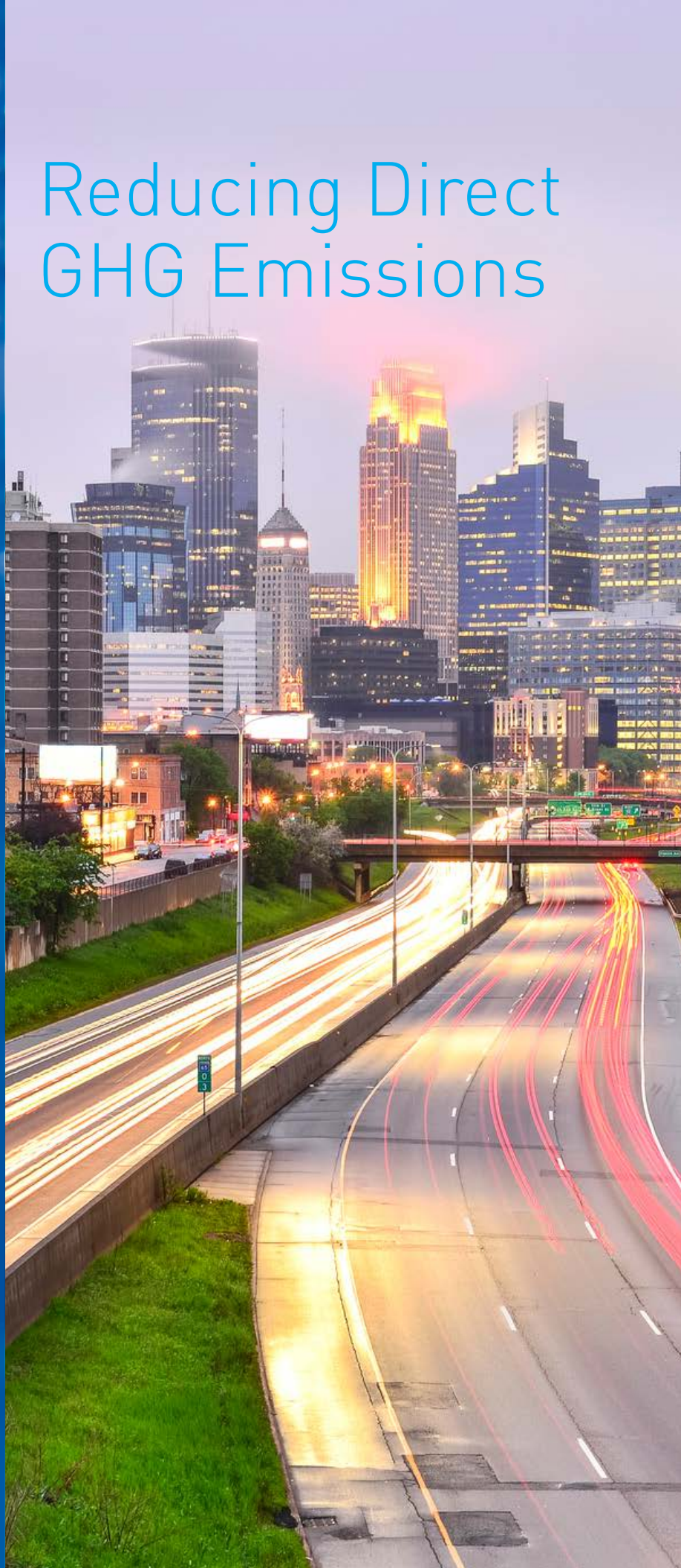
Reducing Direct GHG Emissions

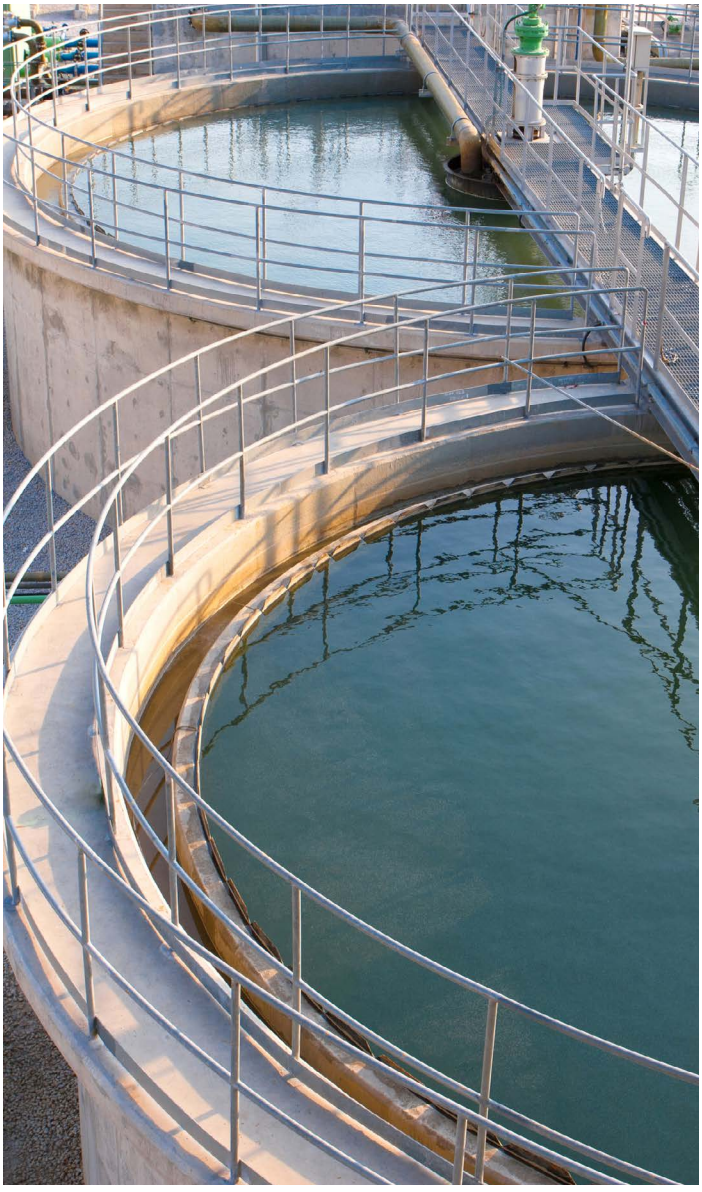


KEY TAKEAWAYS

- Optimize vehicle use and reduce idling by using telematics and driver training to lower emissions.
- Transition to electric or renewable heating systems over time.
- Deploy leak detection and real-time monitoring to identify and manage process emissions.

INTRODUCTION

Reducing scope 1 emissions is essential for water utilities looking to lower their carbon footprint and meet greenhouse gas (GHG) reduction targets. Scope 1 emissions refer to direct emissions from sources owned or controlled by the utility, such as fuel combustion in fleet vehicles and stationary sources like boilers, generators, or on-site power generation. Emissions from processes, such as drinking water and wastewater treatment, are also key contributors. Addressing these emissions requires targeted interventions, operational changes, and strategic investments in cleaner technologies to reduce direct emissions and enhance overall sustainability.



ACTIVITIES AND ACTIONS

Target Mobile Combustion Emissions

Driver Behavior and Idle Reduction: Optimizing driver behavior and reducing idling can yield immediate GHG reductions. Training programs that encourage steady speeds, minimize rapid acceleration, and enforce anti-idling policies improve fuel efficiency. Implementing telematics systems enables real-time monitoring of driving performance, further supporting emissions reductions.

Effective fleet management ensures optimal vehicle utilization, reducing emissions from underused assets. Removing excess vehicles, optimizing routes, and deploying monitoring tools enhance fuel efficiency while lowering overall emissions.

Electrifying on-road and off-road vehicle fleets also reduces direct emissions. Establishing charging infrastructure and phased implementation strategies help utilities transition effectively, starting with passenger and medium-duty vehicles before advancing to heavy-duty options.

Tip: *Collaborate with other public agencies for joint procurement to leverage bulk purchasing power and negotiate better pricing on electric fleet vehicles and charging stations.*

Target Stationary Fossil Fuel Combustion

To reduce the stationary combustion of fossil fuels, consider upgrading combustion equipment, implementing waste heat recovery, and optimizing fuel usage through regular maintenance. Another approach is replacing fossil fuels with lower-carbon alternatives like renewable natural gas. Over time, fossil fuel use in heating, steam generation, and other thermal processes should be phased out and replaced with electric-based systems.

Tip: *Take the first steps to move away from fossil fuels by making energy-saving upgrades, figuring out what's needed to electrify existing systems, and making sure new buildings are built for electric heating.*

Target Fugitive and Process Emissions

Methane and nitrous oxide, both potent greenhouse gases, are byproducts of wastewater treatment processes. Reducing these emissions requires a combination of better monitoring, targeted equipment upgrades, and process improvements.

Regular inspections using advanced imaging and remote sensing technologies help identify fugitive and process emission hotspots, enabling targeted leak repairs and process optimization. Real-time continuous monitoring further enhances detection, allowing for timely identification of abnormalities and prompt corrective actions.

Mitigation efforts may require equipment repairs or upgrades, such as replacing leak-prone floating digester covers, upgrading inefficient combustion systems, modifying exhaust and air handling systems, or enhancing aeration systems to allow for greater process control.

Emissions reductions can often be achieved through process optimization. Real-time monitoring data helps operators fine-tune aeration, carbon dosing, sludge retention, and mixing while maintaining treatment objectives. Managing process and fugitive emissions through optimization not only reduces emissions but can also improve treatment performance and lower operational costs.

Tip: *Equip operators with handheld infrared cameras and challenge them to spot and fix leaks during routine inspections. Recognize top "detectives" to make emissions tracking proactive and engaging.*

KEY CHALLENGES AND SOLUTIONS

Fleet Electrification Hits a Roadblock

Even with funding, charging infrastructure gaps, vehicle shortages, and operational constraints can delay fleet electrification. Utilities may struggle with grid limitations, long EV procurement lead times, and uncertain real-world performance.

Solutions:

- Expand charging infrastructure through public-private partnerships.
- Prioritize predictable-use vehicles (e.g., administrative or depot-based fleets) before addressing dispersed or emergency response vehicles.
- Pilot heavy-duty EVs and alternative fuels in controlled settings before committing to a full transition.
- Use telematics and driver training to improve fuel efficiency and battery performance.

Reliability and Cost of Non-Fossil Heating Systems

Organizations may worry that switching from fossil fuel-based heating could increase costs, cause disruptions, or fail to reliably meet demand.

Solutions:

- Conduct pilot-scale projects to test electric heating, heat pumps, or waste heat recovery before full-scale adoption.
- Retain legacy heating as a backup while gradually phasing in non-fossil systems to ensure reliability during the transition.
- Adopt a holistic approach that integrates energy efficiency measures like building envelope improvements, hot water and steam system optimizations, advanced building controls, and HVAC upgrades alongside the transition to a non-fossil heating system.

Managing Process Emissions While Meeting Permit Goals and Energy Targets

Many water and wastewater utilities assume emissions reduction conflicts with compliance, reliability, or efficiency. In reality, most strategies improve performance, cut costs, and align with utility goals. However, without accurate emissions data, utilities cannot assess trade-offs or make informed decisions.

- Deploy real-time N_2O sensors integrated with automated controls to optimize oxygen levels, manage ammonia loads, and adjust carbon dosing while ensuring treatment goals.
- Implement Leak Detection & Repair (LDAR) as part of routine maintenance to find and fix methane leaks in digesters, digester covers, biogas handling systems, storage facilities, pipes, relief valves, CHP units, and flare stacks.
- Educate operators and process engineers about process and fugitive emissions reduction strategies.

UTILITY SPOTLIGHT

Metropolitan Water Reclamation District of Greater Chicago—Leadership in Scope 1 Emissions Reductions

The Metropolitan Water Reclamation District of Greater Chicago (MWRD) has taken a leadership-driven approach to tackling scope 1 emissions, which includes methane (CH_4) and nitrous oxide (N_2O), from wastewater treatment processes. Through rigorous measurement, operational refinement, and a pragmatic focus on carbon efficiency, MWRD is redefining emissions reduction strategies for wastewater utilities.

This case study highlights how MWRD's leadership, commitment to data-driven decision-making, and incremental improvements have led to meaningful progress in emissions reductions while enhancing operational performance.

Measuring to Managing: The Foundation of Emissions Reductions

MWRD first established a GHG inventory in 2005 in collaboration with the University of Illinois at Chicago. However, as methodologies evolved, the organization recognized the need for continuous improvement. When the Intergovernmental Panel on Climate Change (IPCC) updated its emissions factors in 2018 and 2019, MWRD saw its reported N_2O emissions spike dramatically despite no significant operational changes. Recognizing the limitations of default emissions factors, MWRD partnered with Princeton University to deploy real-world measurement campaigns, including mobile monitoring (the "Pace Car" project) and in-situ process monitoring.

> *"You can't manage what you don't measure," explained Jonathan Grabowy, MWRD's Management Engineer. "This philosophy has driven MWRD's commitment to developing accurate emissions data, particularly for process-related methane and nitrous oxide emissions."*

Key Insight: Data-driven emissions tracking ensures utilities can identify high-impact opportunities for reduction and improve long-term strategy.

Process Optimization and Practical Solutions

MWRD's approach to scope 1 emissions reduction is rooted in practical, high-impact solutions that simultaneously improve plant performance.

- Addressing Process Emissions: MWRD has focused on optimizing aeration and sludge management to reduce N_2O emissions, leveraging real-time monitoring and improved process controls to minimize nitrogen loss pathways.
- Methane Capture and Management: By enhancing digester covers, improving gas handling, and investing in leak detection, MWRD is working to reduce fugitive methane emissions while maximizing beneficial biogas use.
- Incremental, Data-Driven Improvements: MWRD emphasizes continuous improvement over sweeping, unrealistic targets.

> *"There's always going to be carbon in wastewater treatment," said Grabowy. "The goal isn't perfection—it's efficiency. How low can we go?"*

Key Insight: Small, targeted improvements in process efficiency lead to significant reductions in emissions over time.

Rethinking Net Zero: A More Pragmatic Approach

Rather than pursuing an absolute "net-zero" target, MWRD frames its efforts around carbon efficiency—maximizing reductions while recognizing the practical limitations of wastewater treatment processes. This perspective is crucial for utilities hesitant to engage in emissions reduction due to the intimidating nature of net-zero commitments.

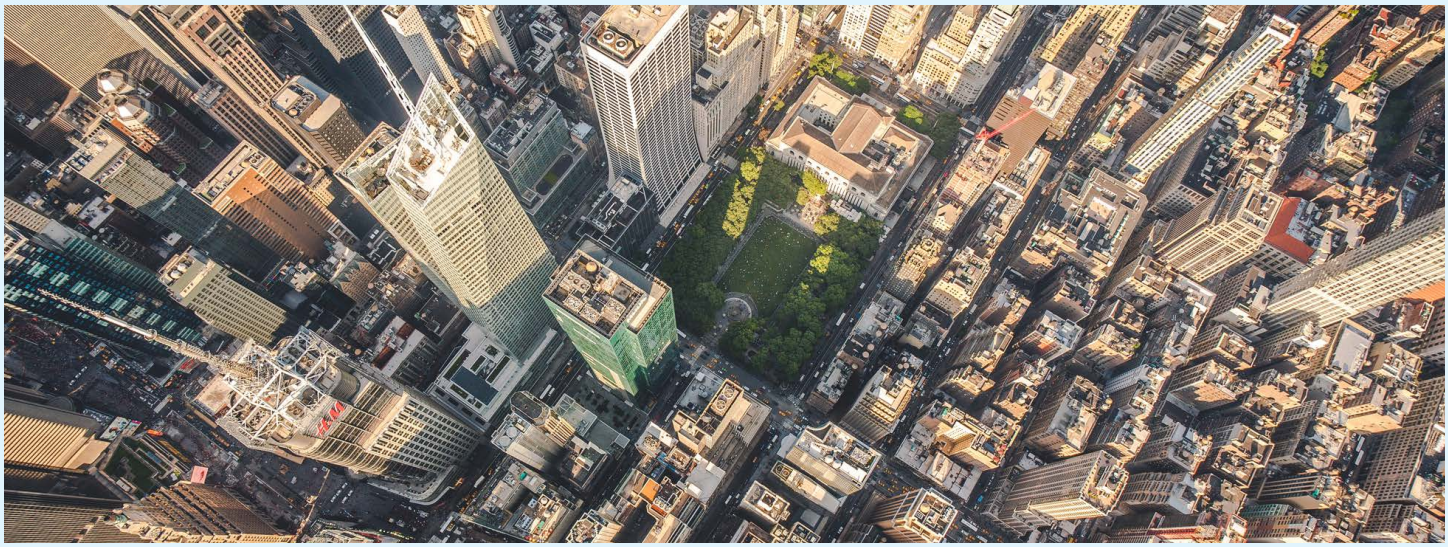
> *"We have to shift the narrative," said Kuldip Kumar, Principal Environmental Scientist at MWRD. "Net zero shouldn't feel like an impossible mandate—it's about reducing as much as we can now while staying open to future solutions."*

Key Insight: A flexible, pragmatic approach to emissions reduction fosters sustained progress and adaptability.

Lessons from MWRD's Experience

- Start with Measurement: Default factors can be misleading. Invest in real-world emissions monitoring to establish a more accurate baseline.
- Focus on Practical Reductions: Many emissions reduction strategies—such as optimizing aeration, improving process control, and reducing fugitive emissions—also enhance overall plant efficiency.
- Adopt a Flexible Mindset: Net zero isn't a fixed destination. Utilities should aim for continuous improvement, leveraging both immediate operational changes and long-term technological advancements.

MWRD's leadership in emission reductions demonstrates that utilities can make substantial progress through strategic process improvements. By focusing on efficiency rather than perfection, MWRD serves as a model for scaling long-term climate action in the water sector.



UTILITY SPOTLIGHT

Columbus Division of Sewerage and Drainage—Unlocking GHG Reductions Through Data-Driven Innovation

The Columbus Division of Sewerage and Drainage (Columbus) embarked on an initiative to reduce scope 1 emissions by optimizing biogas capture in its wastewater treatment operations. What started as a standard biogas utilization study quickly evolved into a transformative project that leveraged advanced data analysis, innovative methane detection technologies, and strategic funding to enhance emissions reductions. This case study underscores the power of data-driven decision-making in achieving meaningful progress toward net-zero goals.

> *"We had trepidation at first—do we really want to know? But knowing we had a pretty good idea of how to address it helped. We also knew that NGOs and other organizations were looking at this. Though it made us uncomfortable, it felt good to be able to respond," said Stacia Eckenwiler, Assistant Administrator at Columbus Division of Sewerage and Drainage.*

Identifying the Problem: Uncovering Hidden Methane Losses

Columbus had long operated a system of anaerobic digesters designed to produce and capture biogas for energy generation. However, during a routine assessment of gas production, engineers observed an inconsistency: digesters with fixed covers demonstrated 20–30 percent higher biogas capture rates than those with floating covers.

Concerned that fugitive emissions were escaping undetected, the utility decided to investigate further. Historically, small methane leaks were assumed to be negligible, but the lack of direct monitoring left room for uncertainty. Recognizing the potential for significant emissions reductions, the utility committed to a deeper analysis to quantify and address the issue.

Key Insight: Small adjustments yield big results. Addressing seemingly minor inefficiencies—such as digester cover integrity—can lead to substantial emissions reductions.

Leveraging Technology for Targeted Emissions Reductions

To validate their suspicions, Columbus used advanced drone-mounted methane sensors and handheld gas imaging cameras to detect leaks, providing real-time visualization of emissions previously invisible to the naked eye.

The results were striking. The floating cover digesters were leaking substantial amounts of methane, not just through anticipated gaps but also from unexpected areas within the digestion and biosolids handling processes. Some of these leaks had safety implications, while others revealed structural deficiencies that had gone unnoticed in routine inspections.

This data-driven approach enabled Columbus to move beyond traditional emissions estimates and pinpoint exactly where interventions were needed.

> *"Seeing it in real-time was eye-opening and much different than doing a mass balance exercise on paper," said Tyler Schweinfurth, Project Manager at Columbus Division of Sewerage and Drainage.*

Key Insight: Technology enables smarter decision-making. Emerging tools like drone-based methane detection can revolutionize how utilities track and manage scope 1 emissions.

Taking Advantage of Funding to Fast-Track a Solution

Rather than delaying action, Columbus capitalized on multiple advantages to implement rapid improvements:

1. Integration with Existing Biogas Projects: The utility had already planned a biogas-to-energy project, providing a framework for improvements that could maximize gas capture and efficiency.
2. Alignment with Broader Sustainability Goals: Columbus framed the initiative as a crucial component of its overall sustainability and operational resilience strategy, securing internal support.
3. Leveraging Federal Funding: The Inflation Reduction Act provided an unexpected but timely opportunity to accelerate mitigation efforts. The funding allowed Columbus to implement immediate upgrades to its digesters, significantly reducing methane leakage in a shorter timeframe than initially projected.

> *"Though it can be overwhelming, fugitive emissions can only have so many sources. So, take one thing at a time and start with low-hanging fruit," said Eckenwiler. "Always be looking to the next step: technology is changing quickly... It's important to come with both data and solutions to make a case to leadership."*

Key Insight: Proactive funding strategies accelerate progress. By staying informed on policy and funding opportunities, Columbus was able to expedite an emissions reduction project that otherwise might have taken years.

Tackling Scope 1 Emissions Step by Step

Columbus' journey illustrates how a routine gas utilization study evolved into a high-impact emissions reduction initiative through technology, strategic planning, and opportunistic funding. By systematically addressing methane leaks, the utility not only reduced its carbon footprint but also improved operational efficiency and infrastructure integrity. This case serves as a model for other utilities seeking to optimize biogas recovery and integrate emissions reductions into their long-term sustainability strategies.

ADDITIONAL RESOURCES AND REFERENCES

1. Explore the International Water Association's Guide to Greenhouse Gas Emissions and Water Resource Recovery Facilities, produced by its Climate Smart Utilities GHG sub-group for ideas on how to reduce scope 1 emissions.

This paper is part of Net Zero Fundamentals, a collection of action-oriented briefs designed to help water and wastewater utilities cut climate pollution and chart a clear path to net zero. Each brief delivers practical insights, real-world utility examples, and implementation guidance for immediate impact. Access the collection of briefing papers on the US Water Alliance website.

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