Water Environment Federation

FINANCING THE FUTURE OF THE U.S. WATER SECTOR

Investment for Resilient Water Infrastructure:
The Role of Private Finance and the Circular Water Economy

Executive Overview

The U.S. water sector is entering a multi-decade capital expansion cycle driven by aging infrastructure, regulatory mandates, climate volatility, and new industrial build-out.

According to capital needs assessments by the U.S. Environmental Protection Agency (EPA), hundreds of billions of dollars will be required for upgrades to drinking water and wastewater systems over the next two decades.

Traditional funding — municipal bonds, federal grants, the State Revolving Fund (SRF) programs, and WIFIA — remains foundational but insufficient to close the investment gap, resolve future uncertainties, and meet the opportunity offered by a transition to a circular water economy. Filling the gap with new financing approaches can unlock economic value, protect public health and the environment, and attract private capital that traditional funding sources alone cannot deliver.

The investment opportunity lies in:

- Leveraging private finance and public-private partnerships (P3s)
- Monetizing circular water assets (water reuse, energy, nutrient recovery, and more)
- Utilizing blended finance to reduce the weighted average cost of capital
- Improving governance across the sector, including to support transparency in the rate base

Water infrastructure is evolving from a traditional rate-dependent utility model into a diversified, climate-aligned, investable infrastructure-asset class with growing capital needs, new financing structures, and new investor demand for stable long-term assets. New approaches will be needed at both the utility and specialist-delivery model level to maximize the benefits of traditional funding sources and secure a safe and efficient sector in the future.

ACKNOWLEDGEMENTS

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Introduction

U.S. water infrastructure faces unprecedented challenges. A combination of aging assets, regulatory mandates, rising demand for water services in some industrial sectors, and climate stress is putting increasing pressure on investment needs as utilities seek to balance fiscal stability, ratepayer affordability, and new funding approaches.

As pressures mount on lower-cost sources of public funding, the investment gap will grow, and new strategies are needed, in part to support development of the circular water economy through models of private funding. Sources of private funding, including infrastructure funds, private equity, and other water-focused investors, are increasingly seeking opportunities that combine long-term returns with positive environmental outcomes. Without new financing models, utilities will face rising risks and declining resilience. This paper outlines how the sector can pivot toward a more investable, circular and financially sustainable future and explores building funding models that drive long-term resilience and growth.

It examines the scale and nature of the current investment needs, the opportunities created by the circular water economy, and financial structures that could attract greater participation from private investors. It seeks to promote dialogue among sector stakeholders, including utility professionals, public officials, regulatory agencies, and private sector participants on how best to address new approaches to financing and advancing the circular water economy.

Private finance alone cannot solve the challenge, but when effectively structured and aligned with public policy objectives, it can significantly expand the pool of available capital and support the deployment of new technologies and delivery models.

Financing challenges in U.S. water infrastructure

1. GROWING INVESTMENT NEEDS

U.S. water infrastructure investment needs are structural and are accelerating, driven by aging assets, regulatory mandates, climate pressures, and wider cost pressures. These forces create unavoidable long-term capital requirements. The investment gap is unavoidable under current cost-recovery models, and the structural pressures expose the limits of the existing financing model, which relies heavily on local ratepayers and municipal borrowing.

AGING ASSETS

With over 148,000 public water systems delivering drinking water through 2.2 million miles of underground pipes, more than 17,500 facilities processing billions of gallons of wastewater daily, and extensive stormwater infrastructure, the U.S. operates one of the largest and most complex water infrastructure systems in the world. Pipes and distribution networks with an average life in excess of 45 years are reaching the end of their intended service life; treatment plants built shortly after the Clean Water Act of the 1970s are reaching design life limits; and climate pressures are stressing systems not designed for current conditions (ASCE, 2025).

The American Society of Civil Engineers (ASCE) 2025 Report Card for America's Infrastructure gave U.S. drinking water and wastewater infrastructure a C- and D+, respectively, demonstrating that such infrastructure in the U.S. is under increasing strain. These forces are driving costs higher with increasing risks to system reliability, affordability, and utility financial stability.

REGULATORY MANDATES

New federal drinking water standards, such as those addressing PFAS and lead contamination, represent one of the most significant regulatory compliance challenges facing utilities in decades. Following the issuance of the EPA's PFAS regulation in 2024, public water systems are required to comply with Maximum Contaminant Levels (MCLs) for six PFAS compounds by 2029. Meeting these standards, as well as the need to replace many lead service lines by 2034, will require significant capital investment by public utilities.

In the wastewater sector, regulatory mandates around combined sewer overflows (CSOs) and nutrient reduction are two of the biggest drivers of capital investment, among other needs. Both stem from enforcement of the Clean Water Act through the National Pollutant Discharge Elimination System, which requires municipalities to meet specific water-quality standards.

CLIMATE

Climate pressures are intensifying both the operational stress on water infrastructure and the increasing scale of investment required to maintain system resilience and a reliable service. Rising temperatures, declining snowpack, erratic precipitation patterns, and increased evaporation are reducing surface water availability and increasing drought frequency and severity, particularly in Western and Southwestern regions (Figure 1).

[1]EPA has proposed to extend this deadline until 2031 and narrow the relevant compounds as part of the rule, but this is not yet final.

Figure 1: Map of overall water stress for the U.S.

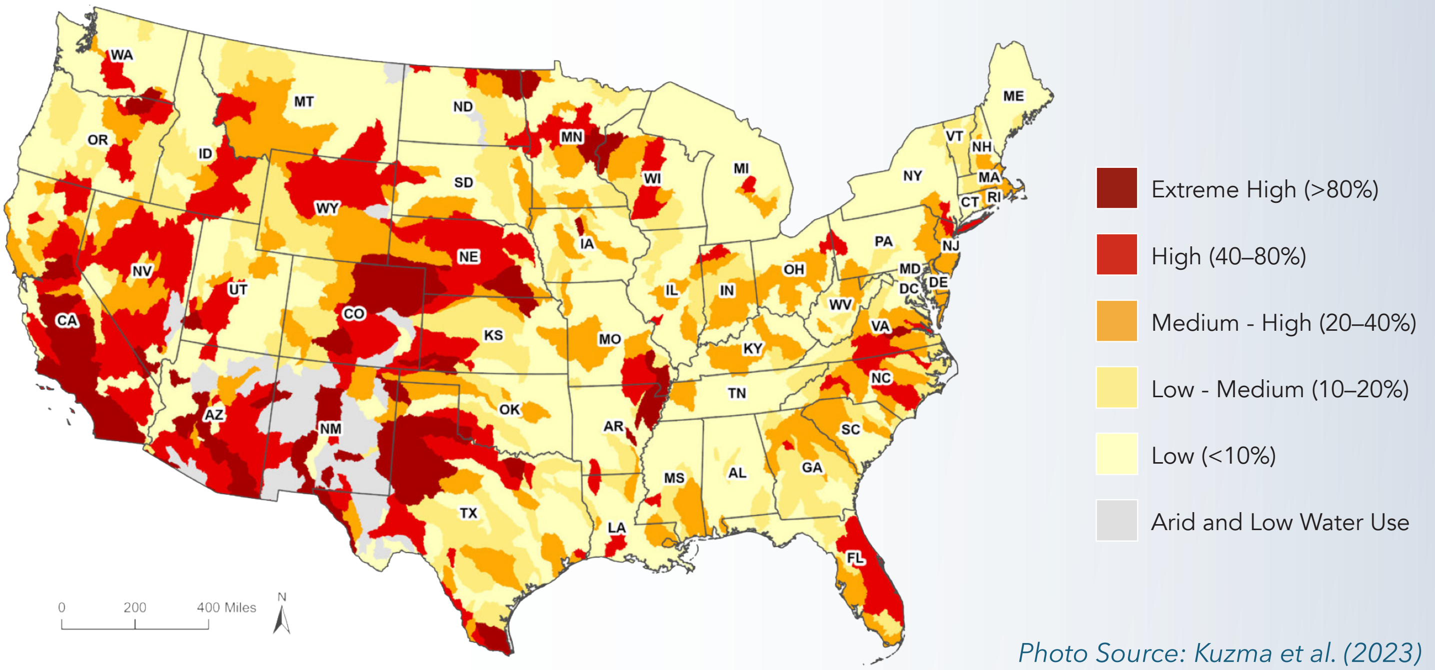


Photo Source: Kuzma et al. (2023)

The U.S. relies on groundwater for roughly 26% of its water supply, and long-term declines in aquifer levels are reducing the reliability of supply while increasing pumping costs. Utilities are looking to diversify water supplies through water reuse, aquifer storage and recovery, desalination, and deeper groundwater extraction, all of which require significant capital investment and energy.

Therefore, utilities must invest in supply diversification, advanced treatment, infrastructure hardening, flood protection, backup power systems, and drought contingency planning to maintain service reliability. Climate adaptation is consequently shifting system resilience into a core component of utility asset management and long-term capital planning.

COSTS

Inflation is exerting significant pressure on utilities, increasing both capital and operating costs. Utilities undertaking major infrastructure projects, such as new water supply initiatives and aging treatment facility replacements, are particularly vulnerable to these economic shifts. Over the past five years, the estimated costs for large-scale investments across many regions, such as advanced treatment facilities, water collection and conveyance systems, and resource recovery opportunities, have doubled, and water utilities have had to defer or reduce the scale of their projects as material costs increased. Additionally, labor shortages and rising wages in the construction sector have further compounded project expenses.

2. SOURCES OF FINANCE

The traditional financing model — local ratepayer funding plus municipal debt — is reaching its limits.

Many households already struggle with water bills, especially in low-income or rural areas. The EPA estimates that between 12 and 19 million households currently lack access to affordable water services (EPA, 2024) and water bills would need to rise significantly in some regions to fully fund infrastructure upgrades, irrespective of funding mechanisms. Such high rate increases can disproportionately affect vulnerable populations, leading to public backlash and potential nonpayment, and political pressure can delay or reduce approved rate hikes, even if investment is urgently needed.

LOCAL UTILITY FUNDING AND MUNICIPAL BONDS

In the U.S., the water utility sector is a shared responsibility among federal, state, and local governments but is predominantly locally financed with 80–90% of infrastructure investment for operations and maintenance, capital improvements, and debt repayment on infrastructure projects, ultimately coming from local ratepayer revenues (Brookings, 2024).

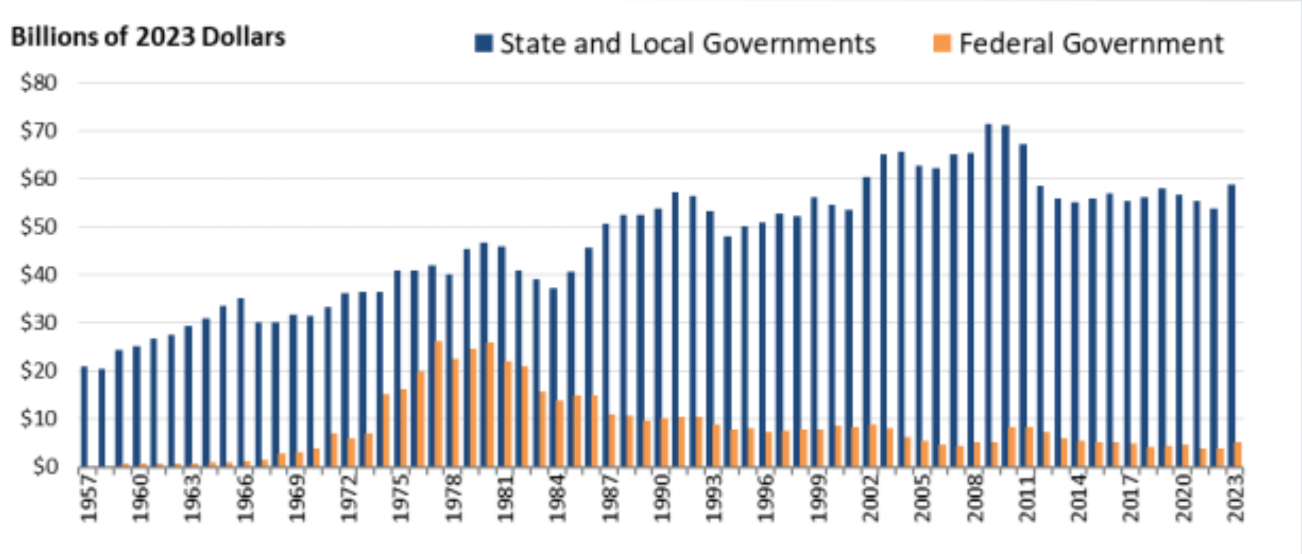
For capital projects, the municipal bond market represents the cornerstone of financing, supporting the construction, rehabilitation, and expansion of drinking water systems, wastewater treatment facilities, and stormwater networks across thousands of communities. In 2016, 70% of U.S. water utilities relied on municipal bonds (Copeland et al., 2016).

In 2025, municipal issuers raised approximately $46 billion in tax-exempt bonds for water and sewer infrastructure, representing about 9% of total tax-exempt municipal bond issuances. These bonds are typically issued by local governments, water authorities, or special districts and are backed by utility revenues or municipal credit (MSRB, 2026). Overall, more than 90% of water and sewer bond issuance is tax-exempt, reflecting the traditional role of municipal debt in funding public infrastructure.

STATE AND FEDERAL FUNDING

State and local governments have historically financed the vast majority of water infrastructure investment, while the federal share is only approximately 8% (Figure 2).

Figure 2: Federal, state, and local water capital investment (1957-2023)



Source: U.S. CBO (2025)

Photo source: THINK b via Adobe Stock

Even though water infrastructure remains predominantly locally financed, federal programs provide important capital backstops, particularly for disadvantaged and rural communities.

SRFs serve as the primary federal financing mechanism for water infrastructure investment. More specifically, the Clean Water State Revolving Fund (CWSRF) focuses on low-cost financing for wastewater treatment, stormwater management, and nonpoint source pollution control, while the Drinking Water State Revolving Fund (DWSRF) provides parallel assistance for drinking water system improvements. Both programs work by capitalizing state-level funds that provide subsidized loans to eligible borrowers, with states required to provide a 20% funding match to access federal funds.

CASE STUDY: BOND FINANCING IN SANTA FE, NEW MEXICO

CHALLENGE: The city of Santa Fe faced severe drought conditions for more than 20 years compounded by population growth. To maintain reliable water services and improve system efficiency, the city has relied on municipal bond financing as a key funding mechanism for capital upgrades.

SOLUTION: In 2021, Santa Fe issued approximately $20 million in water revenue bonds to support a comprehensive water-system modernization program for infrastructure and technology improvements, including advanced metering, pipeline rehabilitation to reduce water loss, modernization of water and recycled-water treatment facilities, and expansion of recycled water capacity.

FINANCING: The bonds were backed by revenues generated from the city's water utility, allowing the municipality to raise capital without relying on general taxation. The city's strong financial position helped secure high credit ratings for its water and wastewater revenue bonds, including an AA+ rating from Fitch Ratings, reflecting stable revenues and responsible financial management.

OUTCOMES: The investment produced several benefits for the city including improved water conservation and reuse allowing potable water supplies to be prioritized for households, improved infrastructure resilience for drought and to support future growth while maintaining affordable water rates for most residents.

Source: Nuveen (2025)

Since their establishment in the late 1980s, SRFs have provided nearly $200 billion in cumulative financing for drinking water and wastewater infrastructure (Environmental Policy and Innovation Centre, 2025). The CWSRF alone has delivered approximately $172 billion in assistance through more than 48,000 loan agreements as of 2023, while the DWSRF has provided $24.5 billion in loans since 1997 (Brookings, 2024).

Designed to complement the SRFs, the Water Infrastructure Finance and Innovation Act (WIFIA) program provides long-term, low-cost supplemental loans for large-scale regional and national projects over $20 million. Since its inception in 2014, the WIFIA program has provided $21 billion in loans, supporting $47 billion in total water infrastructure investment. WIFIA has been instrumental in supporting large water reuse projects with multiple projects receiving individual loans in excess of $500 million.

OUTLOOK FOR FEDERAL FUNDING

Federal funding for water infrastructure has not kept pace with the pressing need to rehabilitate and replace aging systems, and existing funding mechanisms remain insufficient to meet capital requirements. The use of "earmarks" to specify specific allocation of funds has also further constrained resources for the SRFs in recent years.

The 2021 Infrastructure Investment and Jobs Act (IIJA) represented the largest federal infrastructure investment in decades, allocating more than $53 billion to drinking water, wastewater, and stormwater systems. This marked a significant, albeit temporary, reversal of the long-term decline in federal funding for water infrastructure.

A widening investment gap, along with rising capital requirements and uncertainty about federal funding further complicates long-term infrastructure planning and investment for public utilities.

The 2026 budget proposal announced in May 2025 proposed a nearly 90% cut in the SRF's annual funding, and the IIJA is scheduled to expire in September 2026. At the same time, potential discussion around the repeal of the tax-exemption for municipal bonds could result in utilities borrowing costs for infrastructure projects in a sum over $823 billion (GFOA, 2025). While such cuts and policies may not fully come to pass, the specter of such proposals increases uncertainty about where much needed capital for investments will come from.

3. SCALE OF THE INVESTMENT GAP

Affordability constraints and borrowing capacity limits the effectiveness of the traditional model. Because affordability and debt capacity constraints limit traditional tools, the resulting shortfall becomes visible when examining the scale of the investment gap.

Utilities face structural financial constraints in meeting this challenge, including reliance on ratepayer revenues, affordability concerns, debt limits, and uneven access to capital markets. These pressures are widening the gap between investment needs and available funding, increasing life cycle costs and heightening risks to system reliability.

In partnership with ASCE, the Value of Water Campaign released its "Bridging the Gap: The Power of Investment in Water" study in 2024, which projected a growing disparity between the nation's infrastructure needs and the level of investments.

The study explored two future infrastructure funding scenarios: one in which infrastructure investments continue to be made using IIJA funding levels; and one in which investments return to pre-IIJA levels. It found that the annual funding gap for the nation's water infrastructure could increase more than 12% if IIJA levels of funding are maintained compared to a scenario that reverts to pre-IIJA levels of funding.

Reliable water systems underpin a wide range of economic sectors, making sustained investment essential for long-term economic stability. Without sufficient investment to close the water infrastructure investment gap, the U.S. economy could forgo nearly $3.9 trillion in GDP over the next 20 years (Voice of Water, 2025).


Photo source: tuastockphoto via Adobe Stock

4. PRIVATE PARTICIPATION IN THE WATER INFRASTRUCTURE

Given the magnitude of this gap, utilities must look beyond traditional public funding toward complementary private and blended finance solutions.

Unlike some countries where private companies fully operate national systems, most U.S. water utilities are publicly owned with private capital used through ownership in certain systems, partnerships, or project financing. Private capital can accelerate delivery, transfer risk, and unlock circular value when paired with strong governance.

A portion of U.S. water infrastructure is fully owned and operated by private or "investor-owned utilities" with roughly 15% of Americans receiving their services from private utilities (USWA, 2023). American Water, California Water Service Group and several smaller, Western-based utility groups are privately owned, but they raise capital through equity markets, corporate debt, and other commercial sources to invest in infrastructure treatment plants, pipelines, and distribution networks. They also earn regulated returns approved by state public utility commissions, as do publicly owned utilities. These utilities can also access the tax-exempt municipal bond market through use of qualified private activity bonds where the use of proceeds qualifies as public infrastructure.

Additional private funding can also come from public-private partnerships (P3s), where a private firm finances, builds, or operates infrastructure while the public sector retains ownership. Typically, a private company will sign a long-term contract with a publicly owned utility to construct, operate, and finance a treatment facility or similar entity, with funding provided as equity while debt is sourced from banks or infrastructure funds. Common P3 structures include design-build-operate (DBO), design-build-finance-operate (DBFO), as well as long-term concession agreements where a private party may undertake operations and investment for a whole network.

Growing interest in investor-owned utilities, spanning both for-profit and nonprofit companies, is reshaping the U.S. water sector. P3s and other forms of private capital participation can help accelerate project delivery, introduce technical innovation, share risk, and provide access to additional financing capacity. When structured with strong governance and regulatory oversight, these models can support reliable service delivery while enabling utilities to modernize infrastructure and build resilience, including for the circular water economy. Asset ownership held by private investors is increasing, which is driven by the prospect of stable and long-term returns.

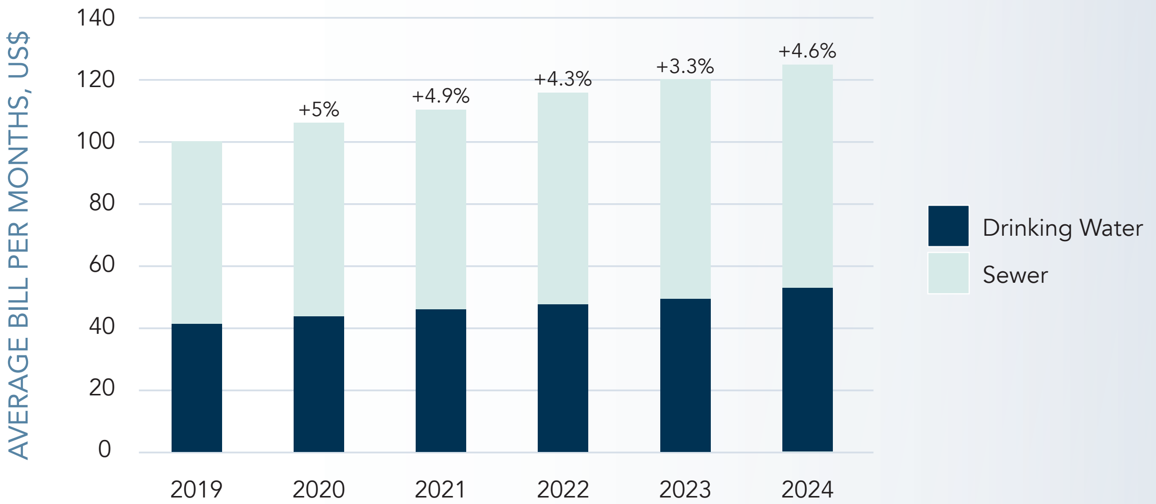
5. IMPACT ON THE RATE BASE

Expanding private participation requires careful attention to rate impacts, equity, and regulatory oversight.

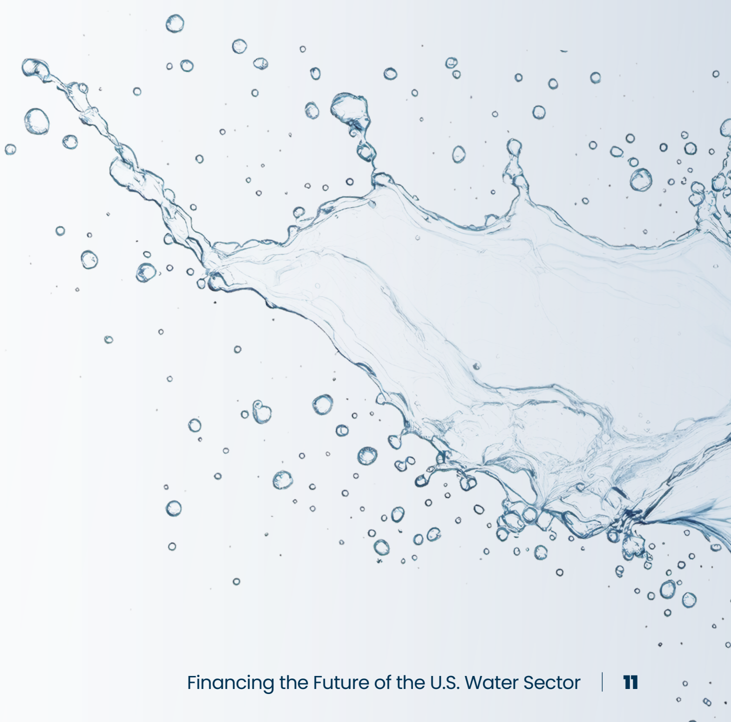
Water utilities across the U.S. are balancing multiple competing priorities and investing in infrastructure to meet regulatory requirements while preserving affordability for residents. As capital investment needs continue to grow, utilities face pressure to increase water rates to offset the cost of delivery services. Ratepayers already shoulder the burden for approximately 95% of the nation's drinking water and wastewater infrastructure (Koehle et al., 2019).

This pressure has already caused concerns about the affordability of water services, particularly for low-income households and communities already facing financial strain. Between 2019 and 2024, combined water and wastewater bills increased by 24%, where wastewater alone accounted for approximately 59% of households' monthly utility bills (Figure 3).

Figure 3: Household water and sewer bills in the U.S. (2019-2024)



Source: Bluefield Research (2025)



Closing the investment gap through the circular water economy

1. INVESTMENT OPPORTUNITY

The circular water economy directly addresses the core financing bottleneck facing U.S. utilities: Rates cannot rise fast enough to fund required upgrades, grants are limited, and many utilities are approaching debt capacity constraints. Circular value is not an environmental concept; it is a financing strategy that strengthens creditworthiness and reduces long-term exposure.

Water utilities in the U.S. have historically operated under a linear model of water management centered on extraction, delivery, and disposal. While this model has enabled large-scale water service delivery, it has also contributed to rising costs and environmental degradation, as well as missed opportunities for economic value for utilities, the economy, and society at large.

The circular water economy offers an alternative approach by enabling utilities to transition from a traditional single-revenue model to a value-generating model, where water becomes a recovered resource rather than discarded waste. It recognizes that water has value far beyond a single use, and that well-designed systems can recover and reuse resources while restoring ecosystems.

The circular water economy can be described in three categories.

REDUCE Minimize water usage and wastage through efficient practices.

RECOVER Extract valuable resources like energy or nutrients from wastewater.

REGENERATE Restore natural ecosystems and recharge aquifers through sustainable water management.

The approach treats water not as a disposable resource but as an economic asset. By shifting toward circular systems, such as water reuse, resource recovery from wastewater, and improved efficiency across supply chains, governments and businesses can reduce water scarcity while creating investment opportunities across sectors.

Investments in advanced treatment technologies, decentralized reuse systems, nutrient and energy recovery from wastewater, and digital water management solutions can unlock both environmental and economic value. Demand for circular water solutions is expected to grow and provide investors the potential for long-term, infrastructure-backed returns while supporting sustainable resource management and climate resilience.

Photo source: Kalyakan via Adobe Stock

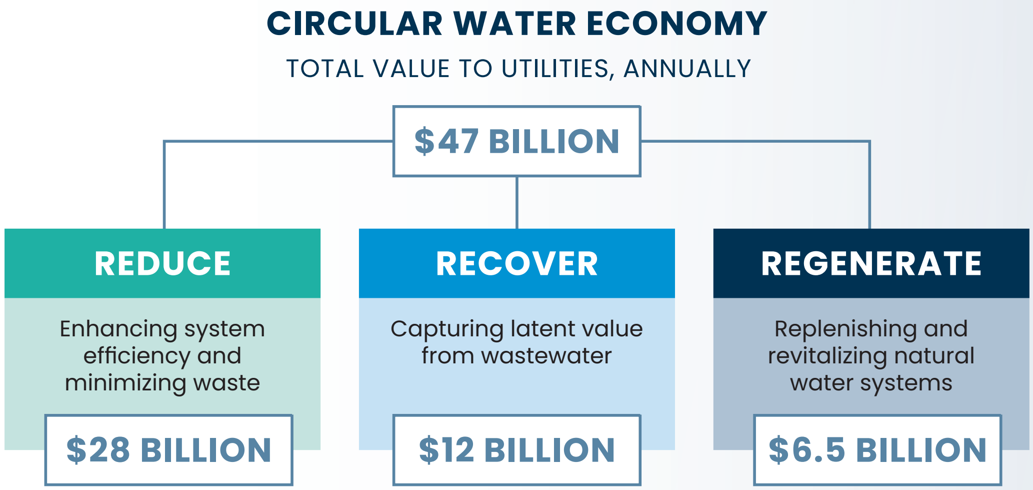
2. UNLOCKING VALUE FOR UTILITIES

The circular water economy creates monetizable value that can relieve pressure on ratepayers and improve project investability.

In the U.S., WEF estimates that circular water economy strategies represent a $47 billion annual opportunity for utilities and municipalities, generated through avoided costs, improved system performance, and new revenue streams (Figure 4).

At the utility level, circular strategies can reduce operational and capital costs, improve asset efficiency, and generate new sources of revenue by turning waste streams into valuable resources. These approaches provide direct benefits to water-dependent industries by improving supply reliability, stabilizing costs, and enabling more sustainable production practices. At the same time, circular water investments can catalyze local job creation. Apart from economic benefits, there are societal and environmental benefits, such as improved water quality, restored ecosystems, reduced greenhouse gas emissions, better public health outcomes, and more equitable access to clean water.

Figure 4: Circular Water Economy Valuation Summary



Source: WEF (2025)

REDUCE

Utilities incur substantial revenue losses from non-revenue water loss resulting from leaks in distribution networks, illegal connections, metering inaccuracies, and non-payment of water bills. It is estimated that 2.7 trillion gallons of treated water are lost each year (Bluefield Research, 2025) with non-revenue water costing utilities more than $10 billion each year.

With an estimated $18 billion market potential from new applications, water reuse is increasingly recognized as a cornerstone of resilient water resource planning in the U.S., helping ensure reliable water supplies at the federal, state, and local levels.

CASE STUDY: RECYCLED WATER FOR DATA CENTERS IN LOUDOUN COUNTY, VIRGINIA

CHALLENGE: Loudoun County has experienced explosive growth in data center development, with facilities requiring large volumes of water for cooling, placing strain on public water supplies. Without alternative sources, this demand could compete with residential needs, particularly during peak summer months.

SOLUTION: Loudoun Water developed a reclaimed water program that uses treated wastewater for non-potable industrial applications, notably data center cooling. Central to this approach was the construction of the Broad Run Water Reclamation Facility, which treats wastewater to high standards suitable for reuse, and a dedicated "purple pipe" distribution network to deliver reclaimed water to participating data centers.

FINANCING: Implementation has been funded through a combination of utility capital and customer connection fees. Charges for reclaimed water service are generally lower than for potable water, creating an economic incentive for data centers to participate.

OUTCOMES: By 2024, Loudoun Water was supplying reclaimed water annually to data centers, reducing demand on potable water sources and thus conserving drinking water and supporting regional sustainability goals. The reuse system also reduced nutrient loads that would otherwise be discharged into local waterways and provided a lower-cost cooling water alternative for participating facilities.

Source: Loudoun Water

RECOVER

Investing in resource recovery presents a significant economic opportunity for U.S. utilities by transforming treatment systems into monetizable assets. Each day, up to 60 billion gallons of wastewater flow through over 17,500 publicly owned treatment facilities, carrying recoverable water, embedded energy, and valuable nutrients. Rather than treating this stream solely as a disposal challenge, utilities can capture and monetize these resources while reducing operating costs, generating new revenue streams, and improving long-term financial resilience. Water reuse systems, anaerobic digestion for biogas production, and nutrient recovery processes allow utilities to offset energy purchases, sell recycled water for industrial or agricultural use, and produce marketable byproducts like fertilizers.

There are a variety of available resource recovery opportunities such as capturing the energy in wastewater by utilizing biogas from anaerobic digesters in a combined heat and power system allows wastewater facilities to produce some or all their own electricity and space heating, turning them into "net zero" consumers of energy. An estimated $12 billion annual market is available in recovering the latent value from wastewater, including $9 billion from biogas recovery and $3 billion from recovery of nutrients and biosolids.

Photo source: Punyawee via Adobe Stock

CASE STUDY: WATER RESOURCE RECOVERY FACILITY IN ODENSE, DENMARK

CHALLENGE: Wastewater treatment facilities are energy intensive, requiring significant energy for aeration, pumping, and treatment processes. In response, the European Union is requiring utilities to comply with stringent regulations related to effluent standards and carbon neutrality by 2045.

SOLUTION: Faced with increasing energy costs, aging infrastructure and compliance requirements, utilities in Denmark pioneered the adoption of resource recovery, transforming traditional wastewater treatment plants into facilities recovering valuable resources. VCS Denmark integrated advanced sludge treatment, biogas production and energy recovery technologies at the municipal wastewater treatment plant in Odense.

FINANCING: The project adopted a phased approach to investment, enabling VCS to fund improvements progressively, reinvesting savings and performance gains into subsequent phases rather than relying on a one-off major funding package.

OUTCOMES: By 2013, the facility achieved energy neutrality and by 2024 was producing 150% of its energy requirements with excess electricity sold to the local grid. Today, the plant also recovers thermal energy from treated effluent, increasing energy generated to 330% of self-sufficiency.

Source: Jacobs (2025)

REGENERATE

Regeneration strategies treat ecosystems, including wetlands, aquifers, and watersheds, as active infrastructure. Restored urban wetlands provide natural stormwater management by absorbing excess rainfall and reducing flood risks to infrastructure and treatment costs for utilities. By capturing stormwater, restoring degraded landscapes, and enhancing groundwater recharge, these efforts not only improve water quality and availability but also deliver broader co-benefits, such as increased biodiversity, carbon sequestration, and climate resilience. Regeneration is about working with nature to secure water for the long term.

Managed aquifer recharge is one such leading approach that involves replenishing depleted aquifers with treated wastewater, stormwater, or other sources that can be directed into the ground through injection wells, basins, or infiltration zones. This helps stabilize groundwater levels, slow land subsidence, and protect against saltwater intrusion while also maintaining flows that support rivers, wetlands, and ecosystems downstream.

WEF estimates an additional $6.5 billion annual market opportunity lies in investments in watershed health, aquifer recharge, and nature-based systems.

3. ECONOMIC, ENVIRONMENTAL, AND SOCIAL IMPACTS

Circular water economy projects can boost economic growth through new revenue streams and job creation, reduce environmental impacts, and provide social benefits through more reliable, resilient, and equitable water services.

Investing in a circular water economy offers significant economic, environmental, and social benefits beyond direct commercial opportunities for utilities. By reducing dependence on freshwater sources and promoting water reuse, circular systems can help stabilize the cost and availability of water for households, agriculture, and industry over time. This reliability supports economic growth by ensuring that businesses can operate efficiently during droughts. Investments in circular water infrastructure generate local jobs and stimulate regional economies by promoting skilled and unskilled employment opportunities across construction, technology, and utility sectors.

The environmental and social benefits of a circular water economy are equally impactful, particularly in improving public health and community resilience. By reducing pollution and recovering resources, these systems protect water quality and mitigate risks associated with contamination. Water-efficient technologies and recycling initiatives often come with educational and workforce development programs, fostering local knowledge, skill-building, and community engagement, which strengthen social cohesion and long-term regional stability.

Beyond local communities, a circular water economy contributes to national economic resilience and sustainability. By recovering energy, nutrients, and other resources from wastewater, circular systems create new industries and value chains, stimulating innovation in water technology, agriculture, and energy sectors. Overall, the shift toward a circular water economy represents not only a strategic financial opportunity but also an opportunity to enhance economic stability, environmental protection, and social well-being.

4. WATER PRICING, TECHNOLOGY, AND INFRASTRUCTURE

From complex water-pricing structures to technological and operational barriers and aging infrastructure, circular water economy projects can still face many challenges.

Given that many water utilities in the U.S. already face financial pressure from maintaining and upgrading existing infrastructure, utilities may delay or avoid implementation due to budget constraints. This is compounded by the relatively low price of freshwater in many regions, which can inhibit the development of alternative supplies. Traditional utility rate structures and cost recovery models often limit utilities' ability to generate revenue from recovered resources such as energy, nutrients, or reclaimed water.

Water pricing structures often do not reflect the full cost of supply, making traditional water extraction appear cheaper than efficiency upgrades or reuse. This weakens the economic case for circular water initiatives because utilities and industries have little direct incentive to invest in alternative water sources. Without pricing mechanisms that better reflect water scarcity and environmental costs, circular solutions can struggle to compete economically with conventional water supply methods.

Because much of the existing water infrastructure in the U.S. was designed on a linear model, the speed of the technological and infrastructure transformation needed to implement the circular water economy is a challenge.

Transitioning to a circular approach where water is reused multiple times and valuable resources — energy and nutrients — are recovered often requires major upgrades or redesigns of existing facilities and distribution networks.

Integrating advanced treatment technologies into existing facilities can be complex and costly. Utilities may also need to invest in workforce training, new monitoring systems, and operational expertise to manage these processes safely and efficiently. In addition, non-potable water reuse requires new distribution infrastructure that can be difficult and expensive to install in already developed urban environments.

Photo source: reewungjunerr via Adobe Stock

The age and fragmentation of many U.S. water systems can cause infrastructure limitations as retrofitting these systems can be challenging.

As a result, the transition toward circular water systems requires long-term infrastructure planning and coordination across multiple water management sectors. The need for specialized operational expertise can further compound this effort for smaller utilities. As a result, many utilities struggle to adopt advanced treatment solutions, slowing the broader transition toward circular water systems.

Wastewater utilities must balance the potential long-term savings from resource recovery and operational efficiency against the higher capital and operational costs of these systems. Large-scale adoption of circular water technologies will depend on supportive policy frameworks, access to public funding and innovative financing mechanisms that help utilities manage the initial investment risk.

5. INSTITUTIONAL AND REGULATORY DRIVERS

Institutional and regulatory drivers shape the circular water economy by influencing investment incentives, setting standards, and guiding utility planning, while often creating both opportunities and obstacles for project implementation.

Institutional and regulatory complexity can constrain the expansion of the circular water economy. Water governance in the U.S. is highly decentralized, with responsibilities distributed across federal, state, and local authorities. This fragmented governance structure can make it difficult to coordinate policies and regulations that support integrated circular water systems.

For example, regulatory uncertainty around water reuse and resource recovery can also slow implementation. While some states have developed comprehensive frameworks for recycled water and potable reuse, others lack clear standards or permitting pathways. Therefore, utilities may face lengthy approval processes or unclear regulatory requirements when proposing innovative reuse projects. This uncertainty can discourage investment and experimentation with circular water technologies, particularly when utilities are responsible for maintaining strict public health and environmental compliance.

Permitting processes for reuse projects, nutrient recovery, and biosolids management can also be hard to navigate, creating uncertainty for utilities and investors. Emerging concerns around contaminants such as PFAS have further complicated the regulatory landscape, particularly for biosolids land application and wastewater treatment.

Harmonizing regulations to support water reuse and resource recovery practices can reduce uncertainty for utilities, industries, and investors, encouraging adoption of circular water solutions. Collaboration among entities such as the EPA, state agencies, municipalities, and private stakeholders can help streamline permitting processes, align water quality standards, and facilitate data sharing and innovation. Policies that provide financial incentives, grants, and public–private partnership frameworks can stimulate investment in technologies for wastewater reuse, nutrient recovery, and decentralized treatment systems.

Mobilizing capital

1. ESTABLISHED FINANCING SOURCES

Established financing sources remain essential but cannot close the gap alone.

As with all water infrastructure, user fees and other types of water service-related revenues remain foundational for utility finance, providing predictable income to cover operations and debt service to invest in infrastructure projects. Many utilities adjust rates to reflect full cost recovery while also offering tiered pricing to encourage conservation and reuse. These revenue streams are typically essential to underpin long-term financing instruments.

Federal and state programs provide subsidized capital and risk mitigation to unlock projects that might otherwise be unaffordable. The CWSRF explicitly supports resource recovery, energy generation, water reuse, stormwater capture, and decentralized treatment initiatives. WIFIA loans have funded advanced recycled water production that enhances groundwater sustainability and reduces seawater intrusion in projects like Pure Water Soquel in California. Similarly, new potential initiatives add to this effort, such as the proposed Advancing Water Reuse Act, which would provide tax credits for private investment in water reuse projects to promote investment in the sector.

Increasingly, blended and performance-based financing models help bridge the availability of traditional sources of capital with private or other sources and align environmental outcomes with investment returns. Environmental Impact Bonds (EIBs), first deployed by DC Water (see the case study below), illustrate how investor returns can be tied to achieving specific environmental performance. In this case, upfront capital was secured to construct stormwater mitigation infrastructure, and performance outcomes were assessed to determine investor payments, blending public authority financing with private investment and outcome incentives. By combining user fees, tax-advantaged finance, and state and federal funds with innovative structures that reward performance, these blended models expand the pool of capital for circular water projects while promoting efficiency and long-term sustainability.

With enhanced technology and capital risk, conventional treatment projects use well-established technologies with predictable costs: Financing risk is relatively low with investors; and lenders are familiar with expected returns; and traditional sources of capital are generally available. Circular water projects can involve advanced or emerging technologies, and higher technical and operational risk can make traditional financing harder and require blended finance to reduce risk.

There are many other factors that may make a utility engage with partners both for delivery and financing when planning a circular water economy project. The challenge in navigating regulatory compliance, while creating uncertainty for lenders and investors, may prompt utilities to offload risks to partners, including stakeholder management. Partners' expertise in collaborating across sectors may improve the chances of success and persuade inexperienced utilities to create joint ventures or public-private partnerships.

2. PRIVATE FINANCE AND P3S

Private capital is increasingly important in financing the circular water economy, but its effectiveness depends on governance, risk allocation, and contract design.

As investment demands grow, and with limited public funding, municipalities often cannot cover the costs of modern water treatment, reuse systems, and decentralized technologies on their own. Private investors, including infrastructure funds, venture capital, and private equity, are increasingly interested in supplying the necessary funding to bridge this gap, enabling utilities and industrial users to implement more efficient and sustainable water management solutions.

Investor-owned utilities, like their more numerous publicly owned peers, will mobilize private capital to advance the circular water economy by financing the necessary infrastructure and technologies through mechanisms such as long-term infrastructure investment, green bonds, and public-private partnerships. These investments generate stable returns through regulated asset bases, long-term service contracts, and new revenue streams from recycled water, recovered resources, and environmental credits typically in line with the objectives of their shareholders.

Beyond infrastructure, private capital also drives innovation in water technologies. Venture capital and private equity fund advanced treatment systems, digital water management platforms, and sensors that optimize water flows and enable resource recovery. Institutional investors increasingly seek sustainable and impact-oriented projects, valuing environmental, social, and governance outcomes alongside financial returns. By supporting technology development, scaling reuse infrastructure, and promoting sustainable investment, private capital is helping drive the transition toward a more resilient and circular water economy.

CASE STUDY: CITY OF RIALTO, CALIFORNIA

CHALLENGE: The city of Rialto faced significant capital needs in its aging water infrastructure, including outdated treatment facilities and deferred maintenance. Limited municipal resources and budget constraints made it difficult for the city to fund the necessary upgrades on its own without imposing steep tax increases or water rate hikes that could burden residents.

SOLUTION: In 2012, Rialto entered a 30-year P3 concession agreement with a private partner to operate, manage, and invest in the city's water system. Under the agreement, the private partner assumed responsibility for capital improvements, operations, and maintenance, bringing private financing and expertise to the project.

FINANCING: The financing model relied on private capital from the concessionaire and its investment partners, including Ullico and Table Rock Capital, rather than city-issued municipal bonds. The private partner committed to investment for system upgrades, and the arrangement included the settlement of existing city water debt as part of the financial structure.

OUTCOMES: The P3 enabled Rialto to accelerate infrastructure improvements, such as rehabilitation of treatment processes and the installation of new meters. Operational performance improved through upgraded systems and management practices, and the city was able to stabilize its financial position without significant rate spikes.

Source: Orrick LLC

PUBLIC-PRIVATE PARTNERSHIPS

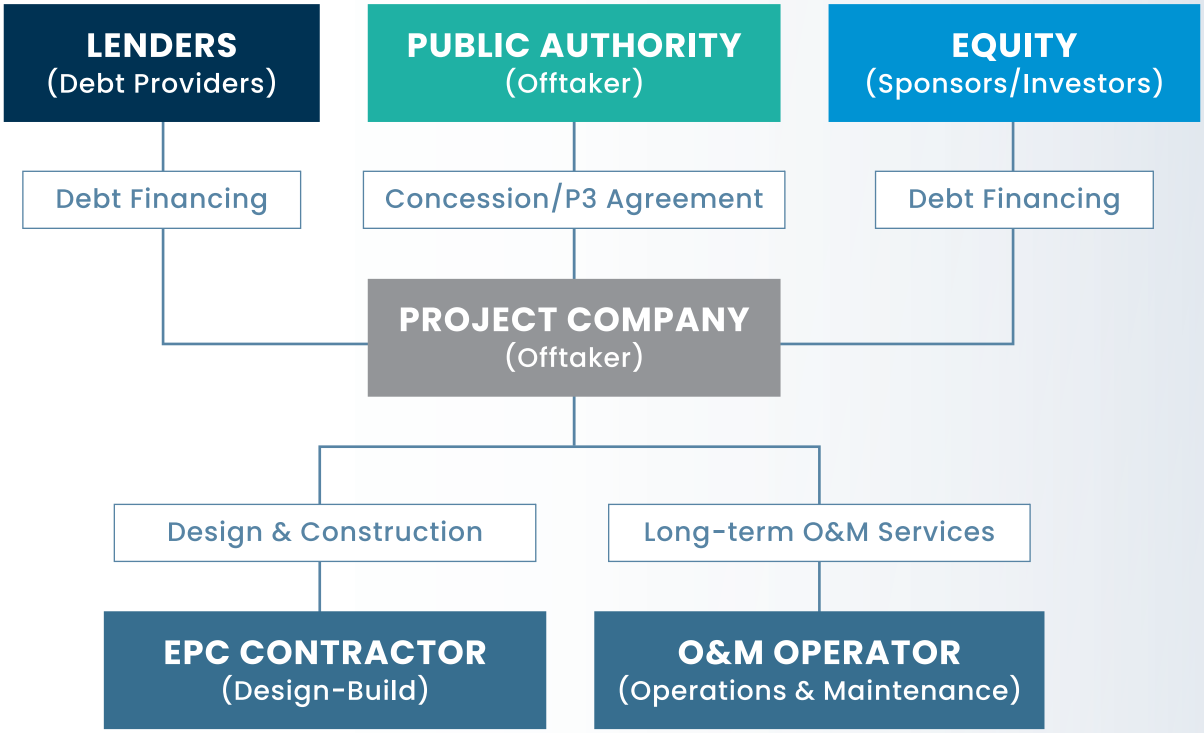
P3s are a key mechanism through which private capital supports circular water projects. In these arrangements, private financiers provide upfront capital and technical expertise while public entities ensure regulatory compliance and equitable service. This collaboration can result in faster project delivery, operational efficiencies, and shared risk, making large-scale projects more feasible. Blended financing structures that combine private investment with public funds, grants, or guarantees further help reduce financial risk and unlock capital for projects that deliver both environmental and social benefits.

Under P3 arrangements, private sector partners design, build, finance, and operate water infrastructure in collaboration with local governments. By shifting financial and operational risk to private entities, municipalities can accelerate projects that promote reuse, energy recovery from wastewater, and advanced treatment technologies. P3s are increasingly seen to address financial and delivery challenges for water projects.

Typical structures such as build-own-operate (BOO) and build-own-operate-transfer (BOOT) allow private operators to enter into long-term agreements in which a private entity participates in the design, construction, financing, operation, and/or maintenance of public water assets, while ownership and regulatory oversight remain with a public authority. They are often led by a project developer consortium in partnership with operating and financing partners, who agree to a long-term contract with the public utility partner to deliver an agreed service over a 15-, 20-, or 25-year period in return for an agreed "take or pay" or similar commercial contract.

Private capital can play several roles in these projects. Infrastructure investors, technology providers, and engineering firms may finance, build, and operate specialized treatment facilities, often under long-term performance-based contracts, with no upfront capital from the municipality and with no apparent additional costs for ratepayers.

Figure 5: Typical public-private partnership structure



Source: WEF (2025)

CASE STUDY: CITY OF ALICE, TEXAS

CHALLENGE: The city of Alice faced long-term water scarcity and rising water costs due to prolonged drought conditions and heavy reliance on external freshwater sources. Local water supplies from traditional reservoirs were increasingly stressed, prompting the city to seek a more resilient, autonomous, and cost-stable water source for its residents.

SOLUTION: The city entered a P3 with Seven Seas Water Group under a water-as-a-service model to design, build, operate, and maintain a brackish water desalination plant. Located on city land, the facility treats brackish groundwater from the region's aquifers using advanced reverse osmosis technology to produce high-quality potable water. This project was the first P3 brackish water treatment plant in Texas.

FINANCING: Seven Seas Water Group financed and constructed the plant, and currently operates and maintains it for the contract term. The city pays for the delivered water at fixed, cost-effective rates, reducing financial risk and budgetary pressure on ratepayers. Project planning and construction were also partially supported by the Texas Drinking Water State Revolving Fund.

OUTCOMES: The plant was commissioned in July 2025, delivering up to 2.7 million gallons per day of clean drinking water to the City of Alice's distribution system. The facility enhances local water security, reduces dependence on distant sources, and stabilizes long-term water costs for residents.

Source: Seven Seas Water Group

There are examples involving industrial and other private owner-operators cooperating with public utilities to deliver a privately financed solution such as the Richmond Advanced Recycled Expansion Water Project involving the East Bay Municipal Utility District (EBMUD). In this case EBMUD built and operated the facility on Chevron's refinery site to treat secondary effluent sourced from regional wastewater systems using advanced processes, but the project was financed by Chevron. Other similar models will likely evolve.

Despite the clear benefits, careful structuring and active management of P3s by the public sector entity is essential to protect the long-term interests of the public and ratepayers. Contracts must be designed with clear performance standards, transparent pricing mechanisms, and well-defined risk allocation to prevent excessive costs or service deterioration over time. Strong regulatory oversight and independent monitoring are critical to ensure compliance, particularly given the long asset life cycles and limited competition once contracts are in place. Provisions for periodic review, adjustment, and potential renegotiation should also be built in to address changing economic, environmental, and social conditions without undermining accountability. Additionally, safeguards, such as caps on tariff increases, requirements for reinvestment, and penalties for non-performance, help ensure that private partners deliver value while maintaining affordability, service quality, and environmental sustainability for communities throughout the duration of the agreement.

The use of P3s in the water sector remains relatively low. This reflects practical and institutional constraints, including skepticism among stakeholders about the costs and benefits of P3 arrangements, concerns about ceding operational or technical control of critical public goods to private partners, and the absence of strong executive or political support. In addition, many utilities face limited internal capacity, both managerial and technical, to evaluate, structure, procure, and negotiate P3 transactions, and there are gaps in financial and legal expertise related to these contractual structures (AWWA, 2019).

The P3 market is well established in the U.K., Australia, and Canada, and can be expected to deepen in the U.S. as concession terms become standardized and valuation transparency is enhanced from higher transaction volumes. As compliance costs rise and infrastructure ages, municipalities are increasingly exploring P3 structures to transfer construction risk, accelerate capital improvements, and access private-sector technical expertise.

Photo source: ENGINEER - STUDIO via Adobe Stock

3. GREEN BONDS AND NEW FORMS OF FINANCE

Green bonds can reduce the overall cost of capital when tied to circular outcomes.

Green bonds and environmental impact bonds are gaining traction as a means of financing circular water economy projects, allowing utilities to raise capital specifically for sustainability-oriented projects. These financing tools align investor returns with measurable environmental outcomes such as reduced pollution, improved watershed resilience, and increased water recycling capacity. Several utilities have issued green bonds specifically to support circular water infrastructure. The first certified water bond was issued by the San Francisco Public Utilities Commission in 2016, with over $8 billion in bonds issued globally since.

Outcome-based financing and market-based incentives are beginning to support circular water innovation. Pay-for-performance contracts and environmental impact bonds link investor repayment to verified environmental improvements, encouraging cost-effective solutions. Water quality trading markets, where entities that reduce nutrient pollution beyond regulatory requirements can sell credits to others, create financial incentives for circular practices like nutrient recovery. Meanwhile, early-stage venture capital or impact funds can support technology related investments. Together, these mechanisms help mobilize private investment, stimulate technological innovation, and create scalable financial pathways for transitioning the water sector toward a more resilient and circular model.

CASE STUDY: DC WATER CLEAN RIVERS PROJECT

CHALLENGE: Washington, D.C., faced chronic combined sewer overflows, which caused untreated sewage and stormwater to enter the Anacostia and Potomac Rivers. This created severe environmental and public health risks, leading to water pollution, ecosystem degradation, and non-compliance with federal regulations. Aging infrastructure and urban development exacerbated the problem, requiring a comprehensive, long-term solution.

SOLUTION: DC Water implemented a large-scale infrastructure project to capture and store stormwater and sewage during heavy rains. The project included the construction of underground storage tunnels, pump stations, and green infrastructure to ensure that water entering local rivers meets environmental standards.

FINANCING: DC Water issued a pioneering green bond to finance elements of its Clean Rivers Project, addressing stormwater management and water quality while attracting environmentally focused investors. This issuance was among the first certified green bonds in U.S. debt markets and illustrates how tax-exempt funding tied to environmental outcomes can support circular water infrastructure such as green stormwater infrastructure that reduces runoff and enhances natural resource outcomes.

OUTCOMES: The project has significantly reduced combined sewer overflows, improving water quality in the Anacostia and Potomac Rivers. It has enhanced public health and environmental resilience, regenerated aquatic habitats, and ensured compliance with federal regulations.

Source: DC Water

4. BLENDED FINANCE

Blended finance unlocks projects that would otherwise stall.

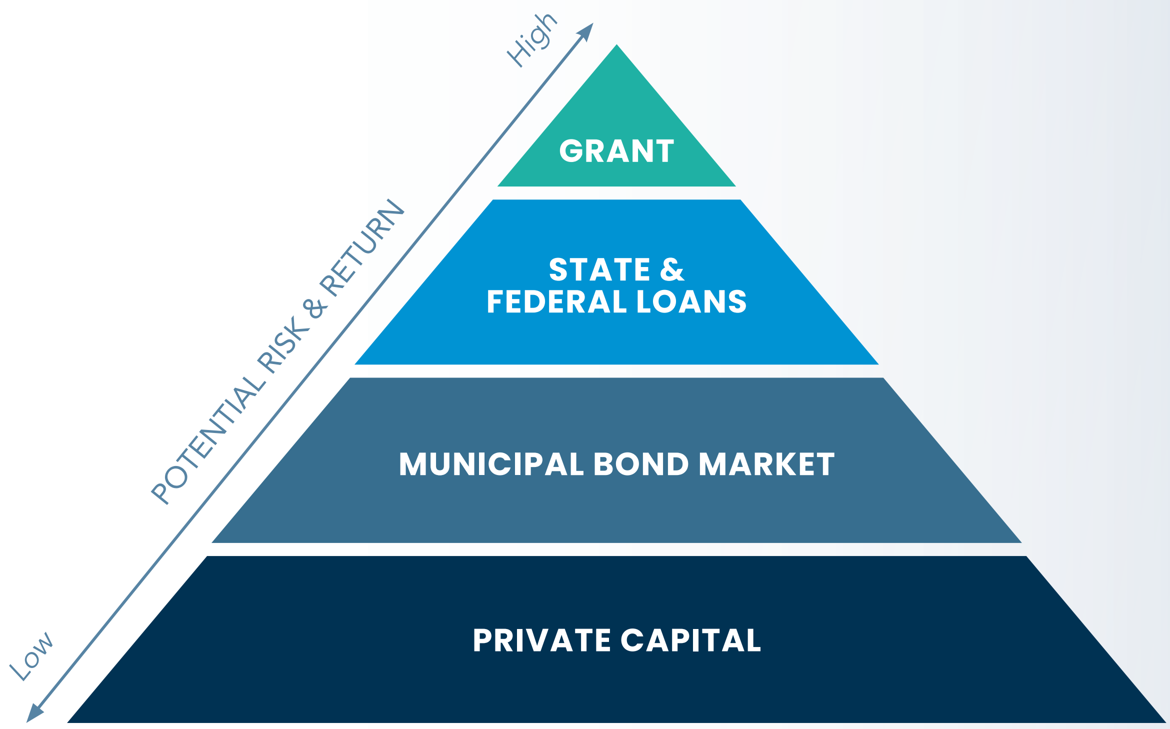
Blended finance leverages a combination of state and federal funding with private capital to bridge the investment gap in maintaining and upgrading water systems. While the SRF programs provide low-interest loans, grants, and technical assistance to utilities, state funds can complement these programs with additional financing, subsidies, or credit enhancements. Combining these public resources with private investment, as well as capital raised through municipal bonds or private project finance vehicles, can both de-risk projects and make them more attractive to private investors.

The capital stack concept describes the relative cost of funding to the borrower with grants being the lowest cost of funding, state or federal loans being next, then bonds, and finally, private project finance and equity being the most expensive (Figure 6). On the other hand, the level of risk in implementing a complex infrastructure project may move in the opposite direction with a utility assuming a high level of delivery and operational risk should it seek to implement a project alone, causing it to partner with a privately financed P3 to secure the project.

Through municipal bonds or project finance, private investors can provide upfront capital for construction, and other capital investment, while public funds, including SRFs, can absorb some of the risk or provide credit enhancements. Sharing risk can reduce the overall cost of capital, making large-scale water projects financially feasible. For example, a utility may use SRF loans to lower principal repayment obligations, which improves the credit profile of a municipal bond issuance, attracting private investors on more favorable terms than would be possible through private lending alone.

Blended finance also helps maintain affordable water rates for consumers. By leveraging federal and state SRFs and targeted subsidies, utilities can reduce borrowing costs and avoid passing excessive costs onto ratepayers. A combination of structured project finance arrangements can allow repayment schedules to be matched to project revenue streams and ensure infrastructure investments, including in the circular water economy, do not create undue financial burdens on ratepayers. This integrated approach promotes financial sustainability for utilities while protecting equitable access to safe and reliable water services.

Figure 6: Capital stack showing affordability across alternative financing instruments



Source: WEF (2025)

5. SUPPORT FOR SMALLER UTILITIES

Smaller utilities need aggregation and technical support to participate.

P3 arrangements are typically undertaken by larger and better-resourced utilities or, in some cases, by the related public agencies. As a result, many smaller communities with limited financial and institutional capacity remain largely excluded from the economic and social benefits that P3-supported projects can generate. Small, rural systems also face structural constraints that drive higher costs per customer. Low population density requires longer distribution networks while fixed infrastructure costs remain largely unchanged. At the same time, many small systems operate with limited scale, constrained financial resources, persistent staffing shortages, and increasing regulatory requirements related to water quality. In this context, multiple water systems within the same region may jointly contract with a private operator to manage or maintain specific infrastructure assets.

By pooling demand, these arrangements can generate economies of scale, enabling utilities to access specialized expertise, staffing, and operational services at a lower unit cost than each system could achieve independently. In some cases, the private partner may also play a coordinating role, facilitating agreements and operational arrangements among utilities that may lack the institutional capacity to structure and manage collaborative contracts on their own.

Smaller utilities can strengthen their role by coordinating investment through shared planning platforms and regional partnerships. By forming coalitions or watershed-based alliances, utilities can jointly identify opportunities to recover and reuse water, nutrients, and energy across municipal boundaries. Regional planning helps align infrastructure goals, such as water reuse systems, biosolids processing, and energy recovery facilities, so that projects achieve economies of scale that smaller utilities might not reach alone.

Access to financing can be improved by aggregating projects and developing pooled funding mechanisms. Smaller utilities often struggle to attract capital for innovative circular water initiatives because projects are relatively small and perceived as risky. By bundling similar investments, utilities can create larger, more investable portfolios. Public finance institutions, SRFs, and regional infrastructure banks can support this model by offering blended finance structures that combine grants, concessional loans, and private capital. Such mechanisms reduce financial risk while enabling utilities to pursue circular solutions that generate long-term operational savings and environmental benefits.

Way Forward and Recommendations

The need to invest in aging water, infrastructure is growing and the funding gap is widening as pressures from aging assets, regulatory mandates, climate change, and population shifts take their toll. Meanwhile, rate-base pressures will continue, and increasing demand from new industrial users, such as data centers, may only worsen the gap.

The imperative to invest in the circular water economy both increases the challenge and provides an opportunity. Alternative sources of financing to those traditionally provided by the municipal bond market and public sector will need to be found to bridge the investment gap. Closing the U.S. water infrastructure investment gap will require coordinated action at the federal, state, local, and private sector. With systems aging, climate pressures intensifying, and ratepayer affordability constraints growing, several steps should be considered:

1. Modernize and expand federal water financing programs

- Expand the EPA's SRFs for drinking water and clean water and scale up the WIFIA program to provide more low-cost, long-term loans and credit assistance while protecting the funds from earmarks that diminish their revolving nature.
- Streamline application timelines.
- Focus available assistance on communities that need it most while reducing barriers to applying for and accessing funding.

Stakeholders: Congress, EPA, State SRF administrators, and providers of technical assistance

2. Promote use of public-private partnerships

- Encourage well-structured P3s for large or complex projects, including clear risk allocation frameworks, performance-based contracts, and standardize procurement templates at the state level.
- Examples include supporting utilities in assigning construction, performance, and operational risks to the parties best able to manage them, while protecting public interests through performance-based contracts.
- Develop standardized procurement templates and technical support provisions for local utilities that may lack experience negotiating P3s.

Stakeholders: EPA, state-based infrastructure agencies, utilities, private sector developers and advisors

3. Unlock private investment through financial innovation

- Create structures that make water projects investable at scale, such as water-focused infrastructure funds and green bonds.
- Engage institutional investors, such as pension funds and insurance companies, for potential sources of financing for capital programs.
- Municipalities and utilities can issue bonds tied to environmental outcomes, such as water reuse, energy-efficient treatment, or climate resilience, which may lower borrowing costs.
- Use blended finance, including credit enhancements from federal or state guarantees, to reduce perceived risk and crowd in private investors.
- Aggregate small projects.

Stakeholders: EPA, states, institutional and private investors, rating agencies, and utilities


Photo source: blanol via Adobe Stock

4. Improve utility creditworthiness and rate design

- Include full-cost pricing where water rates reflect the true cost of service, including operations, maintenance, and future capital needs to improve long-term system reliability and creditworthiness.
- Investigate and implement measures to protect low-income households.
- Regulators can help by supporting discount programs or multi-year rate plans to provide revenue stability and investor confidence while protecting vulnerable households with lifeline rates, or discount programs.

Stakeholders: Utilities, EPA, municipalities, public utility commissions, and investors

5. Prioritize climate resilience and data-driven investment

- Integrate climate risk assessments into capital planning.
- Integrate projections for extreme weather events into long-term capital planning and using federal and state funding programs to prioritize projects that reduce climate risk through efforts such as stormwater capture, water reuse, aquifer recharge, and flood protection.
- Invest in “upstream” projects, such as watershed protection and green infrastructure, to enhance resilience while providing environmental benefits.

Stakeholders: EPA, FEMA, state environmental and water agencies, utilities, technical and engineering advisors

The U.S. water investment gap cannot be closed by public funding alone, but its foundational role remains critical. A blended model combining federal support, local rate reform, and carefully structured private investment can offer the most viable path forward. The key is aligning risk allocation, affordability, and long-term asset performance to attract capital while protecting public interests.

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