



IDRA Collective Action to Address Water Scarcity

A Path of Innovation and Collaboration



2025

UN's definition of water scarcity



scarcity in fresh water of acceptable quality



scarcity in access to water services



scarcity due to the lack of adequate infrastructure



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On behalf of the International Desalination and Reuse Association, we are pleased to introduce the IDRA White Paper on Collective Action to Address Water Scarcity.

This paper is both a call to action and a reflection of the momentum building across our community to advance solutions that ensure resilient water supplies for a changing world.

We extend our sincere appreciation to the many partners who made this work possible. Our gratitude goes first to Boston Consulting Group (BCG) for their expertise and partnership in developing the paper, with special thanks to **Yvonne Zhou and Hon. Christopher Holmes** for their leadership, guidance, and support in bringing this collaboration to life. We also thank **Stantec, with appreciation to John Hanula**, for their generous support in design, layout, and print. Finally, we are grateful to the Abu Dhabi Department of Energy, with special thanks to **H.E. Undersecretary Ahmed Al Rumaithi**, for hosting the IDRA Leaders Summit 2024 and the World Congress, where the seeds of this paper were planted and where dialogue among global leaders shaped its direction.

This White Paper draws on contributions from across the sector—utilities, technology providers, researchers, policymakers, and advocates—whose insights and case studies demonstrate that collective action is not only possible but already underway. Together, we can scale reuse, desalination, and innovation as essential tools to address water scarcity and build sustainable futures for communities worldwide.



Shannon K. McCarthy
IDRA Secretary General

Jon Freedman
IDRA President

Fady Juez
Former IDRA President



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The urgency of water scarcity demands bold and decisive action, where every drop is precious. Building on the momentum of the 2024 IDRA World Congress in Abu Dhabi, we are paving the way for resilient water systems by advancing desalination and reuse technologies that can transform communities worldwide. In Abu Dhabi, we are proving that innovation and sustainability go hand in hand, from the world’s largest reverse osmosis desalination plant to pioneering circular water reuse projects. Together, we must now scale these solutions to secure water for future generations.”

—HE Eng. Ahmed Mohammed Belajer Al Rumaithi
Undersecretary, Abu Dhabi
Department of Energy



“

Water scarcity is a silent bomb, which has far less visibility than those that destroy buildings, but is no less lethal.”

—UN reporter Agudo, 2024

Water scarcity hampers economic development, triggers social and humanitarian crisis, and damages local environment.

—Laville, 2023, Montanari, 2019, Gates, 2023

Executive Summary

A Systemic Crisis Requiring Urgent Action

Water scarcity has escalated from a regional challenge to a global systemic crisis. Inadequate supply infrastructure, surging demand, and climate change are straining water resources worldwide. This scarcity threatens economic development, social stability, and environmental health. Without bold intervention, billions could face water insecurity within decades.

Innovative Solutions at Scale

The report identifies ten transformative levers across the water value chain to turn the tide. Breakthroughs in technology and practice—ranging from energy-efficient desalination and wastewater reuse to digital infrastructure, AI-driven management, and nature-based solutions—can dramatically expand supply and improve efficiency. These innovations are already in action: large-scale projects around the world demonstrate their viability, proving that a water-secure future is attainable.

Overcoming Barriers with Collaboration

Scaling these solutions demands coordinated, systems-level change. High costs, fragmented regulations, and public skepticism impede the adoption of non-traditional water solutions. Overcoming these barriers requires joint action across technology, finance, policy, and public engagement. Governments must integrate water planning and streamline regulation; industry and investors must finance and scale new technologies; and communities must embrace water conservation and reuse.

Global Mandate for Transformation

Addressing the water crisis is no longer a choice but a strategic imperative for governments, industries, and communities alike. The road ahead demands not just technological progress, but bold leadership and aligned action across the ecosystem. The insights in this report underscore that the tools exist—and so does the urgency. What’s needed now is the will to scale what works, fund what’s proven, and govern with clarity and foresight. This is not merely about solving for scarcity—it’s about building resilient, adaptive water systems that underpin long-term economic, environmental, and social stability.

Collaborating Where It Counts: 100 Priority Basins to Scale Impact

Water is the foundation for the environment, economies, and societies globally, yet the world's supply is under unprecedented stress. Demand is set to outstrip supply by 40% as early as 2030. Nearly 2 billion people lack access to safe drinking water. While pollution, from industrial discharge to agricultural runoff, renders much of what remains unsafe. Climate change intensifies the extremes: floods devastate communities in one region, while prolonged drought cripples economies in another. The crisis is not a distant threat; it's here, it's accelerating, and it touches every sector, every nation, every person.

Businesses cannot thrive in a water-insecure environment. Companies face disrupted supply chains, rising costs, reputational risk, and growing regulatory pressure. While they have the influence, resources, and innovation capacity to be a force for change, no single corporate actor can solve the water crisis. Solutions demand collaboration across sectors, linking corporate ambition with the mandates of government, the expertise of civil society, and the lived experience of local communities. Through well-designed partnerships, we can align policy, investment, and innovation to deliver scalable, lasting solutions that protect water for people, nature, and economies. Collective action and broader collaboratives are no longer a "nice to have"—they are the only way forward.

Driving Impact: A Tool in the Toolkit

The **CEO Water Mandate** mobilizes business leaders to address global water challenges through corporate water stewardship. The **Water Resilience Coalition (WRC)**, a CEO-led leadership group within the CEO Water Mandate, scales collective action activities across 100 Priority Basins (Figure 1) to achieve positive water impact and long-term water resilience in those locations by 2030. These two organizations, in collaboration with strategic partners, including the IDRA, help build the mechanisms that can help address the global water crisis.

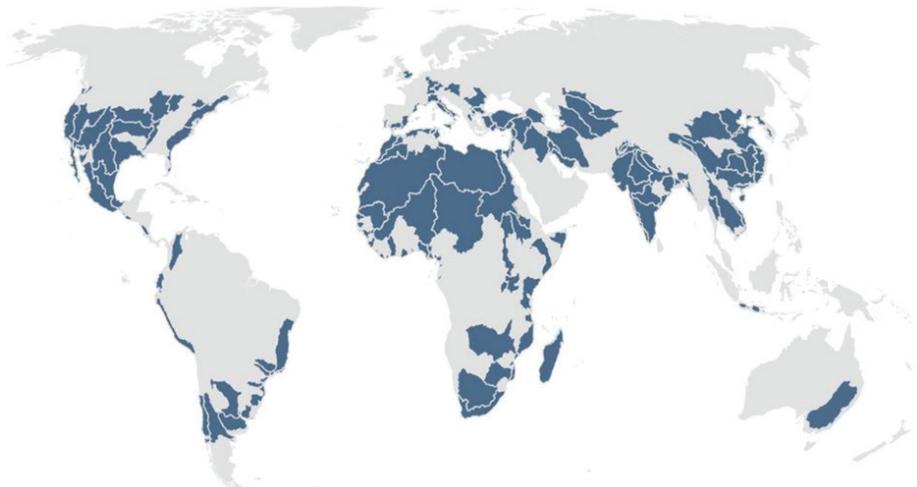


Figure 1: The 100 Priority Basins from the Water Resilience Coalition

Scaling Water Impact Through Basin Collaboratives

The Basin Collaborative is a key mechanism to operationalize the WRC's vision, enabling on-the-ground coordination, joint goal-setting, and measurable impact. Collaboratives ensure that diverse interventions, whether nature-based restoration, agricultural efficiency, advanced reuse, or desalination, are scaled and their outcomes connected to resilience goals.

Basin Collaboratives support these objectives by:

- Setting shared basin targets and curating project portfolios that align with basin challenges and water resource management policies.
- Establishing joint governance structures to engage and coordinate public, private, and community action.
- Standardizing selection, tracking, and reporting so project outcomes are aggregated against basin-wide indicators.
- Mobilizing sustained investment through multi-year, multi-party commitments rather than one-off project funding.

From Projects to Systemic Change: Current Collaborative Models

Several Collaboratives have already been successfully implemented across the 100 Priority Basins. Some examples include:

The California Water Resilience Initiative (CWRI), launched in 2023, unites corporate partners to address the state’s projected 10% water supply gap. With 44 projects already underway - many in advanced reuse and efficiency - CWRI is on track to reach 17% of its 2030 goal within its first two years. To date, this project has achieved 175,000 acre-feet of water benefits across 53 projects by 21 companies.

The Mississippi River Water Action Collaborative (MRWAC), for example, is working to implement projects across 24 million acres by 2035, addressing 20% of the basin’s shared water challenges while unlocking funding for the remaining 80%. Its model ensures that site-level benefits are accounted for against basin-wide targets, creating visibility and accountability at scale.

In both cases, the Collaborative framework connects local wins to systemic outcomes, enabling scale and sustained impact that would be unattainable through independent projects alone.

Digital Tools to Accelerate Impact

The digital tools of CEO Water Mandate and WRC enable smarter, faster, and more collaborative water management, with a particular focus on the 100 Priority Basins.

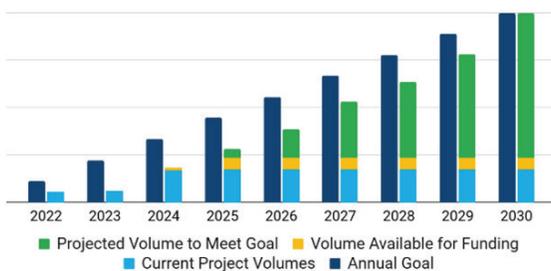
Key Digital Tools, Focus Areas, and Innovation Highlights

- **Basin Diagnostics & Monitoring:** Using advanced satellite imagery and in-situ data, this system establishes baseline conditions in a basin and tracks ongoing changes in basin health in response to on-the-ground projects.
- **The WRC Collective Action Basin Hub:** A new digital platform to accelerate investment in projects that address priority basin challenges and aggregate corporate and basin-wide impacts.



California Water Resilience Initiative

Progress to 2030 Target (1 Million AFY)



- **Project Portfolios:** Hosted in the Collective Action Basin Hub, the project portfolio is a list of curated projects that are designed to address the shared water challenges in a basin, are ready for investment, and are prepared to scale impact.
- **Digital Twins:** AI-powered basin models that simulate future conditions (e.g., climate scenarios, population growth) to guide risk mitigation and target setting.
- **Open Data Access:** Project and basin health data is publicly shared via the Water Action Hub, with dashboards showing aggregated and anonymized corporate impact to drive transparency and unlock public-sector partnerships.

Call to Action: The Opportunity for IDRA Members, Partners and Stakeholders

IDRA members are advancing some of the most powerful levers in the global water toolbox, including desalination, reuse, digital monitoring, and efficiency. The next frontier is to embed these innovations into Basin Collaboratives to endure and multiply benefits.

We invite IDRA members to join the movement toward basin-scale water resilience. Bring your technologies and projects into Collaborative frameworks that unite public, private, and community action. Together, we can ensure that every innovation, whether in desalination, reuse, or beyond, contributes not just to a single site's success, but to the sustained security of entire basins and the billions who depend on them.

Let's turn proven solutions into permanent resilience.



For more information on Basin Collaboratives, contact the Water Resilience Coalition Coordinator:

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10%



live in countries with high or critical water stress

25%



lack safely managed drinking water



3 out of 4 jobs are dependent on water

Urgency to address global water scarcity

Water is fundamental for driving economic and social development. It plays a critical role in agriculture, industry, energy production, and daily human activities, making it indispensable for both survival and progress. Proper water use is vital for ensuring food security, maintaining public health, and enabling the functioning of essential services.

Water scarcity challenges

- 720 million or ~ 10% of the global population lived in countries with high or critical water stress
- One in four people lack safely managed drinking water
- 20–50% Projected increase of global water demand
- ~3,200 m³/yr global fresh water deficit by 2050 as projected

Impact of water scarcity

Shortage of water leads to increased unemployment rate and drop in local GDP.

- 3 out of 4 jobs are either heavily or moderately dependent on water.
- One single hour of water shutdown in pharmaceutical industry will cost €1 million. (Lagan, 2024)
- It is estimated that in some regions in Europe, water scarcity is leading to a 6% drop of GDP in the next few years.

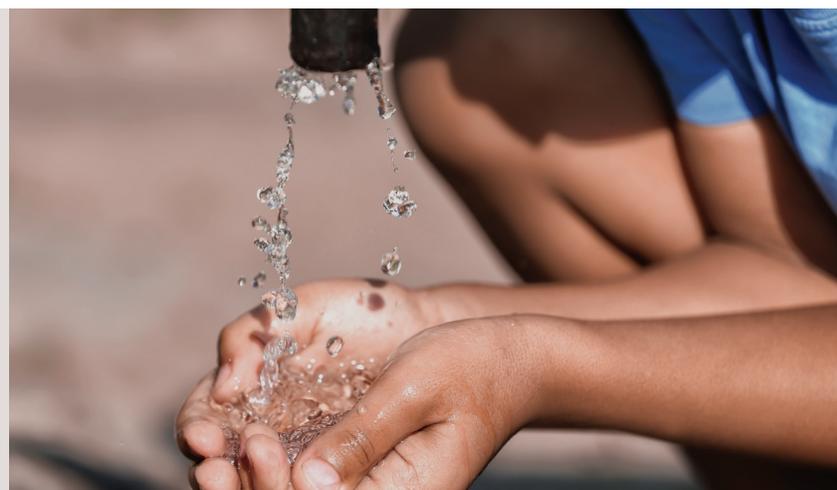
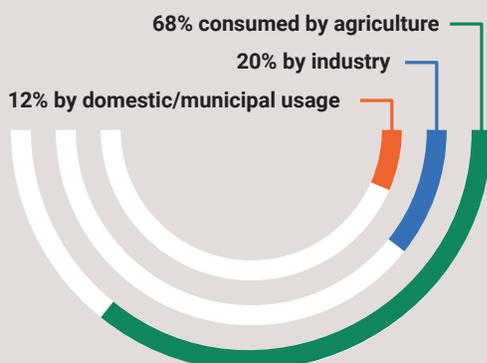
Lack of safe water jeopardizes human lives and increases social inequality

- Each day, an estimated 4,000 people lose their lives to diseases directly caused by unsafe water, poor sanitation, and inadequate hygiene.
- Female family members usually take the responsibility in most households with on demand water supply depriving their rights to education or work leading to potential social problems.

Water scarcity damages local ecosystem

- the Aral Sea in Central Asia has undergone significant shrinkage and a severe loss of biodiversity in recent decades.

Global freshwater consumption:



Address the Challenge

Key levers to transform global water system supported by innovative technologies

Confronting the escalating challenges of water scarcity demands a systemic transformation of how water is sourced, managed, and reused.

To address insufficient supply, actions must focus on regulating over-extraction, diversifying water sources, and expanding infrastructure to ensure reliable and equitable access. Tackling inefficiencies in distribution and usage requires modernizing networks to reduce losses, improving allocation through data-driven governance, and encouraging more responsible consumption via targeted behavioral interventions and technological solutions. Building long-term resilience calls for embedding climate adaptation into water planning and operations, as well as restoring natural ecosystems that play a critical role in sustaining the water cycle. Together, these efforts form an integrated response that aligns short-term needs with long-term sustainability, enabling water systems to remain secure and adaptive amid intensifying environmental and societal pressures. Regionally, the Middle East and North Africa have long been recognized as regions severely impacted by water scarcity, with 14 out of the 17 most water-stressed countries in the world located there. It's also worth noting that regions in Southern Asia, Oceania and North America have all been undergoing increasing water stress levels as climate change continues to exert impact and water demand keeps growing.

The global water scarcity issues are driven by **3 root causes**

- 1 From the supply side, water system is facing challenge of inadequate freshwater production infrastructure and outdated water distribution networks.** Water is by default a scarce resource as less than 0.1% of the earth's water is accessible freshwater that human can use directly. While desalination and wastewater treatment techniques can increase availability of fresh water resource, the high financial, energy and labour cost needed limit the global wide scaled application. In addition outdated water distribution networks leads to high volume of non-revenue water totaling ~126 billion m³/year globally.
- 2 On the demand side, water mismanagement in agriculture and industry, population growth, and urbanization further increase demand of water.** Population growth is key drivers of the increasing demand for freshwater, while urbanization further exacerbates this issue by concentrating large populations in cities and encroaching wetlands. Water mismanagement in agriculture and industrial activities leads to excessive wastage and depletion of water resources.
- 3 Additionally, a water system with unsustainable practices or failures to adapt swiftly to extreme events further jeopardizes a society's water security.** Climate change impacts water systems through droughts, unpredictable rainfall, and accelerated glacier melting, necessitating a resilient water system capable of quick adjustment to mitigate risk during such events. Nature-based solution and carbon emission technologies contribute to the long sustainability of local water system by eliminating environmental impacts to the lowest possibility.

Ten Levers to Transform Water Systems

To address the complex drivers of global water scarcity, we have identified ten high-impact levers across the water value chain—spanning production, distribution, usage, and treatment. These levers represent areas where targeted innovation, investment, and policy action can unlock significant gains in water availability, efficiency, and resilience. Large-scale projects around the world are already demonstrating the commercial viability and scalability of these solutions. The following exhibit summarizes each lever, its systemic value, and IDRA’s role in advancing adoption.

		10 Levers	What is it	Why It Matters	IDRA Role
Production	1	Monitor and regulate groundwater usage	Ensure sustainable use and quality of aquifers through monitoring, restoration, and preventive management	Groundwater overuse or contamination poses long-term environmental and economic crisis	Advocates for smart monitoring to safeguard groundwater
	2	Diversify water supply via alternative resource options	Use scalable, energy- and cost-efficient alternatives such as desalination, rainwater harvesting, and atmosphere moisture capture	Alternative water sources are essential to alleviate pressure on freshwater supplies and enhance water security amid rapid urban growth and climate stress	Drives standardization and adoption of cost-effective desalination solutions
Distribution	3	Reduce water loss via modernized infrastructure	Use digital monitoring and IoT-enabled sensors to enable real-time system diagnostics, allowing for timely detection and resolution of infrastructure issues	Aging water infrastructure drives high water losses and operational inefficiencies	Promotes IoT and AI solutions to enhance water distribution efficiency
	4	Deploy decentralized water systems	Deploy systems with scalable, localized technologies (e.g., modular treatment, desalination units) to provide reliable water access with lower infrastructure demands	Decentralized water systems offer a cost-effective solution for remote regions where centralized infrastructure is impractical	Facilitates scaling of modular water treatment technologies for under-served regions
	5	Ensure sustainable water allocation via AI-powered regulatory frameworks	Implement a regulatory framework that allocates water through enforceable policies, pricing structures, and forecasting tools to optimize usage across sectors	Effective regulatory frameworks are essential to manage competing demands, prevent overuse, and ensure equitable, sustainable access to water	Promotes AI tools and policies for equitable water distribution
Water Usage	6	Enhance water usage efficiency via tech-enabled behavioral changes	Adopt water-efficient technologies and data-driven tools to optimize consumption and drive behavioral change in agriculture, industry, and households	Reducing inefficient water use across sectors eases pressure on limited resources and mitigates growing water scarcity	Encourages adoption of low-water technologies to reduce demand
	7	Conduct public educational campaigns	Deploy targeted educational campaigns to inform communities about water challenges and promote adoption of sustainable practices	Raising public awareness drives collective action; limited understanding of water scarcity hinders effective conservation	Raises awareness to overcome barriers to desalination and reuse adoption
Water Treatment	8	Promote on-site water treatment and circulation usage	Implement localized treatment systems to recycle wastewater at the source and increase overall water-use efficiency	Centralized wastewater systems often lack coverage and capacity, making on-site treatment essential to expand reuse and reduce infrastructure strain	Drives innovation in on-site reuse for sustainable water systems
Cross Whole Value Chain	9	Improve water system resilience via climate-adapted strategies	Deploy forecasting tools, backup systems, and diversified storage solutions to ensure stable supply under climate uncertainty	Strengthening climate resilience is critical to safeguard water systems against increasing stress from extreme weather, rising demand, and supply disruptions	Promotes adaptive technologies climate-resilient water security
	10	Adopt nature-positive solutions and promote green energy across the water system	Integrate nature-based designs and low-carbon technologies into water systems to enhance ecological performance and reduce emissions	Minimizing environmental impact is essential to prevent long-term degradation of ecological infrastructure and align with water sustainability goals	Promotes integration of green energy and eco-friendly approaches into water systems

Key Innovative Technology Enablers

2 Cost and energy effective desalination techniques

- **High-recovery SWRO:** Recovers up to 60% of seawater, lowering costs, chemical use, and waste while extending membrane life compared to conventional systems.
- **Pump centralization:** Streamlines plant operations by consolidating pumps, improving energy efficiency and reducing maintenance.
- **ED/EDR:** Uses ion-exchange membranes and electricity to efficiently desalinate brackish water, requiring less energy than reverse osmosis for low to moderate salinity.

3 Digitalized infrastructure

- **Acoustic IoT sensors:** Detect leak sounds in pipes and send real-time alerts through a monitoring platform.
- **AI leak detection:** Analyze flow data using machine learning to identify leaks early.
- **Smart pressure control:** Use automated valves to adjust pressure and reduce water loss.

5 Digital twin of water supply and demand system

- **AI-Based Water Management:** Predict water demand & supply gaps and adjust distribution dynamically

6 Low water consumption technology

- **Drought-resistant crops:** Use plant varieties adapted to low water conditions through traits like deep roots and reduced water loss.
- **Efficient industrial cooling:** Implement closed-loop systems and heat exchangers to cut water use while maintaining equipment performance.
- **Water-saving appliances:** Deploy low-flow fixtures and efficient appliances to reduce water use in homes and commercial buildings.
- **Precision agriculture:** Use sensors and data to match irrigation with crop needs, minimizing water waste.
- **AI-based optimization:** Apply machine learning to improve water efficiency in industrial processes

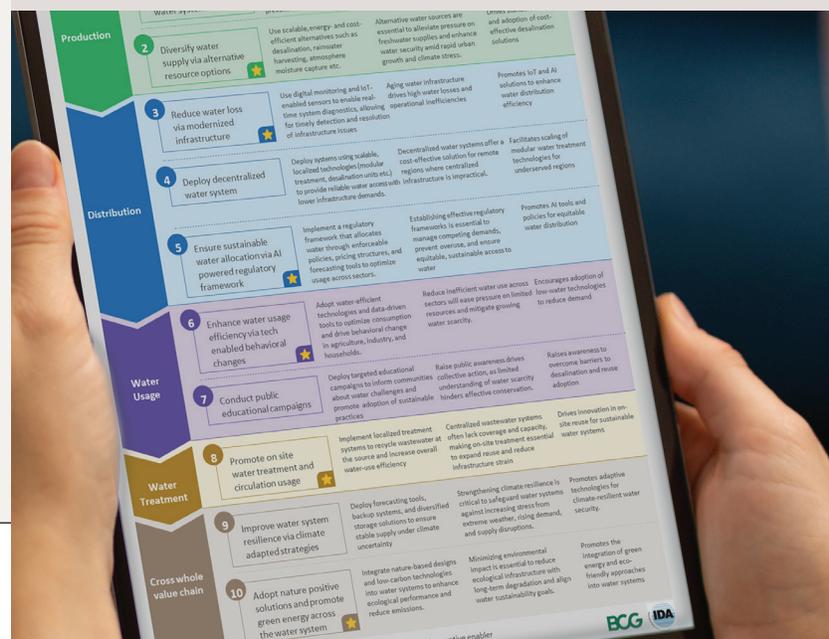
8 Advanced water circulation

- **Membrane bioreactors (MBR):** Combine biological treatment and filtration for efficient on-site wastewater reuse.
- **Greywater recycling:** Treat and reuse water from sinks and showers for irrigation or cooling.

10 Nature-based solutions

- **Wetland water circulation:** Use nature-based solutions to treat wastewater with low energy use.
- **Green stormwater infrastructure:** Apply permeable surfaces and rain gardens to manage runoff and boost water retention.
- **Deep ocean desalination:** Leverage seabed pressure to cut energy use by 40%, avoid chemicals, and eliminate toxic brine discharge.
- **CCUS in desalination:** Use saltwater to create carbon-capturing solvents, enabling freshwater production with carbon removal.
- **Solar-powered pumps:** Extract water in off-grid areas using solar energy to reduce emissions.

Building on these levers, a growing number of large-scale projects across the water value chain are demonstrating the viability of scaling innovative technologies. These initiatives signal a clear shift from conceptual solutions to commercially proven models, underscoring the sector's readiness to adopt next-generation approaches. The following examples highlight how innovation is moving from the margins to the mainstream, with tangible implications for resilience, efficiency, and long-term value creation.



DESALRO 2.0 desalination plant

Breakthrough desalination technologies can scale locally, but global adoption hinges on overcoming awareness gaps, integration barriers, and short-term cost bias

Project leader

- ITC

Technology Support

- Danfoss

Key innovative approach

- Cost & energy effective freshwater production techniques

Project Introduction

- The project was led by Spain's PPP ecosystem DESAL+ LIVING LAB, with tech support from Danfoss on high-pressure pumps
- Aim to achieve the lowest possible energy consumption using the latest technology in modular, high-pressure seawater desalination system

Barriers to Apply Globally

- Some markets not yet familiar with the new technology
- Insufficient focus on lifetime energy cost of desalination systems at the time project decision
- Complex to retrofit new technology to existing desalination plants

Key Achievement

- Guinness World Record pending confirmation (below 1.8 kWh/m³) - lowest specific energy consumption (SEC) seawater RO desalination plant - up to 25% less energy consumption than in conventional designs.
- Scaled commercially in Spain with over 10 systems being built incorporating the same technology



Advanced Recycled Water Program at Midwestern Ammonia Plant

Advanced water reuse drives \$2.5 M in annual savings and a 20% boost in tertiary water use, but faces global regulatory hurdles

Leading Constructor

- ChemTreat, Inc.

Project Introduction

- ChemTreat partnered with a Midwestern ammonia facility to tackle severe corrosion and scaling caused by frequent switching between city makeup water and phosphate-rich tertiary recycled water. By replacing the incumbent phosphate cooling program with a tailored non-phosphate solution and upgrading pretreatment controls, the team unlocked safe reuse of treated effluent across multiple systems.

Barriers to Apply Globally

- Variable phosphate-discharge limits: regulations differ widely by region, complicating approval and permitting of non-phosphate systems.

Key Innovative Approach

- FlexPro® non-phosphate cooling treatment: delivers corrosion protection without adding phosphate to the effluent
- RL5000 high-pH booster: raises conductivity for enhanced scale control
- CL457 biofouling cleaner: maintains pretreatment system health
- Rental DAF unit: deployed to strip excess phosphate during makeup-water spikes

Key Achievement

- +20% tertiary water usage
- \$2.5 M annual reduction in city-water makeup costs
- Stabilized cooling performance and consistent compliance with effluent limits, boosting overall plant productivity



TAQA Water Solutions Deploys AI-Powered SCADA System for Sustainable Water Future

Project leader

- TAQA Water Solutions

Project introduction

- Implementation of state-of-the-art SCADA system with a total cost of about 26 million USD, enabling integrated, real-time monitoring and control of TAQA Water Solutions' extensive network, from pumping stations to treatment plants.

Key Achievement

- Significant cost reduction: The system also aims to deliver a 12 per cent reduction in maintenance costs and lower energy consumption, with total annual savings of more than AED10 million.
- Sustainability gains: Optimised energy consumption will enable a reduction in the treatment plants' carbon emissions by 6,500 metric tonnes annually.

Barriers to Apply Globally

- High initial cost to implement
- Expert knowledge to maintain

Key Innovative approach

- AI Smart monitoring for Enhanced operational efficiency: Real-time monitoring, automation, and improved data accessibility will enable faster response times, timely initiation of preventative maintenance, reduced errors, and data-driven decision-making.
- Data Accessibility: Direct data accessibility with real-time insights into key performance indicators, including water recycling, flow rate, salinity, and power consumption, empowers managers to make informed decisions and optimise performance.
- Strengthened security: Latest cybersecurity measures and physical security enhancements will bolster the safeguarding of critical infrastructure reducing risk and increasing resilience
- Integral approach: Integrated with other operational software such as Maximo 8.0 and central SCADA system of other relevant entities.



Efficient TDS Removal without RO Enables >90 % On-Site Water Reuse at NEOM

Advanced Nanotechnology for TDS Removal in Concrete Patching Plants

Leading Constructor

- GI Aqua Tech GmbH

Project Introduction

- At NEOM’s concrete-patching facilities, wastewater is highly alkaline (pH 12.8–13.2) and rich in TDS, oils, cement particles and solids. GI Aqua Tech’s modular G-NANO system uses chemical-mechanical nanomaterials in a compact, plug-and-play unit to strip out contaminants—enabling rapid deployment and decentralized, non-RO treatment with minimal human intervention.

Barriers to Apply Globally

- Regulatory approval for novel nanomaterials can be lengthy and uncertain
- Operator unfamiliarity with non-biological, decentralized systems
- Site-specific customization increases design and OPEX complexity
- Higher upfront capex versus conventional disposal or RO plants

Waste water treatment plant for Ruwais housing complex

Advanced water reuse can scale sustainably, but global uptake is limited by cost, regulation, and cultural resistance

Project leader

- Metito

Barriers to apply globally

- High infrastructure upgrade cost
- High energy consumptions
- Intensive regulatory approval requirement to use treated water
- Culture resistance to use treated water

Key innovative approach

- Advanced water circulation

Key Innovative Approach

- Modular G-NANO units with automated controls for 24–48 hr setup
- Chemical-mechanical nanomaterial treatment achieving >90 % TDS removal without RO
- Compact footprint—80 % smaller than conventional water-treatment plants
- Decentralized operation—prefabricated, plug-and-play modules requiring minimal maintenance

Key Achievement

- >90 % water reuse potential on-site, supporting NEOM’s circular-water goals
- 99.9 % TSS removal, 97.6 % COD reduction, 97.9 % BOD reduction
- >90 % TDS removal (from 6 000–8 000 ppm down to 500–2 000 ppm)
- Operational cost savings > \$25 per m³ compared to conventional disposal



Project introduction

- Metito led the construction of drinking water and wastewater treatment facilities as part of the infrastructure augmentation in the industrial complex

Key achievement

- The facility treats 25,000 m³/day of raw sewage for landscape and irrigation use
- Continuous supply of drinking water through disinfecting water stored in 20M gallon capacity storage tanks

Innovation Case 6

Al Wathba wetland circular water irrigation

Circular water reuse in wetlands shows strong environmental benefits, but scaling faces regulatory, cost, and collaboration hurdles

Leading constructor

- TAQA Water Solutions

Key Innovative Approach

- Advanced water circulation
- Nature-based solutions

Key Achievement

- Support circularity under national standard
- 1,000 Ghaf trees are irrigated entirely with recycled water
- Contribute to Abu Dhabi's Net Zero strategy
- Each tree can absorb ~4200 tons of carbon dioxide during its lifespan
- Increase and maintained biodiversity
- Serves as a public educational campaign through tourism activities

Project introduction

- TAQA water solutions signed contract to create a Ghaf tree grove in Al Wathba wetland reserve by utilizing recycled water for irrigation

Barriers to Apply Globally

- High construction cost
- Lack of collaboration between government, water circulation solution providers, research institutions etc.
- Lack of clear regulation for applying recycled water in wetlands
- Limited public awareness in circular water application use cases



Innovation Case 7

Smart water networks upgrade in France

Smart water networks can significantly cut losses, but scaling is hindered by high costs and specialized skill demands

Project leader

- SUEZ

Project introduction

- SUEZ was hired to deploy its 'ON' connect metering and AQUADVANCED Water Network solutions by the Greater Poitiers' government
- Acoustic sensors are placed along the pipes to detect repetitive noises from water leaks. Data are transmitted to a monitor platform which identifies leaks, triggers alerts

Key achievement

- Water production fell by 10% indicating nearly 1 million m³ water produced are saved over the first two years

Key Innovative Technologies

- Digital leak detection and monitoring through IoT and AI platform
- Engineering failure monitoring

Barriers to Apply Globally

- High up front cost and maintenance costs
- High skill requirement for maintenance staff





These showcased projects collectively demonstrate cutting-edge water innovations achieving notable technical, environmental, and economic milestones.

Advanced water recycling and nature-based solutions are turning waste streams into resources. In parallel, breakthroughs in desalination technology have slashed energy requirements. These achievements show that sustainability can go hand-in-hand with scale and cost-effectiveness – the new large plants provide reliable, affordable water, and novel solutions proven in pilots are rapidly moving into commercial deployment across regions.

Despite this progress, several barriers still impede wider adoption of these innovations. Foremost are the financial and energy constraints: implementing such advanced systems often demands high upfront capital investment, and even with efficiency gains they can remain energy-intensive at full scale, affecting overall water costs. Regulatory and institutional hurdles also slow uptake – in many places there are strict or unclear rules around reusing treated wastewater and a lack of coordination among the government, industry, and research partners needed to support circular water projects. Public perception and expertise gaps add to the challenge: communities can be hesitant to trust recycled water, and these complex technologies require specialized knowledge to design and operate, making it difficult to retrofit older facilities or expand into markets not yet familiar with them.

From Innovation to Integration: Regional Models in Action

Transforming water systems at scale requires more than just new tools. It demands integrated regional efforts—where policy, finance, infrastructure, and community engagement converge to create lasting change.

The following regional case studies illustrate how cities, countries, and local coalitions are building adaptive water ecosystems that embed innovation into broader frameworks of resilience, equity, and long-term planning. These examples highlight how systemic coordination—across public and private actors, technologies and territories—can turn water innovation into sustained water security.

Water Innovation as an Economic Catalyst in Singapore

Singapore PUB Case Study | Turning water scarcity into growth opportunities

Local Challenges

At independence in 1965, Singapore relied solely on local catchment and imported water—yet its 582 km² land area meant limited catchment capacity. Rapid industrialisation from the 1980s drove surging demand from semiconductors, pharmaceuticals and petrochemicals. These natural constraints threatened both supply security and economic resilience.

PUB's Introduction

Reconstituted in 2001 as Singapore's National Water Agency, PUB's mission is to ensure a sustainable water supply for all. Its "Water for All" vision calls on every Singaporean to use water wisely and underpins the development of a more resilient, diversified water strategy.

Four National Taps

To reduce dependence on rain and imports, PUB expanded Singapore's sources to four "taps":

Local Catchment & Imported Water

- The original baseline supply—sufficient in early decades but inadequate for long-term growth.

NEWater Programme

- Recycles municipal and industrial wastewater through advanced membrane and UV treatment to meet WHO drinking-water standards.
- 1990s demo plant proved viability; today factories at Kranji, Ulu Pandan and Changi produce an average 142 Mm³/y (21% of total) (2016–23).
- Tuas NEWater Factory (by 2027) will further boost capacity.

Desalination Expansion

- First Tuas plant opened in 2005 using reverse osmosis to turn seawater into potable supply.
- Now five plants operate year-round, providing a climate-resilient source even in dry spells.
- Ongoing R&D aims to cut energy use from 3.5 kWh/m³ today to below 2 kWh/m³.

R&D & Next-Gen Innovation

- PUB continually invests in next-generation membranes, pre-treatment technologies and energy-efficient processes to drive down costs and carbon footprint across all new water taps.

Key Achievements

- NEWater share: 21% of total supply
- Average NEWater sales: 142 Mm³/yr (2016–23)
- Desalination plants: 5 operational
- Energy target: < 2 kWh per m³

Regional Case 2



Smart water technology advancing UAE's food & water security goals

UAE case study | Smart Tech drives down water losses

Local Challenges

- High non-revenue water losses due to outdated water distribution infrastructure
- The seasonal changes in water supply & demand further exaggerate the challenge
- Limited water and arable land mean the UAE imports ~90% of its food

Key initiatives

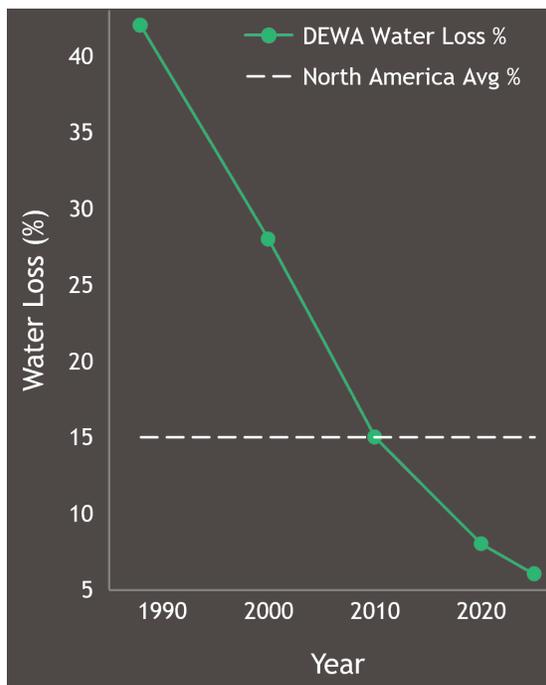
- Smart Metering & SCADA: With technical support from SUEZ, DEWA converted all water meters to smart meters and established an integrated SCADA control center, covering 3,000 km of pipes, enabling 24/7 remote monitoring of flow, pressure, and leaks
- District Metered Areas (DMA): The network is partitioned into zones to pinpoint leaks. DEWA's system can detect anomalies (over 2.6 million post-meter leaks identified in 6 years) and trigger rapid repairs
- Infrastructure Upgrades: Aging pipes are being replaced or rehabilitated. Utilities use corrosion-resistant materials (with FPI providing composite pipes) and install automated pressure controls and flow sensors.

Key Achievements

- Graph showing Reduction in Water Loss—DEWA vs North America Average

Key Entities

- Dubai's Electricity & Water Authority to lead the transformation of local water distribution system
- International experts included Suez to bring in world best practice
- Local private sector players such as Future Pipe Industries to support infrastructure upgrades



Regional Case 3



Water, a foundation for social wellbeing and community resilience

Southern California Case Study | Collaborative & Integrated Water Management

Local Challenges

- Persistent droughts and climate-driven water scarcity have raised risks for household water access, public health, and quality of life
- Dependence on overdrawn sources like the Colorado River and Sierra Nevada snowpack has made supply less predictable, especially for vulnerable and low-income communities

Key initiatives

- Inter-State Collaboration-Colorado River Plans: California joined Arizona and Nevada in a 2023 consensus agreement to conserve significant Colorado River water.
- Integrated Resource Management: Southern California is investing heavily in recycled water and local supply to reduce its need for imported water, through flagship projects such as Pure Water Southern California
- Water usage management: Southern Californians have dramatically cut per-capita usage over the past decades through efficient appliances and landscaping ordinances.
- Infrastructure Upgrades: MWD has developed massive storage capacity such as Diamond Valley Lake reservoir and groundwater banking programs

Key Achievements

- Enabled reliable household water access despite recurring droughts, preventing health crises and supporting stable urban life.

- Promoted water equity by integrating conservation programs with targeted community outreach and subsidy mechanisms.
- Strengthened community trust through transparent planning and interstate cooperation, reinforcing public confidence in long-term water security.
- Fostered a water-conscious culture in Southern California that values sustainability, inclusion, and collective responsibility.

Key Entities

- Metropolitan Water District of Southern California (MWD) works with other states via the Colorado River Compact
- Local utilities like Los Angeles Department of Water & Power supports the implementation of a unified water management strategy

Collaboration Enablers

Key enablers fostering ecosystem collaboration needed to scale up innovation impact

The regional case studies in the previous section show how success depends not only on deploying advanced technologies, but on aligning public policy, finance, regulation, and community engagement. These multi-lever water strategies thrive when national and city-level actors coordinate across the value chain from network optimization and leak detection to wastewater reuse and diversified sourcing.

To replicate and scale such results globally, water systems need a foundation of collaboration enablers: the institutional, financial, and policy mechanisms that unlock innovation at scale. These include robust governance models, blended financing instruments, regulatory alignment, streamlined permitting, public-private dialogue, and technical education.

This section identifies six critical enablers and the actions that governments, financial institutions, industry players, and civil society can take to scale up the innovations outlined earlier. Together, these levers of collaboration form the bridge from promising pilots to resilient, large-scale transformation.

1 Co-invest in joint R&D and commercialization

Industry players should expand investment in cost-effective, energy-efficient technologies through both internal R&D and joint initiatives with research institutions. IDRA facilitates cross-border collaboration by convening global industry partners on shared research agendas and accelerating commercial readiness of desalination and reuse innovations.

2 Align financial incentives with strategic outcomes

Governments should deploy targeted subsidies and tax incentives for high-impact technologies, while financing institutions provide blended capital tools such as concessional loans or water bonds. IDRA supports the development of these financing models, working with multilateral banks and project sponsors.

3 Standardize to create demand certainty

Governments must design holistic standards in water production, distribution and usage including energy consumption in water production/treatment facilities, non-revenue water rate in distribution system, wastewater reuse rate, water usage efficiency in agriculture, industry and urban life. Timely adjustments based on tech upgrade is also important. IDRA plays a convening role, helping align regulatory frameworks with technology capabilities and creating clarity for investors and technology providers.

4 Develop integrated water policy frameworks

Governments must establish comprehensive water governance models that integrate resource planning, infrastructure investment, and environmental policy. IDRA collaborates with policymakers to embed desalination and reuse as core components of national water strategies, aligning them with sustainability objectives.

5 Foster public-private communication

Effective policy and adoption depend on continuous feedback between technology providers and government. IDRA helps structure this dialogue, providing case studies, impact data, and structured feedback loops between innovators and regulators.

6 Mobilize industry-led education alliances

Industry players should coordinate public-facing campaigns to communicate the value of sustainable water technologies. IDRA acts as a global education platform, enabling joint outreach initiatives that promote water reuse, desalination, and conservation across communities.



Collaboration Case 1

SWPC's Public-Private Partnership Governance, Financing and Operational Framework for Water Infrastructure Expansion

Local challenges

- High dependency on desalination water and rising demand due to population growth and industrial development
- Government shoulder high cost of water project with urgent demand to adopt new investment models in order to expand capacity & improve efficiency

SWPC Introduction

- Established in 2018, formerly the Water & Electricity Company to spearhead water sector PPPs
- Sole offtaker for independent water producers
- Tendering all major water projects in partnership with private investors

SWPC's Impact

- Expansion of water infrastructure through Build-Own-Operate projects: Successfully tendered over 20 projects since 2019 includes desalination plants (IWPs), wastewater treatment plants (ISTPs), independent water transmission pipeline (IWTP).
- Competitive tendering process to advocate tech innovation: Achieved the world's lowest desalination tariff at just \$0.41 per cubic meter
- Mobilized private sector investors: Plan to attract and mobilize an estimated \$30B of estimated total investment by 2030



Collaboration Case 2

Regulatory and Governance Framework for Water-Rights Reform, Mandating Seawater Use and Recycling in Mining

Local challenges

- Chile has been enduring a "mega-drought" for over a decade
- The mining industry traditionally drew billions of liters of freshwater, threatening the local community and fragile ecosystem in a water-scarce environment

PPP Collaboration Model

- Water Code Reform (2022): Ended perpetual water rights, pressures mining firms to relinquish any hoarded water rights they aren't actively using, freeing up resources
- Mandatory seawater use: current Government policy and project approvals heavily favor mines that incorporate seawater. Several new mines or expansions (such as Teck's Quebrada Blanca Phase 2 and expansions by state-run Codelco) have been approved only on the condition that they do not draw freshwater, instead piping in desalinated water from the coast
- Water Efficiency and Recycling: Chilean regulators take water reuse performance as key evaluation criteria during environmental permit reviews to encourage water recycling in mining companies

SWPC's Impact

- Seater usage: 30%
- Mining industry avg water reuse: 75%





Collaboration Case 3

Arab Fund Water Initiative: Multi-DFI Governance and Blended-Finance Framework for Integrated WEF-Nexus Projects

Local challenges

- The MENA region faces deepening water stress driven by climate change, rapid urbanization, and fragmented institutional frameworks.

PPP Collaboration Model

- Launched by the Arab Fund for Economic and Social Development in partnership with the World Bank, Green Climate Fund, Saudi Fund for Development and other ACG institutions to co-design and finance integrated WEF Nexus projects that are climate-resilient, inclusive, and scalable.

Impact

- Blended finance & de-risking instruments: Concessional capital, guarantees, green bonds & carbon finance to mobilize private and institutional investors.
- Institutional reform & capacity building: Strengthen governance, regulation & service delivery.
- Innovation & technology: Renewable-powered desalination, circular water use, managed aquifer recharge & digital tools for smart irrigation.
- Regional cooperation: Shared data/knowledge systems & transboundary agreements to improve policy alignment and resilience.

Governance & Roll-out

- Underpinned by a multi-stakeholder Steering Committee of DFIs and a Technical Advisory Board, with flagship demonstration projects kicking off in 2026 to scale investment across the region



Funding Mechanisms and Pilot Projects

Funding Mechanisms:

- Blending Finance
- Green and Blue Bonds
- Carbon Credits

Pilot Projects:

- Renewable Desalination
- Managed Aquifer Recharge
- Smart Irrigation
- Wastewater Reuse
- Urban Water Modernization

Conclusion and Call for Action

The worldwide community of water system should leverage innovation and collaboration to transform the global water crisis into an opportunity for sustainable development. By harnessing the power of cutting-edge technologies under the 10 levers, we can mitigate the effects of water scarcity and climate change. Collaboration between industries, governments, financial institutions, and communities is essential to scaling these solutions, ensuring sufficient and equitable access to water, and creating a more sustainable and resilient future for all. Now is the moment to act, turning today's challenges into tomorrow's opportunities for progress and prosperity.

The International Desalination and Reuse Association (IDRA) call on the global water community to unite in scaling desalination and water reuse as transformative solutions to the water crisis. By leveraging IDRA's expertise, networks, and advocacy, stakeholders can turn innovative technologies into actionable strategies for a water-secure future.

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“

Desalination and water reuse are not just solutions for today's water crisis—they are the foundation for a sustainable tomorrow. IDRA is committed to leading this transformation through innovation and collaboration”

**–Shannon McCarthy,
IDRA Secretary General**

The tools, technologies, and solutions exist, yet we still see low adoption of innovation in some parts of the world. It's time for collective action to secure water for future generations. I look forward to the journey together.”

–Yvonne Zhou, Managing Director and Senior Partner, Global Leader of Climate & Sustainability Practice at Boston Consulting Group

The technologies to address water scarcity and improve energy efficiency already exist. The challenge of implementation lies in increasing uptake of proven solutions and reducing the economic gaps to ensure the total cost of ownership approach to investment.”

–Michale Bejorn, VP at Danfoss HPP

Overall the private sector contributes by innovating in technology. We need to (further) support the change of the entire ecosystem, all stakeholders, institution, end users, regulators and so on. In the past, there have been debate about the role of the private and public sector. We absolutely believe that only a joint effort by all stakeholders of both private and public will succeed in addressing this sustainability change.”

**–Jose Cheurlin,
CEO of SUEZ Middle-East**

It is essential to promote diplomatic cooperation between countries, equitable resource management, and sustainable water governance.... A key strategy to combat climate change is to promote sustainable and efficient infrastructures by Public-Private Partnerships (PPPs). This type of contract supports government bodies in implementing effective water policies.”

–Pedro Almagro, CEO Lantania