy-related challenges hindering widespread use of sensors, some of the most critical identified were the demonstration of the value of and demand for lower-cost sensors and monitoring systems, providing incentives for private and public sector investment, and linking sensor capabilities with efficiency and other economic benefits.

Achieving Widespread Adoption and Scale-up of Innovative Wastewater Technologies – Much of U.S. wastewater treatment infrastructure is aging, outdated, and inadequate. Yet many opportunities for innovation and efficiency exist for municipalities. By leveraging new technologies that reduce energy use, increase operational efficiency, capture nutrients, and increase water reuse, authorities have options for financing the needed upgrades. The workshop discussion focused on identifying areas where the Partnership could accelerate use of innovative technology and financing options. While a number of groups are already focusing on improving wastewater treatment, the work is far from done. While the principal challenges of water pricing and general risk adversity within the sector remain, participants identified several potential areas for the Partnership to add value: supporting, through education and stakeholder engagement, the ability to use public-private partnerships; building institutional and human capacities for the utility of the future; and fostering systems-oriented thinking.

In both cases, the focus was how the Partnership can contribute its multi-sectoral perspectives to build upon other efforts to accelerate the adoption, deployment, and scale-up of water technologies. A common theme in both discussions was that the challenges may be more about financing, policy, and institutional capacities than about technology.

OVERVIEW OF THE PARTERNSHIP AND WORKSHOP

Formed as a result of the Technology Market Summit, held in May 2012, the Partnership on Technology Innovation and the Environment (Partnership) is a voluntary collaborative of government, academic, business, and environmental organizations committed to accelerating the development, adoption, deployment, and export of technologies that protect health and the environmental while contributing to economic growth.

The Partnership is based on the premise that the multi-sector collaboration can catalyze and enable substantive innovation and technology deployment better than can any one group or sector on its own. As of June 2014, Members included:

- U.S. Environmental Protection Agency
- U.S. Department of Energy (in process of joining)
- Center for Environmental Policy at American University
- Environmental Defense Fund
- Initiative for Global Environmental Leadership, Wharton School, University of Pennsylvania
- World Business Council for Sustainable Development

In December 2013, the Partnership selected water technology innovation and financing as its first topic because it presents opportunities for examining the relationships among technology, financing, policy, and information and determining ways of facilitating technology innovation and scale-up. Given the historically and generally low prices of water, slow market uptake, and insufficient levels of investment in water technology and infrastructure, and challenges climate change presents, the Partnership saw this as an area where it could potentially make a significant contribution.

To focus its efforts, the Partnership used the Water Technology Innovation Blueprint developed by the U.S Environmental Protection Agency. The Blueprint identified what EPA considered it's "top ten key market opportunities for technology innovations" in the water arena. Members of the Partnership identified potential areas where the multi-sector Partnership could provide value added through in-depth discussions with experts in drinking water, wastewater treatment, monitoring research, and water finance/investment. Based on the results, the Partnership selected three issues for attention, as specified in the initial work plan, and created a workgroup for each. For each of the three issues – nutrient monitoring, wastewater financing and innovation, and drinking water monitoring and efficiency – the Partnership selected co-chairs, who enlisted a range of organizations working in each area. Each workgroup identified both barriers and opportunities, developed initial thoughts and recommendations to take advantage of the opportunities

and overcome the barriers, and prepared for the engagement with a wider group of stakeholders at an expert workshop. [1]

On June 27, 2014, the Partnership convened experts to obtain input on the initial thoughts and recommendations and, if possible, agree on next steps. The Expert Workshop on Water Technologies, held at American University, provided a forum where representatives from the government, academia, the private sector, and the investment community collectively could discuss what is needed to advance efforts to accelerate the adoption and scale-up of relevant technologies.

During the Workshop, experts had the opportunity to provide feedback, identify common lessons learned, and agree on next steps. The two issue areas were:

Challenging Nutrients: Technology Innovation for Better Water Quality

The ability to reduce nutrient pollution and improve water quality is hindered by an overall lack of monitoring and the high costs of collecting such data. Based on the model of a *market stimulation challenge*, the goal of this project is, within the next three years, to achieve a significant reduction (in the range of 80-90%) in the cost of nutrient monitoring technology while maintaining or improving sensor quality and reliability. The Partnership is promoting this goal by assessing user requirements for nutrient sensors and evaluating market-driven mechanisms to lower the price and expand the use of sensor technologies.

Achieving Widespread Adoption and Scale-up of Innovative Wastewater Technologies

Much of U.S. wastewater treatment infrastructure is aging, outdated, and inadequate. Yet many opportunities for innovation and efficiency exist for municipalities. By leveraging new technologies that reduce energy use, increase operational efficiency, capture marketable nutrients and other resources, and increase water reuse, authorities have options for financing the needed upgrades. The goal of this group is to identify and implement actions within the next twelve to 18 months to accelerate use of existing as well as new innovative technology and financing options, although with an emphasis on commercially-ready technologies.

During concurrent breakout sessions, experts in each group focused on developing concrete actions the Partnership could take to promote the scale-up of environmental technologies. Participants examined opportunities and barriers, and then extended the discussions to look at options to move forward and, where appropriate, to add value to existing efforts. During a plenary session between the breakout sessions, experts looked across issues to see what lessons could be drawn and to identify shared opportunities across technology areas.

[1] The drinking water workgroup prepared a plan for action and completed several analytical tasks, but it was decided in mid-June that it had not made sufficient progress to enable a fruitful discussion at the workshop. The workshop focused on the nutrient monitoring and wastewater topics.

Workshop participants included representatives of federal agencies, water sector organization representatives, water quality managers, technology providers and experts, experts in technology financing, and other thought leaders in water policy, technology, and innovation (see Appendix 2 for complete list of participants).

WORKGROUP 1 – CHALLENGING NUTRIENTS

Overview

Nutrient pollution that impacts the water quality of U.S. rivers, lakes, and estuaries comes from a variety of sources, including wastewater treatment; agricultural, urban and suburban run-off; and atmospheric deposition. Excess nutrients cause algal blooms and oxygen-deprived dead zones, leading to economic losses and damage to aquatic life and resources.

The lack of accurate, real-time monitoring limits the development of innovative watershed-scale monitoring, modeling, and management programs that could help reduce nutrient pollution, especially from nonpoint sources. Water quality monitoring is highly distributed among many agencies and organizations and has not seen significant advances due to high cost and the challenges associated with purchasing and deploying nutrient sensor technologies. While there are real-time sensor technologies available, they are prohibitively expensive for many of the state agencies, NGOs, and other groups that would otherwise utilize them. This limits the availability of real-time monitoring at the necessary high resolution in time and space of nutrients in rivers, streams, lakes and estuaries.

The Partnership is working with EPA and the Alliance for Coastal Technologies (ACT) on an interagency Water Nutrient Sensor Challenge to lower the price and increase the availability of nutrient sensing technology. Together with developer and user groups, the Partnership is assessing user requirements for nutrient sensors and demonstrating market potential to lower the price and increase the development and adoption of sensor technologies. To complement this effort, the workshop gathered a variety of stakeholders to discuss opportunities across the broader landscape of policy and finance that may enable broad use of real-time nutrient sensors and transform how data are collected and used.

Discussion

ACT, a NOAA-funded partnership between university research institutions, environmental agencies, and technology manufacturers, opened the session by giving an overview of its work and role in to the Nutrient Sensor Challenge. ACT is helping to advance and accelerate sensor development and adoption by providing expert, third party testing and verification of effective and reliable sensors based on criteria for use in coastal and freshwater environments. As a partner in the Nutrient Sensor Challenge, ACT will help manufacturers identify technology needs, quantify market and end user

requirements, and work with the Partnership to verify existence of a market for sensors that meet identified specifications. Ultimately it will provide information to the consumer on tested sensors; it will not endorse or certify any of the tested products.

In an effort to identify the potential markets for affordable sensors, participants discussed the value of spatially and temporally rich data that could be provided by such sensors. Participants agreed that these data would allow scientists to improve nonpoint source loading models, better identify critical points in the watershed for management, and facilitate the development of smart farms that increase nutrient use efficiency and minimize environmental impacts. Local information could be used to engage citizen scientists and be used for public education and communications.

Participants thought that the infusion of new data streams would be particularly helpful to implementation of nutrient trading programs, Section 303(d) programs (Total Maximum Daily Load, or TMDL), and U.S. Department of Agriculture (USDA) Natural Resource Conservation Service programs. Conservation measures funded or mandated by these programs often have variable impacts on local waters as a result of differences in watershed conditions and the type and maintenance of the practice implemented. Sensors could provide a means of better quantifying variable impacts, so that static practice-based measurements and model assumptions that are often used in these program can be refined by site-specific performance-based measures.

There was general agreement that markets also existed beyond existing nonpoint source policies and programs and that these markets should be explored. Participants suggested exploring the use of sensors in wastewater treatment plants, well water testing, and measurement of nutrients in agricultural slurries, bilge waste, and aquariums. Participants recommended sensors for use in coastal and ocean planning and in identifying areas prone to harmful algal events and as part of planning and verification processes for oyster restoration. They also discussed the real estate market as a possible user of sensor data to provide more detailed information on waterfront home values and their potential stability.

Participants also agreed that while technology may provide information on nutrient pollution, there are other barriers to sensor deployment unrelated to technology development and data availability/use. For example, there is chronic under-valuation of water (including not incorporating the cost of energy to move the water), a lack of funding to deploy advanced technology, and often a lack of short-term political interest.

Discussion then turned to economic and funding opportunities (short- and long-term) available to increase the development and deployment of nutrient sensor technologies. Initial discussions focused on the role of the Partnership in stimulating investment in affordable, reliable sensors. One participant suggested that if industry leaders such as Intel were to adopt such a technology, it would help create demand and economies of scale to commercialize the technology, which in turn would make such investments more attractive for the private sector.

Participants discussed several business models that may also be appealing for investment. In the first, the service providers charge for data management, but the nutrient sensor itself is virtually free of cost. This model is similar to the model currently used by mobile phone providers such as Verizon and AT&T, whereby they sell the phones at a very low cost when you commit to using their data plan for a certain amount of time. In the second model, service providers charge a larger amount for the tool (sensors), but provide the service at a reasonable cost. Participants also discussed a third model, sometimes called the third-party or social media model, in which the data is the marketable commodity. A third party provides the sensors and data delivery necessary for monitoring, and then they are able to market the data to various parties. An example of this would be how Google markets the data from users to interested parties.

There was agreement that each model involved trade-offs. For instance, the first model may create legal issues associated with privacy and data ownership due to the provision of the open data. The third-party model requires a fair bit of up-front investment on the part of third parties for whom incentives may not exist, even though there could be huge opportunities for public education and engagement with the data it would produce.

Participants suggested that the Partnership might be able to stimulate sensor investment in the agricultural community, by convening discussions on the incorporation of sensors in point-nonpoint nutrient trading programs. Trading systems tend to be built upon rather sparse information on baseline loads, thereby creating a great deal of uncertainty. This uncertainty increases the need for uncertainty buffers (often manifest as higher per-trade costs) that may discourage watershed-level trading regimes. Affordable, real-time nutrient data that are dense in both space and time could reduce these uncertainties and add a much-needed element of accountability and verification into the trade transaction, thereby stimulating more demand. Participants suggested that the costs of installing and operating dense networks of affordable nutrient sensors could be incorporated into transactions costs within trading programs, thus providing a sustained investment in further development and deployment of nutrient sensing technology.

Participants acknowledged the challenges with trading schemes, including lack of demand in small watersheds, uncertainty in best management practice performance, lack of funds and tools to monitor performance, and distrust between trading partners. The group recommended that trusted parties such as USDA and aggregators work with farmers to help stimulate change by providing direct financial incentives to the landowner/farmer to use sensors to better detect, manage, and reduce nutrient pollution.

Conclusions

Participants agreed that the value of sensor technology could only be realized if the information generated by sensors informed policy and management decisions. Unless the connection is made between decision making and sensor deployment, it may be difficult to fully market the technology. Guidelines or discussion that explore this technology and the use of data in existing or proposed programs may be particularly helpful. Small

watershed pilot studies examining how sensors might could be used in TMDL verification or trading programs might be particularly useful.

In addition, participants agreed that lack of private sector funding was likely to continue to be an issue, even with "affordable" pricing, particularly if citizen scientists were to become major users of sensor technology. Exploration of successful current projects (e.g. EPRI Ohio River Model; NYC Drinking Water Supply watersheds) and examination financial and political variables may be of use.

Next Steps

Based on the discussion, the Partnership might consider:

- Working with ACT as part of the larger Nutrient Sensor Challenge to better identify and quantify the market for nutrient sensors and the use of data they provide.
- Demonstration of definitive widespread interest in sensor acquisition would likely help provide incentives for manufacturers to lower sensor costs.
- Investigating marketing sensors to the agriculture and development communities, in order to provide verification of practices or adjustment of trading ratios. This would involve convening experts to develop a mutually acceptable program and conducting a pilot study in a small watershed to explore outcomes.
- Exploring means of incorporating sensors into incentive-based programs that reward performance (actual changes in water quality) rather than practice implementation.

WORKGROUP 2 – WASTEWATER

Overview

Wastewater utilities face substantial challenges—from aging infrastructure to lagging capital investment to rising external pressures, such as population growth, continued urbanization, new contaminants, and climate change. Water utility managers must fix immediate problems, repair systems with less access to capital than in the past, and position their utility for a changing future, all while increasing efficiency and attempting to avoid excessive burdens on ratepayers. The National Association of Clean Water Agencies (NACWA), the Water Environment Research Foundation (WERF), and the Water Environment Federation (WEF) have developed a vision for a Utility of the Future (UOTF) that outlines these challenges by and tackles them by leveraging innovative technologies and processes to reduce costs and increase revenues.

Whether the UOTF will be able to reach a 'break even' point through innovative technologies to generate revenues from resource recovery while reducing costs through

energy efficiency is a complicated question. Currently, most utilities break even on a budgetary level, and a few have reached breakeven on energy used and produced, but likely no utilities break even from becoming so cost efficient that they can rely entirely on non-fee revenues that render use rates unnecessary. This being said, there are many innovative technologies available that can help utilities make progress the vision of the UOTF and toward financial sustainability. Some experts maintain that the main challenge for utilities is not technology—the primary challenge is finding financing, having the organizational and procurement practices, and the political will to adopt new technologies and innovative new ways to manage.

Discussion

There was agreement among workshop participants that wastewater utilities cannot continue to operate as they have for the past forty years. One participant used the analogy that utilities were given a free house about forty years ago when federal government aid was high, but now they need to pay not only to paint the house but also to repair its sagging structure. One of the problems complicating the current state of many utilities is inadequate rate revenue. Generally, rate increases have not been adequate and consistent, and thus current rates are artificially low. Usually utilities need to raise rates to levels that better reflect the full cost to provide the service, but doing so is politically difficult, in part because fees are by nature regressive, imposing a heavier burden on low-income customers. One participant recounted how a utility in Alexandria, VA had to raise its rates by 25% in one year but, following this adjustment, through stringent cost control and adoption of innovative technologies and processes, has been able to limit increases to 1-2% per annum. Another participant, from a utility near Norfolk, VA, predicted that, unless there was a significant change, the utility was facing the need for 8-10% annual rate increases for the next 10-15 years.

When asked if there were a few promising technologies, workshop participants indicated that it wasn't about one or two key technologies, but more about taking a systemic approach to the financial integrity of the utility. Some participants advocated for development and adoption of intensification technologies (that make existing infrastructure more efficient and effective), green infrastructure (using vegetation, soil, and natural processes to reduce storm runoff and manage water), and more effective metering and monitoring. The consensus of the discussion was that there is a need to approach the challenges with a 'web of technologies,' because each utility is different. Implementation of new technologies depends greatly on the existing infrastructure and must fit within the treatment plant's footprint. A systemic approach helps both to identify which technologies are applicable and to prioritize which are the most appropriate and cost-effective for each unique operation.

However, a systemic approach is easier said than done, and highlights a broader human resources challenge. While the approach is beneficial and necessary, it requires human resources that most small municipalities simply don't have. There is a shortage of skilled employees in the wastewater sector and this is worsening as the current generation of utility experts retires. Most universities training wastewater facility managers are not

teaching with systems thinking, and small- and medium-sized municipalities lack the resources to hire professionals with the expertise to look beyond the day-to-day repairs to strategic upgrades and how to finance them.

One of the most extensively discussed potential solutions to the challenges facing utilities was public-private partnerships (PPPs), especially the successful concession model that was employed in Bayonne, NJ and Rialto, CA. In this type of partnership, a private company takes over the operations and maintenance of a utility for 20 to 40 years and pays the utility's (or city's) debt in exchange for a share of the revenues over that time. The format of these agreements is very important, and while participants viewed Bayonne and Rialto favorably, they criticized a similar partnership in the UK because there was very poor maintenance and care by the private sector partner. Additionally, these types of agreements are not universally appealing to the private sector because the rates of return are often lower than what most investors will accept and because revenue caps may be built into the agreements (caps are often mandated by state laws). One participant suggested that investing in wastewater utilities could be an option for pension funds, which have a lot of capital and need safe investments like these. This idea wasn't universally accepted, however, and another participant argued that pension funds are often reluctant to accept lower rates of return simply to satisfy a political agenda.

Participants also noted that public employee unions and corporate accountability advocates often work to block private sector involvement. There was agreement that further education is needed to counteract misinformation and that effective stakeholder engagement is needed to address the concerns of everyone involved and affected by PPP agreements. One participant pointed to a Canadian example of mandating stakeholder engagement prior to PPPs, similar to the NEPA process in the United States. Committed political leadership must undergird stakeholder engagement and this may be difficult to summon for a long-term, hardly visible issue like wastewater management. To this end, the U.S. Conference of Mayors is working to educate mayors about PPPs and how best to approach these agreements. Beyond mayors, however, there seems to be a gap in education for utility managers and the public about PPPs. Participants identified communication and education about PPPs as a potential opportunity for the Partnership.

In response to concerns about the lack of resources and trained professionals able to take systemic approach to utility management, one participant mentioned a program run by the U.S. Department of Energy wherein students from 'Industrial Assessment Centers' based in universities go to small industries and evaluate opportunities to improve energy efficiency in their operations. After doing so, the students provide a report to the evaluated industry informing them of new technologies and processes they could adopt. The Partnership could consider the development of a similar program that would send students to wastewater utilities (especially ones in small municipalities) to evaluate their operations, providing a systemic view of opportunities to improve energy, water, and process efficiency, as well as to create value from resource recovery. Participants were generally receptive to this idea, especially for its potential to foster another generation of utility experts and leaders from those students.

Finally, another substantial barrier to technology adoption is the lack of state reciprocity of the testing and verification of new technologies. Each state has its own process, typically requiring a pilot at full scale deployment, which is extremely limiting.

Conclusions

The Wastewater Workgroup discussion was fruitful and varied and came to several conclusions. One was that, in the face of crumbling traditional models of financing, innovative new models that include PPPs are one of the most promising future endeavors for wastewater utilities. Another was that education and stakeholder engagement is sorely needed to both combat the political opposition to these types of partnerships and to demonstrate to stakeholders that these kinds of agreements can solve several problems simultaneously (including debt, human resources, and capital investment).

While there were no obvious technological innovation acceptance barriers identified that might be considered by the workgroup, there were several conclusions that could shed light on future activities. One participant concluded that the problem could be that stakeholders do not know what to do and are not comfortable taking on solutions that are outside their area of expertise and experience. This inhibits adoption of new technologies. A related conclusion was that besides a general shortage of skilled labor in this field, there is also a need for systemic thinking by utility managers, and this skill is not common, especially in small municipalities.

Next Steps

At the end of the workshop, there were a few different paths in front of the Partnership for future work and collaboration in the field. The principal recommendations were to:

> Identify specific research needs and facilitate research projects on potential financing sources for wastewater utility investment, including pension funds and investment firms interested in safe, albeit lower-return investments.
>
> Develop approaches to assist small- and medium-sized municipalities identify and pursue technology improvements that could reduce or recover costs, potentially through the involvement of trained student assessment teams.
>
> Collaborate with the work of the U.S. Conference of Mayors (and others) to educate utility managers, the public, and other stakeholders about PPPs, and engaging them in the process. This effort would highlight the value of well-designed partnerships by discussing successful examples like Rialto, CA and Bayonne, NJ.
>
> Partner with WEF and WERF's Leaders Innovation Forum for Technology (LIFT) program, which promotes the adoption of new water technologies.

Such approaches would capitalize on the multi-sectoral composition of the Partnership and help fill the gaps between existing efforts to realize the utility of the future.

CLOSING SESSION

After a two rounds of discussions in workgroup breakout sessions and time in the plenary discussions in which the two workgroups shared ideas, a closing panel of invited experts representing different kinds of organizations commented on the outcomes of the day and offered their ideas on ways the Partnership could add value in addressing water issues.

Jud Hill, Blue Star Capital:

Recognize that technology is not the driver, and the challenges are more about money and people than specific technologies. One suggestion is to look for best practices from other industries, such as medical, and draw from those. It also is important to think holistically about the economic and political context of these issues. A major challenge is the underpricing of water; it is difficult to stimulate the needed investments and to effect behavioral change when a good is nearly free.

Bernard David, Initiative for Global Environmental Leadership:

Clearly, a lot is going on in water technology innovation and financing. We need to understand and recognize what the market, complemented by public-private partnerships, can work and achieve. In wastewater treatment, a role for the Partnership is to serve as a neutral, third-party source of education and support, especially for medium-sized utilities. It can help them see beyond the day-to-day work to the sources of funding, ways of innovating, and methods for drawing upon the many initiatives underway. That is a possible white space for the Partnership.

Joe Rudek, Environmental Defense Fund:

Focusing on the nutrient discussions, the major policy issues in the near term are TMDLs, USDA and the Farm Bill, and nutrient trading. The Partnership may have opportunities to influence the first and third of these from a financing and innovation perspective. In general, we need a better understanding of how ecosystems function; improved and more widespread monitoring can help by providing better data for targeting problem areas. There also may be room for contributions in terms of (1) integrating in situ sensors with satellite and modeling capabilities and (2) demonstrating the beneficial water quality contributions of improved, efficient agricultural practices through better and expanded monitoring.

Stan Laskowski, University of Pennsylvania:

A priority in water issues is stressing the importance of taking care of our infrastructure. A major challenge is getting action without having it forced upon us by a crisis. The

Partnership can help to draw attention to these issues and educate and communicate with the public, decision-makers, and opinion leaders. Wastewater infrastructure is a critical issue and the Partnership can make a contribution. Our location in the Washington area and ability to pull together many stakeholders are advantages in engaging on these issues.

CONCLUSION

The Expert Workshop resulted in two detailed discussions that dug into monitoring non-point source nutrient pollution and wastewater treatment opportunities. In both cases, the focus was how the Partnership can contribute its multi-sector perspectives to build upon other current efforts to accelerate the adoption, deployment, and scale-up of water technologies. A common theme in both discussions was that the challenges may be more about financing, policy, and institutional capacities than about technology.

The Challenging Nutrients break-out session concluded that less expensive nutrient sensors could help increase data availability and offer benefits in terms of better water quality, more focused priority-setting, effective applications of effluent trading, among others. The group recognized that there are many financial and policy-related challenges. Critical among them are demonstrating the value of and demand for lower-cost sensors and monitoring systems, providing incentives for private and public sector investment, and linking sensor capabilities with efficiency and other economic benefits.

The Wastewater sessions likewise benefited from a wide variety of perspectives – from investors to wastewater facility managers, from federal agencies to mayors. While a number of groups are already addressing the challenge of improving wastewater treatment through innovative technologies and practices, the work is far from done. Principal challenges include water pricing and the generally risk adverse nature of industry. Still, participants identified several potential areas for the Partnership to add-value consistent with its mission: supporting, through education and stakeholder engagement, the ability to use public-private partnerships; building institutional and human capacities for the utility of the future; and fostering systems-oriented thinking.

Attachment 1: Agenda

Attachment 2: List of Participants

Attachment 3: Overview of the Partnership

Attachment 4: Challenging Nutrients Overview

Attachment 5: Wastewater Overview

Attachment 1

Partnership on Technology Innovation and the Environment

Expert Workshop on Water Technologies
June 27, 2014, 9:00 am-4:15 pm
American University, Washington College of Law
4801 Massachusetts Avenue, NW, 20016, 5th Floor
Agenda

Time	*Session*	
8:30am	Sign-in and continental breakfast,* 5th Floor	
9:00am	**Opening plenary, Room 503** • Welcome and Overview of Partnership on Technology Innovation and the Environment - Dan Fiorino • Overview of Technology Issue Areas - Fred Mason, Denice Shaw	
10:15am	Coffee break*/transition time	
10:45am	**Workgroup break-out sessions – Challenges and Opportunities**	
	Wastewater, Room 501	*Challenging Nutrients, Room 500*
12:15pm	Lunch, Room 600	
1:00pm	Mid-course Workgroup Check in, Room 600	
1:30 pm	**Workgroup break-out sessions – Technology Scale Up and Strategies for Moving Forward**	
	Wastewater, Room 501	*Challenging Nutrients, Room 500*
3:00pm	Refreshment break*	
3:15pm	**Closing Session – Outcomes of Workgroups, Cross Cutting Issues, Future Agenda, Room 503** • Outcomes of Workgroups and Next Steps *(30 min)* • Cross Cutting Issues and Making These Models Succeed *(30 min)* – Bernard David, Jon Freedman, Jud Hill, Joe Rudek	
4:15 pm	**Adjourn**	

*Meals and breaks have been generously sponsored by the William K. Reilly Fund for Environmental Governance and Leadership at American University's Center for Environmental Policy

For more information on the PTIE, please visit http://www.american.edu/spa/cep/projects/water-technology-adoption

Challenging Nutrients Workgroup Agenda: Nutrient Sensor Challenge

Objectives – The ability to reduce nutrient pollution and improve water quality is hampered in part by an overall lack of data due to the high cost of sensors and enabling technologies. This workgroup has been focusing on accelerating the development, adoption and use of nutrient sensing technology to ultimately reduce nutrient pollution. Its overall goal is to achieve a significant reduction (target: 80-90%) in cost of nutrient sensing technology within the next three years, while maintaining the quality and interoperability of monitoring. To complement the upcoming Nutrient Sensor Challenge, the objectives of the Expert Workshop are to identify opportunities in policy and finance to further increase development, adoption, and use of such technologies.

Morning Breakout - Policy opportunities

The morning breakout session will provide participants with an overview of the Market Stimulation Challenge, which aims to lower the price of nutrient sensors from their current costs in the range of $25,000 to less than $5,000 within three years. The session will briefly touch on the longer term (10-year) horizon for nutrient sensors, and then focus on discussing the impact and value of spatial and temporal dense data for nutrient policies, monitoring, research, and regulation.

- *What programs or policies will nutrient sensor technology and the data they provide benefit?*
- *What are the challenges and opportunities for integrating nutrient sensor technology and data into these programs and policies?*
- *What projects can PTIE undertake to facilitate increased use of sensor technology and data and maximize the environmental benefit of sensor technologies (in both the short- and long-term)?*

Afternoon Breakout - Finance and Economics

Along with areas to improve policy, there are often financial and economic opportunities that could increase the development and adoption of nutrient sensor technologies. The afternoon session will focus on the following questions:

- *What is the potential economic value to businesses of spatially and temporally dense information about nutrient concentrations and loadings?*
- *What are the outlook and opportunities for long-term investment in water quality sensor development and commercialization?*
- *What are some creative strategies or models for financing deployment of sensor networks in watersheds?*

Wastewater Workgroup Agenda

Objective - The objective of the Wastewater Workgroup is to eliminate barriers to the scale-up and widespread adoption of key technologies that would enable utilities to upgrade wastewater treatment and enhance the viability of operations. The objective of the Expert Workshop is to identify utilities that have made the most progress toward achieving the NACWA, WERF and WEF vision for a Utility of the Future (UOTF), use these case examples to identify key technologies and processes, understand the barriers to widespread adoption of these technologies, determine which of these barriers the PTIE should address and develop action plans.

Morning Breakout

Much of the U.S. wastewater infrastructure is aging, outdated and inadequate. The EPA estimates that investments of some $105 billion are needed to upgrade systems to meet advanced treatment or secondary treatment standards.

- *What are the prospects for funding these improvements (will they be made)?*
- *What are the key conditions and success factors where these investments will be made?*
- *Are there localities where public – private partnerships have been successful in resolving investment needs? What are the lessons learned?*

The UOTF will leverage innovative technologies and processes to reduce costs and increase revenues "by reclaiming and reusing water, extracting and finding commercial uses of nutrients and other constituents, capturing waste heat and latent energy in biosolids and liquid streams, generating renewable energy using its land and other horizontal assets, and using green infrastructure to manage stormwater."

- *Is it envisioned that the UOTF can be self-funding, or at least approach break-even?*
- *Will there be geographic or other differences in the ability of utilities to break-even? If so, what are the factors that will cause these differences?*
- *What utilities have made the most progress toward the UTOF vision (case examples)?*
- *What is the progress of each case towards self-funding (do revenues exceed costs)?*
- *What are the key technologies and processes contributing to each operation's effectiveness and viability?*

Afternoon Breakout

In discussing barriers to the adoption of innovative technologies for wastewater treatment, NACWA, WERF and WEF have noted that "resistance to change is strong, reinforced by regulatory pressures, strained utility budgets, political reluctance to raise rates, customer confusion about the benefits of innovation, skyrocketing demands for capital competing for every dollar, risk and regret associated with technology failure, and venture capital looking elsewhere for faster and safer returns."

- *What currently impedes scale-up and widespread adoption of key technologies?*
- *What are two or three key technologies for which action by PTIE could be instrumental in resolving impediments?*
- *What is the Action Plan to address and eliminate each of the barriers?*
    - *What is the action? Who is accountable? When and how will the action be completed? What are key milestones? What are the key metrics?*

Attachment 2

Partnership on Technology Innovation and the Environment

Attendee Roster
Expert Workshop on Water Technologies, June 27, 2014

David Arscott
Assistant Director, Research Scientist
Stroud Water Research Center

Manjyot Bhan
PhD Student
School of Public Affairs
American University

Ira Birnbaum
Special Advisor, State and Local Energy Efficiency
and Clean Energy
Department of Energy

Charles Bott
Trustee
Water Environment Federation

Michal Brody
Adjunct Professor of Environmental Science
American University

David Burke
Conservation Planning Senior Advisor
Chesapeake Conservancy

Adam Carpenter
Regulatory Analyst
American Water Works Association

Bernard David
Senior Fellow
Initiative for Global Environmental Leadership, Wharton

Patricia Engel
Environmental Scientist
ERG

Colin Enssle
Senior Manager
GE Power & Water

Dan Fiorino
Director
Center for Environmental Policy, American University

Jon Freedman
Global Government Relations Leader
GE Power & Water

Carla Friedrich
Regional Office for North America
UN Environment Programme

Maryann Froehlich
Acting Chief Financial Officer
Environmental Protection Agency

Riordan Frost
PhD Student
School of Public Affairs
American University

Jim Fry
Federal Data Solutions Manager
Verizon

Ravi George
Technology and Innovation Manager
Water Environment Research Foundation

Alexander Golub
Professor and Senior Research Fellow
American University

Attendee Roster
Expert Workshop on Water Technologies, June 27, 2014

Morgan Gopnik
Duke University

Joe Greenblot
Associate Director, Analysis Staff
Office of the Chief Financial Officer
Environmental Protection Agency

Sally Gutierrez
Environmental Technology Innovation Cluster
Development and Support Program Director
Office of Research and Development
Environmental Protection Agency

Steve Harper
Global Director, Environment and Energy Policy
Intel

Thomas Heath
Student
Tufts University

David Henry
LIFT Intern
Water Environment Research Foundation

Jud Hill
Managing Director
Blue Star Capital, LLC

Jeff Lape
Deputy Director, Office of Science and Technology
Office of Water
Environmental Protection Agency

Stanley Laskowski
Lecturer/Advisor
University of Pennsylvania/PGWI

Francine Leech
Student
Bryn Mawr College

Judy Lieberman
Scientist
Environmental Protection Agency

Abby Lindsay
PhD Student
School of International Service
American University

Adnan Mansour
Global Product Leader-Monitoring Solution
GE Power & Water

Anne Marsh
Consultant
PTIE

Fred Mason
Independent

Danielle Miller Wagner
Project Advisor
Center for Environmental Policy
American University

Anne Morgan
Sr. Solution Specialist
Verizon

Partnership on Technology Innovation and the Environment

Attendee Roster
Expert Workshop on Water Technologies, June 27, 2014

Amit Pramanik
Senior Program Director
Water Environment Research Foundation

Matt Ries
Chief Technical Officer
Water Environment Federation

William Rogers
Vice President & Treasurer
American Water

Joe Rudek
Lead Senior Scientist
Environmental Defense Fund

Katie Sarro
Consultant
World Business Council for Sustainable Development

Iliana Sepulveda
Student
University of Pennsylvania

Denice Shaw
Program Manager
Office of Research and Development
Environmental Protection Agency

Tad Slawecki
Senior Engineer
LimnoTech

Beth Stauffer
AAAS Science & Technology Policy Fellow
Environmental Protection Agency

Raffael Stein
Director, Municipal Support Division
Office of Water
Environmental Protection Agency

Mario Tamburri
ACT Director and UMCES Professor
Alliance for Coastal Technologies and UMCES

Bruce Tobey
Partner
Pannone Lopes Devereaux & West

Marisa Tricas
ORISE Fellow, Office of Science and Technology
Office of Water
Environmental Protection Agency

Brian Wee
Chief of External Affairs
National Ecological Observatory Network (NEON), Inc.

Doug Wilson
Oceanographer
Caribbean Wind LLC / Sea-Bird Coastal

Yanyang Wu
Student
University of Pennsylvania

Partnership on Technology Innovation and the Environment

Government, business, investment, academic, and environmental organizations have joined together to accelerate the development, adoption, scale-up, and export of technologies for energy, water, and materials that protect health and the environment. The Partnership on Technology Innovation and the Environment (PTIE) leverages the unique capabilities of the multi-sector collaboration to catalyze and enable substantive innovation and technology deployment that could not be achieved by any of these sectors acting independently.

Current members include:

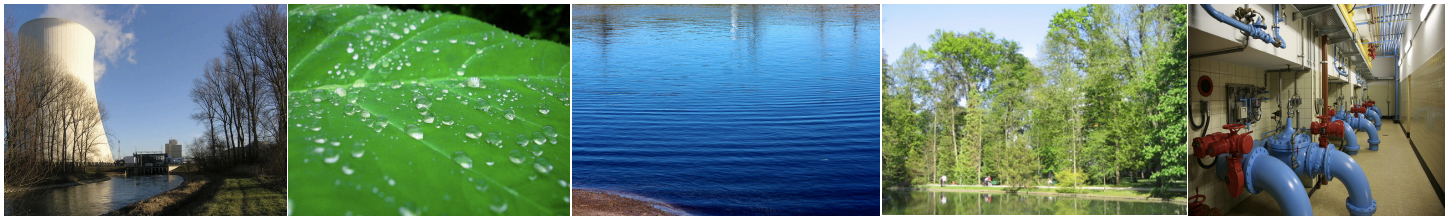
- U.S. Environmental Protection Agency
- U.S. Department of Energy (in process of joining)
- Center for Environmental Policy at American University
- Initiative for Global Environmental Leadership at The Wharton School, University of Pennsylvania
- World Business Council for Sustainable Development
- Environmental Defense Fund

The Partnership focuses on specific, concrete technology areas not addressed by other organizations, to tackle financial, policy, and technological challenges and enable technology scale-up. The Partnership's current focus is on three water technology areas:

1. Financing for More Efficient Drinking Water Systems
2. Challenging Nutrients: Technology Innovation for Better Water Quality
3. Leveraging Financing Models for Innovation in Wastewater Treatment

The Partnership grew out of the Technology Market Summit that was held at American University in May 2012. Several current members, who were also co-sponsors and organizers of that Summit, established the Partnership to continue the multi-stakeholder dialogue, analysis, and collaborations from the Summit.

The Partnership is a non-binding, voluntary collaborative of business, government, academic, and environmental organizations committed to accelerating the development, adoption, deployment and export of technologies that protect health and the environment while contributing to economic growth and creating American jobs. The Center for Environmental Policy at American University is providing management and analytical support for PTIE and is hosting an Expert Workshop on Water Technologies in June 2014.



Water Technology Focus Area:

Challenging Nutrients: Technology Innovation for Better Water Quality

Partnership on Technology Innovation and the Environment

Challenge: The ability to reduce nutrient pollution and improve water quality is hindered by an overall lack of information and data and the currently high cost and effort to collect such data.

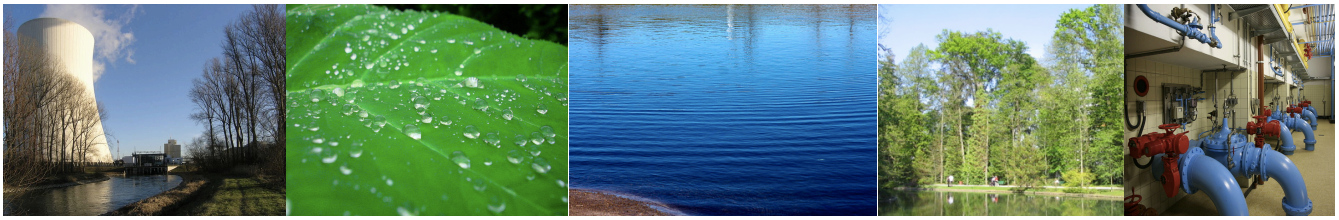
Opportunity: Nutrient sensing technology can help measure nutrients in water, track progress towards goals for nutrient reduction, and provide important information to decision makers.

Planned Result: Within the next three years, achieve a significant reduction (target: 80-90%) in the cost of nutrient sensing technology while maintaining and improving the quality and usability of instruments.

Potential Impact: Identify opportunities in policy and finance to further the research, development and deployment of nutrient sensor technologies.

Nutrient pollution that impacts the water quality of U.S. rivers, lakes and estuaries comes from a variety of sources, including wastewater treatment, agricultural, urban and suburban run-off, and the atmosphere. Excess nutrients frequently cause algal blooms and dead zones resulting in loss of aquatic life, and subsequently an economic resource. The lack of accurate, real-time monitoring limits the development of innovative watershed-scale monitoring and management programs that could help reduce nutrient pollution, especially from nonpoint sources. While there are real-time sensor technologies available, they are prohibitively expensive for many of the state agencies, NGOs, and other groups that would otherwise utilize them.

Partnership Efforts – Working together with technology producers and user groups, the Partnership is assessing user requirements for nutrient sensors and exploring market-driven mechanisms to lower the price and increase the development and adoption of sensor technologies. Furthermore, the Partnership is looking for opportunities across the broader landscape of policy, regulation, and finance that may enable broad use of real-time nutrient sensors and transform how data are collected and used.



Water Technology Focus Area:

Achieving Widespread Adoption & Scale-up of Innovative Wastewater Technologies

Partnership on Technology Innovation and the Environment

Challenge: Much of U.S. wastewater treatment infrastructure is aging, outdated and inadequate, but municipalities face challenges in funding and pursuing development, scale-up, and installation of wastewater technologies.

Opportunity: Leveraging new technologies that reduce energy usage, increase efficiencies, capture nutrients and other valuables, permit water reuse, and thus enable municipalities to finance needed upgrades.

Planned Result Short-Term: The Innovation Partnership uses its multi-sector strengths to identify and implement actions within 12 months that are substantive steps supporting widespread adoption of innovative technologies by wastewater treatment or management facilities in the United States.

Planned Result Long-Term: Accelerated wide-scale adoption of technologies needed for viable operations achieving advanced and secondary wastewater treatment standards.

Most wastewater treatment infrastructure in the United States is deteriorating; however, financing and investment has been inadequate to meet the improvement, repair, and replacement needed to maintain municipal systems. The U.S. Environmental Protection Agency (EPA) estimates investment of some $105 billion is needed to upgrade wastewater treatment systems to meet advanced treatment or secondary treatment standards. Furthermore, new technologies can increase energy and process efficiencies, recover valuables and enable water reuse, thus enhancing financial viability. However, currently available treatment technologies are not being widely adopted.

Example technology innovations include:

- Energy recovery from biosolids
- Recovery of nutrients and other valuables, paired with materials conversion
- Supercritical water oxidation
- Membrane filtration for water reuse
- Green infrastructure

Working with programs underway by key NGOs and others, the Partnership will identify specific innovative wastewater treatment technologies that municipalities are having difficulty in adopting due to financing, regulatory policy, resistance to change, or other barriers. Bringing municipalities together with companies, investors, technical experts, policy makers, regulators, and others, the Partnership will identify and address key barriers and enablers, laying the groundwork needed for successful large-scale adoption.