



Renewing Investment in Our Water System

Over the past century, the United States has developed one of the largest water sectors in the world. This network of dams, aqueducts, levees, treatment facilities and pipelines has enhanced our nation's social, economic and environmental well being by providing reliable access to clean water. However, population growth, urbanization, potential climate change, environmental degradation, aging infrastructure and ever-increasing operation and maintenance costs have led to a need for a renewed investment in our water system.

While innovative and multi-purpose infrastructure solutions, such as green infrastructure projects, demand-side management (DSM) measures and decentralized wastewater treatment systems, can help overcome these challenges, the absence of available and appropriate funding has slowed the widespread adoption of these technological solutions. Federal and state grants, subsidies and tax exemptions for municipal bonds helped produce our current, highly centralized infrastructure.



About the Authors

Newsha K. Ajami, is the director of Urban Water Policy with Stanford University's Water in the West program. She is a hydrologist specializing in sustainable water resource management, water policy and financing, and the water-energy-food nexus. Ajami received her Ph.D. in civil and environmental engineering from the U.C. Irvine, an M.S. in hydrology and water resources from the University of Arizona.

Barton H. ("Buzz") Thompson, Jr., is the Robert E. Paradise Professor in Natural Resources Law, the Perry L. McCarty Director of the Woods Institute for the Environment and a senior fellow with the Stanford Woods Institute. Thompson's research focuses on the management of water and other natural resources. He is co-author of *Legal Control of Water Resources* (4th ed. 2006) and has written extensively on institutional reform, water markets, constitutional issues in water management, managerial uncertainty, endangered species and the public trust doctrine.

Kim Quesnel is a Ph.D. student at Stanford University Department of Civil and Environmental Engineering.

These government funds are currently limited, however, and local utilities are often too cash-strapped to meet existing operations and maintenance obligations let alone fund innovative water projects. Meanwhile, private investors often shy away from water projects due to the potentially high risks associated with new technologies and practices that have limited track records and slow or small rates of return.

"Tapping into Alternative Ways to Fund Innovative and Multi-Purpose Water Projects," a 2016 report a 2016 report issued by Stanford's Water in the West program and the National Science Foundation's Engineering Research Center, Reinventing the Nation's Urban Water Infrastructure (ReNUWIt), identifies and explores

innovative funding and governance mechanisms that can be used to support the integration of new distributed water infrastructure, practices and technologies into the current system. The report also presents a new financing framework that can be used to guide the water sector for the future. This framework, based on analysis of the implementation of successful distributed projects in the electricity sector, can be used as a tool to help the water sector establish alternative financing mechanisms to fund the integration of innovative and multi-purpose projects.

Rethinking Water Infrastructure — Integrating Distributed Water Solutions

Addressing the 21st century challenges facing our water sector requires fresh and renewed thinking. Alternative water management practices, such as distributed and multi-purpose water solutions, can increase the resilience and flexibility of our water and wastewater systems while also extending their lifetimes. These alternative solutions manage water more locally than traditional centralized “gray” infrastructure, eliminating transportation costs, decreasing energy requirements and protecting source water through conservation and reuse. Distributed water projects can also provide cost-sharing opportunities at various scales. Three categories of distributed solutions carry a high potential for changing the water sector landscape:

- **Green infrastructure** uses natural processes such as infiltration or evapotranspiration to reuse stormwater or urban runoff onsite, mimicking natural hydrologic conditions more closely than traditional infrastructure. Currently, most rainwater runs off impervious surfaces and is sent directly to nearby surface water bodies or is captured for treatment at detention ponds before it is discharged. Green infrastructure has the potential to capture and reuse this stormwater, preventing environmental degradation by protecting water from pollutants and debris coming from overland flows.
- **Demand-side management (DSM)** decreases consumption through conservation and efficiency

practices and can be more economically and environmentally sustainable than augmenting supply through new infrastructure or increased source capacity. By decreasing consumption, these practices can help protect source water from waste and contamination.

- **Decentralized wastewater treatment and greywater systems** are small-scale recycling or treatment facilities that manage wastewater locally and complement existing infrastructure. These systems can be appropriate solutions for apartment complexes, small businesses and public buildings that are looking for a more resilient water supply. This water can be treated and reused for non-potable end-uses such as flushing toilets and urinals, outdoor irrigation and decorative foundations.

Barriers to Adoption

Although distributed solutions can offer many social and environmental benefits, a series of barriers often prevent their adoption. Most importantly, there are a few major barriers that directly and indirectly produce financial and governance challenges:

- Currently, many water utilities have **limited access to federal and state funds**.
- There is a **financial gap** between the needs of water service providers and their abilities to generate funds at the local level.
- **Funds from private investors can be difficult to secure**. Due to the water sector’s capital-intensive, risk averse, fragmented and heavily regulated nature, it can be challenging to generate high returns over short time periods on infrastructure investment.
- **Regulatory challenges**, such as long testing and review periods for new technologies and practices, can inhibit new water project development as extended project development times can increase costs.
- **Regulators can be resistant to moving away from the status quo** when public safety is perceived to be a

risk, discouraging potential lenders from investing in products that may not make it to the market.

The Framework — Four critical elements for financing distributed solutions

Case studies of successfully-implemented distributed electricity projects—renewable energy and DSM solutions—reveal four key elements that together can establish a comprehensive financing framework.

- 1. An external force must catalyze change:** An outside stimulus must motivate the shift from traditional to non-traditional solutions. This change can come from direct regulations, market forces, economic incentives or innovative pricing structures.
- 2. A reliable funding source must be identified to implement, operate and maintain these projects:** A set of steady and reliable funding resources has to be established before project implementation can begin. Possible mechanisms include taxes, end-user fees, revolving funds and private capital.
- 3. A pathway that facilitates the flow of financial and technical resources among stakeholders:** Many pathways incentivize residential, commercial, and industrial end-use customers to install new technologies or adopt new practices by offering cost sharing opportunities or by eliminating up-front costs. Some popular mechanisms used in the electricity sector are loans, grants, rebates, tax credits and on-bill initiatives. Examples include the Solar Investment Tax Credit, which encourages residential and commercial customers to purchase and install distributed solar systems and on-bill financing in which service providers pay for device installation and customers later repay the utility for the costs through a reoccurring fee on their utility bill.
- 4. An innovative governance structure that enables project implementation:** Governance structures can help move transactions, push collaborations and enable project construction that might not be

possible in a traditional project management scheme. Examples of novel governance mechanisms include project or financial aggregation, alternative investment structures, end-to-end service companies and net metering.

Water Sector Case Studies

While distributed solutions have been more widely implemented in the electricity sector, there are a few case studies of distributed solutions in the water sector. In the three cases listed below, the water sector used the four critical elements of an effective financing framework discussed above in project development.

- **Philadelphia:** Green City, Clean Waters is a 25-year project to implement green infrastructure for stormwater management. The department has established financing mechanisms such as a stormwater fee program, a grant program and a project aggregation program to encourage implementation of green infrastructure solutions.
- **Cincinnati:** Water managers have implemented a trading program to limit pollution discharges from stormwater runoff. The program utilizes a market-based, auction type permit to motivate landowners to install green infrastructure on their properties.
- **San Francisco:** In 2012, the San Francisco Public Utility Commission set up a non-potable onsite reuse program to increase water savings and diversify the city's water supply portfolio. The program offers grants up to \$500,000 and multiple forms of technical assistance to developers to implement the program.

Policy Recommendations

New policies at various scales can help promote the dissemination of innovative and multi-purpose distributed water solutions.

- **Drive change through regulations and economic forces:** The widespread integration of distributed energy solutions was mainly made possible by

regulatory mandates coupled with financial incentives. For example, growth in the clean energy sector was partly driven by the governmental move toward clean energy, including Renewables Portfolio Standards (RPS), which eventually created a big market opportunity in the sector. Therefore, both federal and state governments have a key role to play in catalyzing change by mandating regulatory compliance coupled with financial incentives.

- **Establish innovative governance structures and funding pathways:** In order to engage various stakeholders in the dissemination of distributed solutions, government agencies should put in place various innovative governance structures such as end-to-end service companies as well as funding pathways including on-bill initiatives and tax credits.
- **Promote cost sharing:** Cost sharing, where expenses are spread among various stakeholders, can make distributed solutions more feasible.
- **Assemble a diverse financing portfolio:** Utilities should have a diverse portfolio of financing mechanisms that are appropriate for various distributed projects based on their scale and scope.
- **Coordinate across scale and sectors:** Both top-down and bottom-up collaborations can significantly aid in the development of distributed solutions. Top-down collaboration involves regulatory agencies across federal, state, and local levels of government coordinating efforts; bottom-up collaboration can aid in better allocation of resources through regional trading efforts or project aggregation.

Conclusions

There is a clear need to transform and modernize our current urban water management practices, technologies and infrastructure. One way to increase the economic and environmental sustainability of our existing network is to adopt more innovative and multi-purpose projects, including distributed solutions. All infrastructure transitions require extensive capital, and the water sector must secure adequate funding if it is to move to a more sustainable and resilient future.

A new financing framework, constructed from best practices in the electricity sector, can help us move towards a more innovative water sector in the United States.

This Research Brief is based on [“Tapping into Alternative Ways to Fund Innovative and Multi-Purpose Water Projects: A Financing Framework from the Electricity Sector.”](#) a 2016 report issued by Stanford’s Water in the West program and the National Science Foundation’s Engineering Research Center, Reinventing the Nation’s Urban Water Infrastructure (ReNUWIt).

Contact Us

Mail

Stanford Woods Institute for the Environment
Jerry Yang & Akiko Yamazaki Environment & Energy Building
MC 4205 / 473 Via Ortega, Stanford, CA 94305

Phone

650.736.8668

Email

environment@stanford.edu

Online

woods.stanford.edu