



**PACIFIC
INSTITUTE**

Harnessing the Power of Water Efficiency and Reuse

March 20, 2023

About the Pacific Institute

- **The Pacific Institute** is an independent, non-partisan global water think tank, founded in 1987 and based in Oakland, California, with staff around the world.
- **Mission:** to create and advance solutions to the world's most pressing water challenges.
- **2030 organizational goal:** to catalyze the transformation to water resilience in the face of climate change.
 - Water Resilience: "The ability of water systems to function so that nature and people, including those on the frontlines and disproportionately impacted, thrive under shocks, stresses, and change."

Agenda

- **Overview:** Shannon Spurlock
- **Water efficiency, a statewide perspective:** Heather Cooley
- **Water reuse, a federal point of view:** Dr. Sharon Nappier
- **Water efficiency and reuse, through a global water and climate equity lens:** Dr. Akiça Bahri
- **Audience Q&A:** Moderated by Shannon Spurlock

Panelists



Shannon Spurlock
Senior Researcher – Public
Policy & Practice Uptake
Pacific Institute
Moderator



Heather Cooley
Director of Research
Pacific Institute



Dr. Sharon Nappier
National Program Leader for
Water Reuse in the Office of
Water at the United States
Environmental Protection
Agency



Dr. Akiça Bahri
Professor, Researcher, and
former Minister of Agriculture,
Water Resources and Fisheries
and Secretary of State in charge
of Water Resources for the
Government of Tunisia

The Intersectionality of SDG6

” Cooperation is necessary to maximize the positive co-benefits, minimize disputes and reduce the negative impacts on water resources, and to improve protection from water hazards at a time of intensification of climatic and hydrological variability.”

UNDP, SIWI and UNICEF (2023). Cooperation Opportunities for Improved Integration Across SDG6. United Nations Development Programme (UNDP), Stockholm International Water Institute (SIWI) and United Nations Children’s Fund (UNICEF) on behalf of UN-Water, New York and Stockholm

United Nations | UN WATER

Cooperation Opportunities for Improved Integration Across SDG6

Logos: unicef, WATER GOVERNANCE FACILITY, SIWI, UNDP

Advancing progress on SDG 6 and the 2030 Sustainable Development Agenda

6 CLEAN WATER AND SANITATION

Target 6.1: Water Quality and Recycling Water efficiency and reuse with advanced water management approaches, including reuse of wastewater. Water research and books include Guide for Developing Drip Irrigation Systems to Support Smallholder Farmers (2021), The Integrated Potential of California’s Urban Water Supply, Water Efficiency, Water Reuse, and Stormwater Capture (2022), On the Water’s Edge: Sanitary Quality Solutions (2016), Water quality improvement frameworks developed, including Net Positive Water report.

Target 6.2: Water Efficiency and Sustainable Wastewater Water efficiency and reuse with advanced efficiency as a key component of resilient water systems. The Integrated Potential of California’s Urban Water Supply, Water Efficiency, Water Reuse, and Stormwater Capture (2022) report outlines how water reuse can be used to improve water efficiency investments. Additional research includes Advancing Affordability through Water Efficiency (2022), The Multiple Benefits of Water Conservation and Efficiency for California Agriculture: Potential Water Savings Associated with Agricultural Water Efficiency Investments (California State University, 2021), Water efficiency prioritized in Frameworks, Including Net Positive Water report.

Target 6.3: Local Participation Water and Climate Enabling works to build local capacity. Sustainable Engagement Guide for Municipalities Solutions (2022) offers guidance for broad stakeholder engagement.

Target 6.4: Inland & Transboundary Water Developed and maintains Water Conflict Observatory. The world’s most comprehensive open source database on water-related violence. Additional research related to water conflict: Sustainable Development Solutions for Peace and Security Challenges (2019), and Understanding and Reducing the Risks of Climate Change for Transboundary Waters (2019).

Target 6.5: Water-Related Ecosystems Research and books focused on ecosystems include: Let’s Go in Diversity: California Flora (2022), Wetlands: California’s Resilient Foundation of Nature-Based Solutions for Resilient Communities (2021), Benefits Accounting of Nature-Based Solutions for Sustainable Landscapes (2020), Ecosystems Resilience Index (2020), California Blue Basis and Salt-Say Ecosystems: Also prioritized in water resilience Frameworks: Net Positive Water, Inland, InPact, Water Resilience Issue Brief, and Inland Report’s Overview.

Target 6.6: Water and Sustainable Development Goals The 2021 report provides early warnings of climate change impacts on water systems and potential solutions that water resilience offers. The 2030 goal is to “enable the transformation to water resilience” and the report outlines strategies to achieve this goal. The report also provides a methodology to assess water resilience across the global climate policy space, including UNFCCC, COP26, and the Paris Agreement. The report also provides a methodology to assess water resilience across the global climate policy space, including UNFCCC, COP26, and the Paris Agreement.

Target 6.7: Water Resilience Water Resilience Framework (WRF) provides a method to build long-term water resilience by analyzing and adapting to climate change. 2022 analysis, one of the first to identify how water resilience can become a driver of climate change. 2021 report The Future of California’s Water Supply-Climate Nexus identified specific water policies that could play an important role in helping meet energy and greenhouse gas emissions goals.

Target 6.8: Water Resilience Developing and enabling private water in corporate water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 6.9: Water Resilience Developing and enabling private water in corporate water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 6.10: Water Resilience Developing and enabling private water in corporate water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 6.11: Water Resilience Developing and enabling private water in corporate water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 6.12: Water Resilience Developing and enabling private water in corporate water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 6.13: Water Resilience Developing and enabling private water in corporate water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 6.14: Water Resilience Developing and enabling private water in corporate water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 6.15: Water Resilience Developing and enabling private water in corporate water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 6.16: Water Resilience Developing and enabling private water in corporate water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 6.17: Water Resilience Developing and enabling private water in corporate water resilience. 2024 Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 1: No Poverty Recognizing agriculture with about 70% of freshwater water usage in food, agriculture and aquaculture. The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 2: Zero Hunger The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 3: Good Health and Well-being The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 4: Quality Education The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 5: Gender Equality The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 7: Affordable and Clean Energy The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 8: Decent Work and Economic Growth The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 9: Industry, Innovation and Infrastructure The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 10: Reduced Inequalities The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 11: Sustainable Cities and Communities The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 12: Responsible Consumption and Production The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 13: Climate Action The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 14: Life Below Water The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 15: Life on Land The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

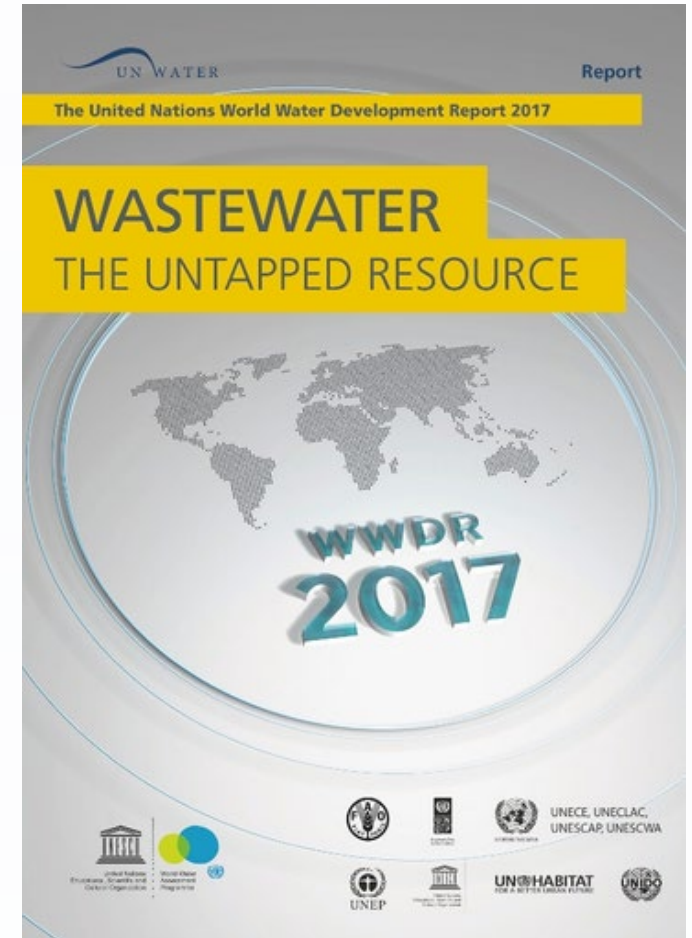
Target 16: Peace, Justice and Strong Institutions The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

Target 17: Partnerships for Goal Achievement The Pacific Institute report and research on water resilience. 2024 Pacific Institute report and research on water resilience.

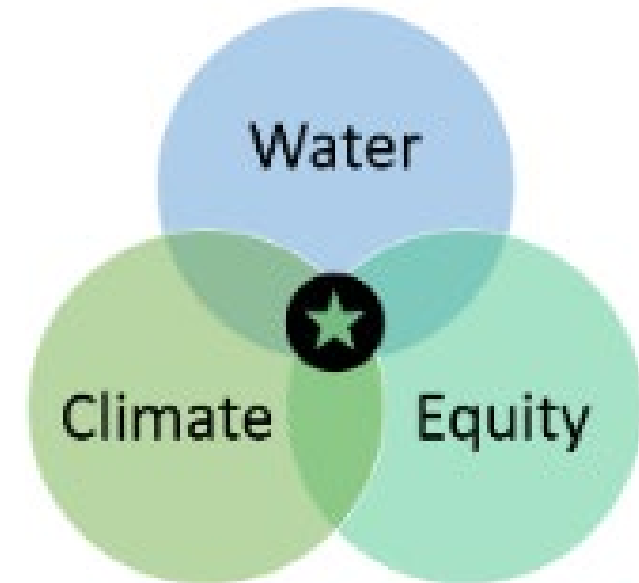
The Pacific Institute’s 2030 goal is to catalyze the transformation to water resilience. The concept of water resilience acknowledges the interconnectivity between SDG 6 and many other SDGs of the 2030 Agenda. This infographic highlights some, but not all, of the key ways our work supports the SDG 6 targets and the broader 17 SDGs using a multi-benefit or co-benefit approach.

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REIMAGINING WATER FOR A CHANGING WORLD
pacinst.org

Water Efficiency (6.4) & Reuse (6.3)



Water & Climate Equity





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Untapped Potential: A California Case Study

Heather Cooley

Director of Research, Pacific Institute

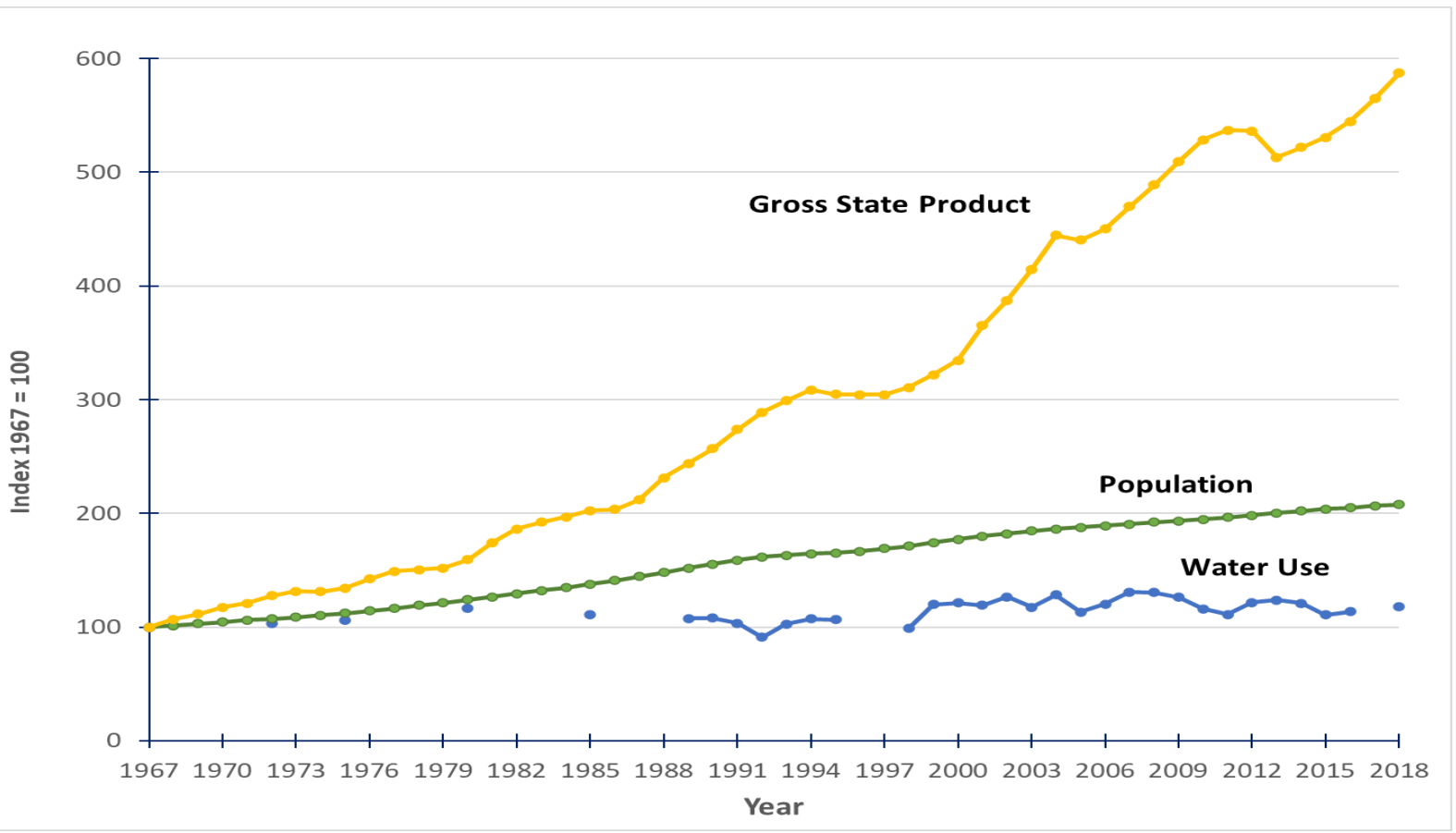
March 2023

Why a California case study?

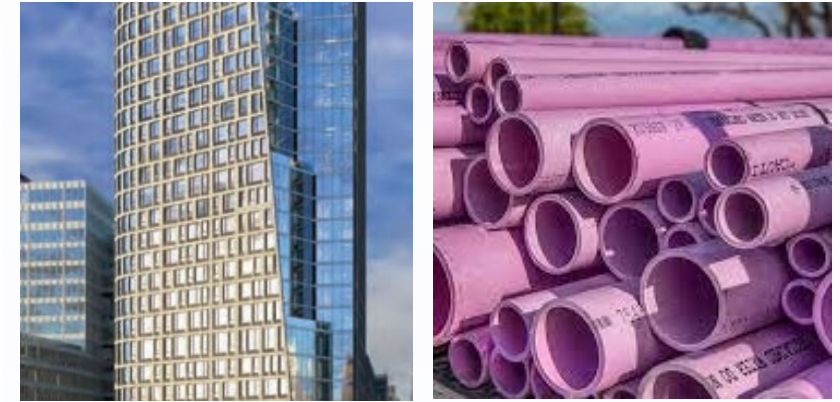
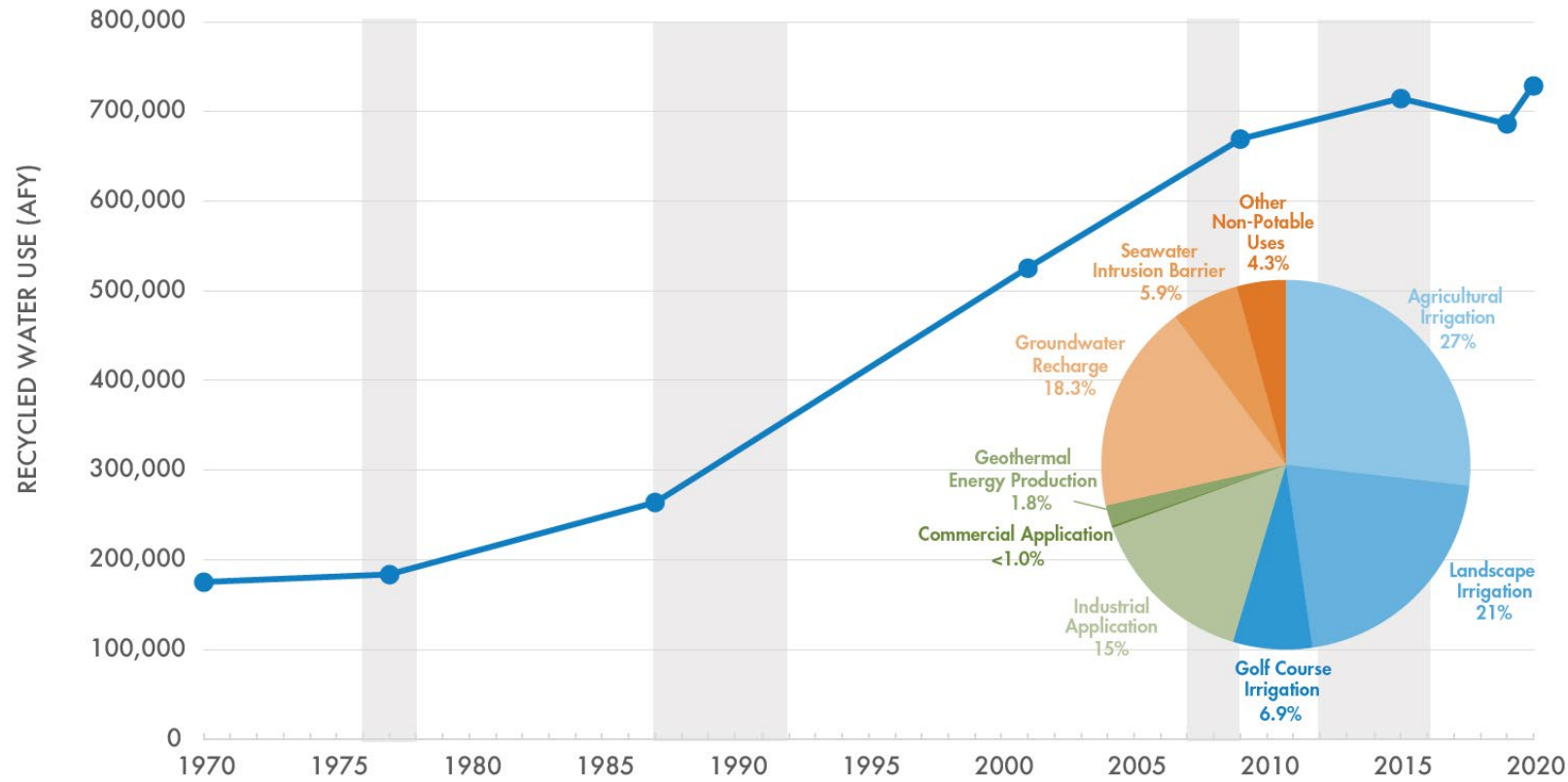
- 40 million people
- \$3.6 trillion economy (4th largest in the world) but major socio-economic disparities
- Highly varied hydrology, with a massive system to move and store water
- Similar set of challenges as seen in other communities:
 - Overtapped rivers and aquifers and persistent flooding
 - Declining ecosystem health
 - Pollution and emerging contaminants
 - Nearly 1 million people lack access to clean water
 - Climate change impacts are intensifying



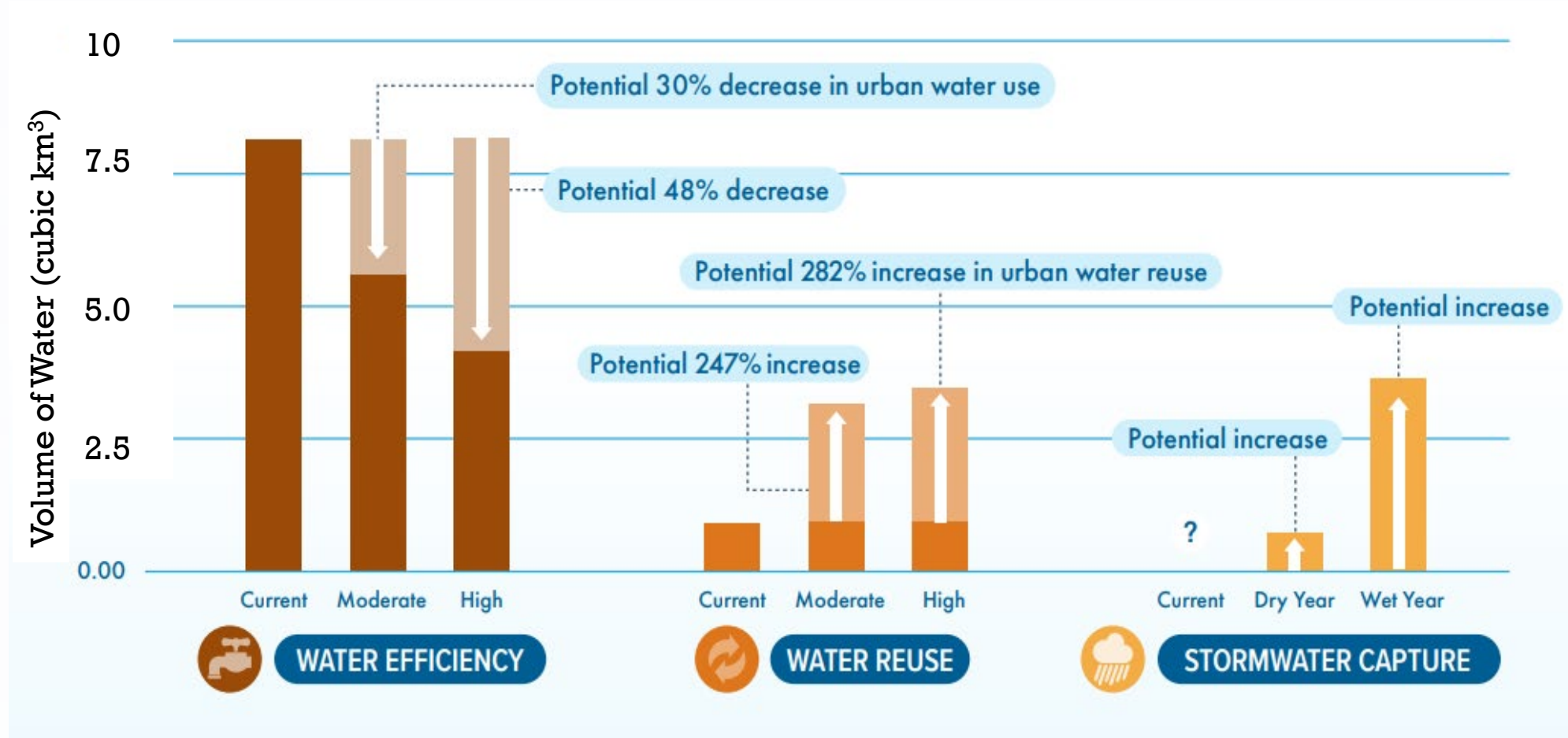
California has experienced a dramatic decoupling of water use and growth.



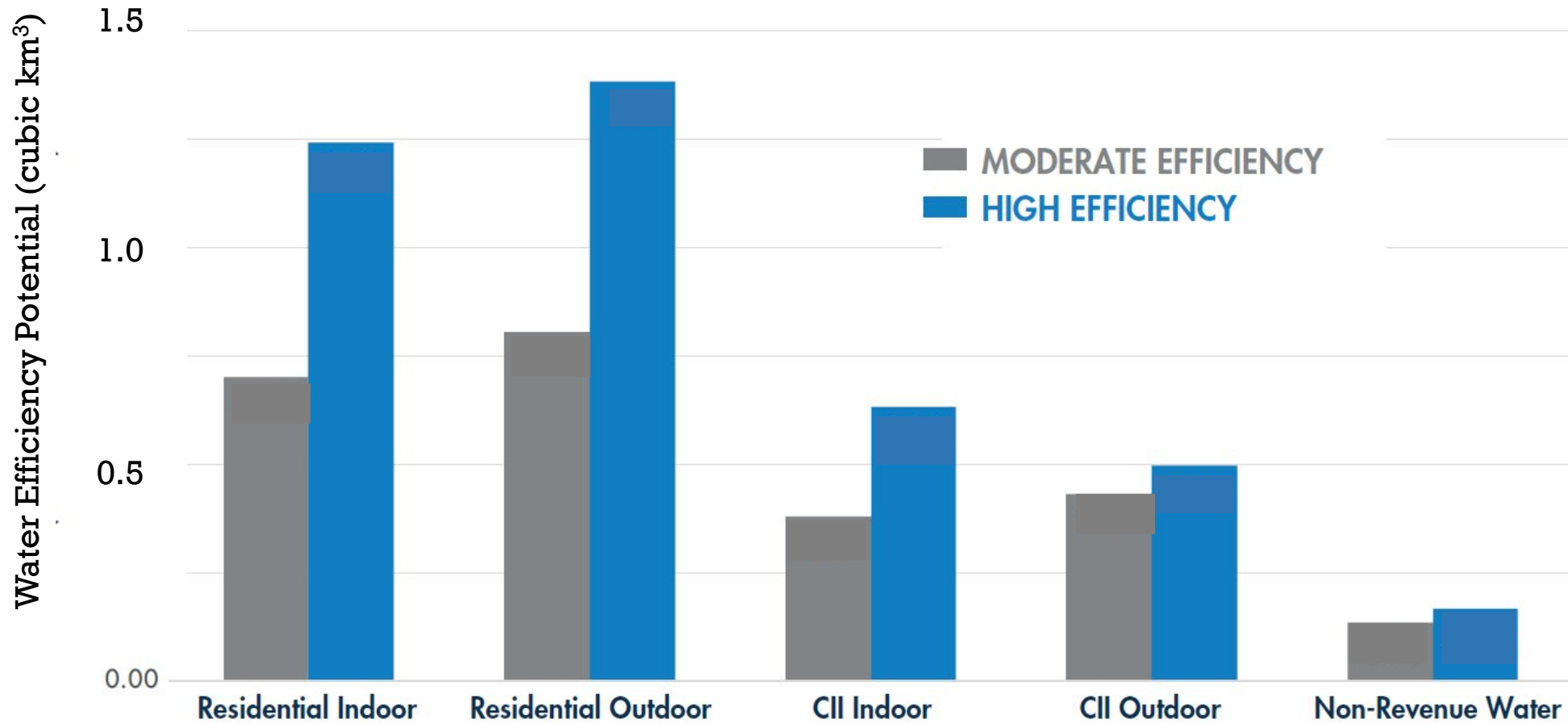
Water reuse has tripled over the last 50 years.



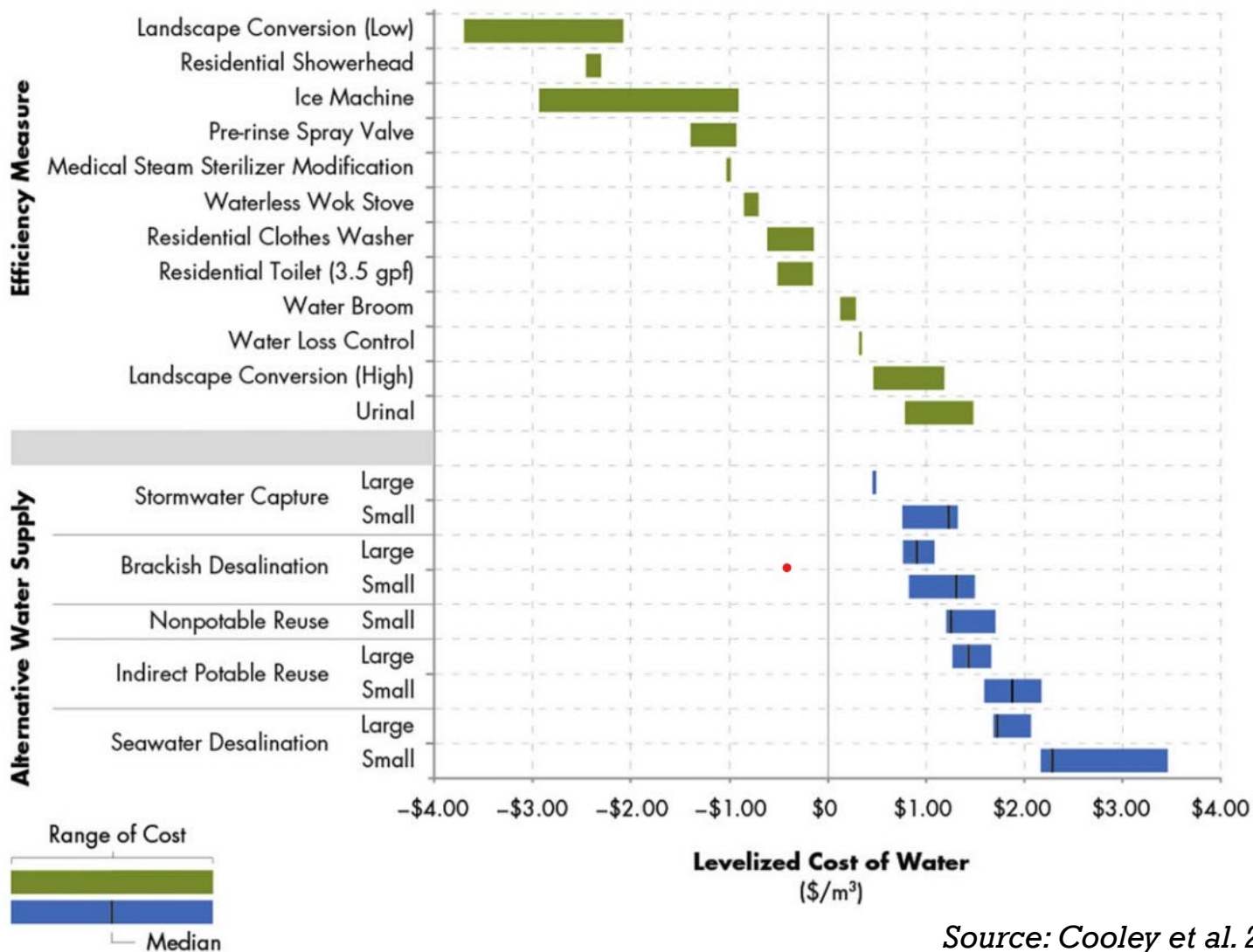
Water efficiency and reuse offer significant untapped potential.



Water efficiency opportunities are possible for every sector.



The cost of water supply options are highly varied.



- Water efficiency is the least expensive water supply option, followed by stormwater capture, brackish desalination, and recycled water.
- Seawater desalination is the most expensive option.

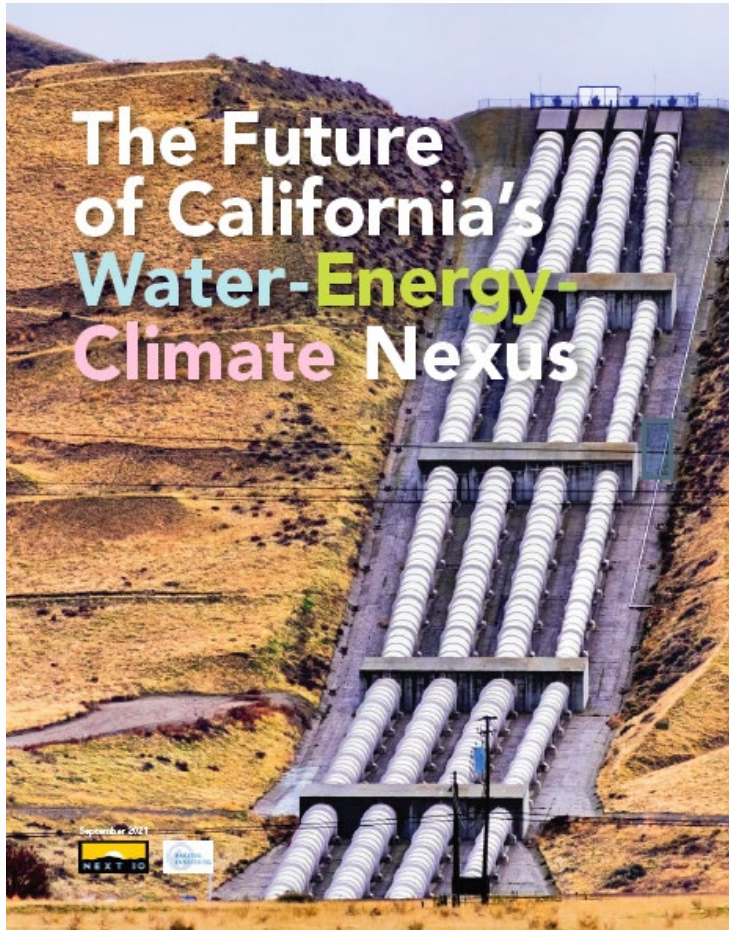
Source: Cooley et al. 2019

Water efficiency and reuse provide multiple benefits, enhancing their cost-effectiveness.



Source: Diring et al. 2019

We can be water-wise and climate-smart.



- Saving water saves energy and reduces greenhouse gas emissions.
- Replacing imported water with water reuse and stormwater capture would reduce energy use and greenhouse gas emissions.
- Energy recovery at wastewater facilities would also reduce greenhouse gas emissions.

Summary and Conclusions

- Persistent and new challenges mean we must fundamentally change how we use and manage water.
- We have significant potential to expand water conservation and efficiency efforts.
- We can also diversify water supplies, including through water reuse and stormwater capture.
- These strategies can help to meet our water and climate goals, while providing additional co-benefits.

National Water Reuse Action Plan (WRAP)

Now in its third year, the WRAP advances reuse through a series of actions by:

- Enabling multistakeholder collaborations
- Creating necessary tools and resources
- Funding critical research and technology development
- Coordinating federal government activities
- Communicating curated information early and often



Actions summarized on **Online Platform:**
(<https://www.epa.gov/waterreuse/wraponline>)

National Water Reuse Action Plan
Improving the Security, Sustainability, and Resilience of Our Nation's Water Resources

Collaborative Implementation (Version 1)

February 2020

NATIONAL WATER REUSE ACTION PLAN
Update on Collaborative Progress—Year 2
March 2022

The **National Water Reuse Action Plan (WRAP)** helps drive progress on reuse by leveraging the expertise of scientists, policymakers, and local experts across the country to **create a more resilient water future** for communities of all sizes. Now two years into WRAP implementation, there are **116 dedicated partner organizations** contributing at various scales. Since February 2020, WRAP collaborators have been working through coordinated actions to address barriers to reuse, including issues related to funding, technology, policy, and organizational capacity. Currently, there are **50 WRAP actions**, with **13 added since** January 2021 on topics such as monitoring practices, plumbing codes and standards, and communication tools. Teams have **finished 267 implementation milestones overall** and **completed 5 total actions to date**, which included deliverables related to funding eligibility, tribal outreach and training, and raising global awareness for reuse. Through the Bipartisan Infrastructure Law, enacted November 2021, lawmakers called for continued WRAP implementation and the creation of a federal reuse interagency working group "to advance water reuse across the U.S." (Sec. 50218).

WRAP YEAR 2 HIGHLIGHTS

At this stage, WRAP collaborators have delivered many critical outputs that lay the groundwork for more substantial impacts in the coming years. The following is a snapshot of some key activities and accomplishments over the past year:

Incorporating Water Reuse into Programs and Policies

- **Expert convening and report on stormwater capture and use.** Investigates opportunities, challenges, and next steps to expand the implementation of stormwater harvesting across the country (Action 3.4, led by EPA, NMSA, WaterReuse, WEF, ReNUWit, and the Johnson Foundation).
- **Integrating Water Reuse into the Clean Water State Revolving Fund** document. Describes the eligibility of water reuse in the CWSRF and highlights successful policies and practices that state CWSRF programs implement to support reuse (Action 6.2a, led by EPA).
- **\$2.4 million in Conservation Innovation Grants.** Awarded across three proposals in this new priority area, reflecting USDA's broader strategy for water reuse on agricultural land (Action 3.1, led by USDA).
- **Collaboration on NPDES permitting processes.** Enhanced understanding of how permitting can support new water management technologies and strategies, including through development of a training *webinar* (collaboration between three WRAP action teams; Action 2.8, Action 2.16, and Action 3.3).
- **Completion of Urban Waters and National Estuary Program water reuse activities.** Highlights the intersection of reuse with these key community-focused programs (Action 1.4, led by EPA).

In February 2022, EPA staff and Assistant Administrator for Water Rodika Fox toured the Scottsdale Water Campus in Arizona. The campus has over two decades of experience in indirect potable reuse, recycling 17 million gallons of treated wastewater annually through aquifer recharge. Photo credit: EPA

\$1.4 billion invested in **7 reuse infrastructure projects** in 2021 through EPA's WIFA loan program.

PARTNERS AND LEADERS

86 Feb 2020 105 Feb 2021 116 Feb 2022

TOTAL WRAP ACTIONS

37 Feb 2020 41 Feb 2021 50 Feb 2022

IMPLEMENTATION MILESTONES

241 359 422

This figure illustrates the growth of WRAP collaborators, actions, and milestones each year since the start of WRAP implementation, with the latest cumulative totals on the right.

Snapshot of WRAP Collaborative



2022 Federal Investments in Water Reuse Infrastructure




Water Reuse Interagency Workgroup (IWG)

“The purpose of the Working Group is to develop and coordinate actions, tools, and resources to advance water reuse across the United States, including through the implementation of the [WRAP]...”

- Formally established, under the Bipartisan Infrastructure Law (Sec. 50218), May 2022
- 6 key duties
- 15 federal agencies participating
- Report to Congress every 2 years
- For more info, visit:
<https://www.epa.gov/waterreuse/water-reuse-interagency-working-group>

WRAP Update on Collaborative Progress

NATIONAL WATER REUSE ACTION PLAN



Update on Collaborative Progress – Year 3

MARCH 2023

The WRAP collaborative marks its third anniversary with increasing evidence of impact. Since inception it has grown to more than 60 actions. Many of these efforts are ongoing, while 13 have successfully concluded. All action outputs—now totaling more than 100—are freely accessible online. The development of this robust suite of tools and resources by WRAP collaborators directly supports the adoption of reuse in communities of all sizes and will help enhance water resilience both locally and nationwide.

“ Water reuse is a key climate adaptation tool that can be leveraged to combat flooding and drought. EPA not only supports the adoption of these innovative solutions but is helping to make them accessible by developing tools and partnerships with the National Water Reuse Action Plan.

– EPA Administrator Michael Regan

WRAP YEAR 3 ACTIVITIES ADVANCING POTABLE AND NON-POTABLE WATER REUSE

Now with more than 130 collaborators, the WRAP and its partners are seeing progress in advancing water reuse capacity across the country. The following highlights reflect accomplishments over the past year in several key categories and show forward momentum through new action commitments.

- 135 Action Leaders & Partner Organizations
- 62 Action Commitments
- 100+ Resources Developed

Numbers since WRAP launch in 2020

Policy and Regulations


- **Compiling state regulations to support reuse adoption.** The REUSE Explorer now includes nine end-use applications searchable by state, source of water, and end-use. (Action 3.1, led by EPA and supported by ACWA, AMWA, ASDWA, ASTHO, CDPHE, FDA, WRF, and WaterReuse)
- **Creating a better understanding of how to permit water reuse projects under the National Pollutant Discharge Elimination System (NPDES) program.** The report, *Navigating the NPDES Permitting Process for Water Reuse Projects*, presents key information and strategies for permitting authorities and permittees to better understand how to permit reuse projects. (Action 2.6, output led by EPA, ACWA, NACWA, NMSA, WaterReuse, and WEF)
- **Supporting state regulators through collaborative information exchanges.** Multiple state associations hosted two webinars featuring state perspectives and relevant resources on [aquifer storage and recovery/managed aquifer recharge](#) and [direct potable reuse](#). (Action 2.2, outputs led by GWPC and ASDWA)
- **Recharging groundwater to increase local resilience.** A recent [white paper, Water Recycling for Climate Resilience Through Enhanced Aquifer Recharge and Aquifer Storage and Recovery](#), explores technical and policy considerations influencing how recycled water can be used to recharge groundwater. (Action 7.4, output led by EPA)

★ **New action:** *Advance Strategies for Permitting Innovative Wastewater Management Practices and Water Reuse Through the NPDES Program* (Action 2.19, led by EPA, UC Berkeley, and Stanford University)

★ **New action:** *Highlight Water Reuse Opportunities in the National Pretreatment Program Framework* (Action 8.7, led by EPA)

★ **New action:** *Support Multi-Stakeholder Alignment to Advance Reuse Along the U.S.–Mexico Border* (Action 11.4, led by CONAGUA and EPA)

Sign up for EPA's water reuse email updates to learn about the latest activities and find opportunities to get engaged.



- Year 3 highlights
 - Policy and Regulations
 - Research Funding
 - Infrastructure Investment
 - Engagement, Communications, and Education
 - Stormwater Capture and Use
 - Agricultural Reuse
 - Onsite Industrial Reuse
 - Non-potable Reuse

- Access your copy:
 - <https://www.epa.gov/waterreuse/national-water-reuse-action-plan-updates-collaborative-progress#update>



WRAP Year 3 Activity Highlights: *Policy and Regulations*

Regulations and End-Use Specifications Explorer (REUSExplorer)

View REUSExplorer Webinar

In September 2022, EPA hosted a webinar that demonstrated how to use the REUSExplorer. The one-hour-long session explores the different guidelines and regulations for water reuse developed across states for a variety of water sources and end-use applications. You can view a [recording of the webinar](#).



News in Water Reuse Regulations and Guidelines

Reuse regulations are in the works by several states. Check out the latest information.

[Latest news](#)



Recent and Upcoming Water Reuse Activities

Learn about the latest events and activities, including highlights of the REUSExplorer.

[See events](#)



Distribution of Reuse Regulations and Guidelines

Explore metrics and maps associated with existing reuse regulations.

[View maps](#)

New content was added February 2023.

The information provided is a summary of state-specific chemical and microbial specifications for a variety of water reuse applications as of October 2021. Results included in this explorer were derived from the regulations, guidance, laws, or policy documents of each state and language from the state documents was preserved to the degree possible. These summaries are not legally binding and do not replace or modify any state or federal laws; please always refer to your state for the latest information. You can search the tool for the following reuse end-use applications: potable, onsite non-potable water reuse, centralized non-potable reuse, consumption by livestock, agriculture, landscaping, environmental restoration, industry, and impoundments. This tool was developed by EPA and partners as part of the Water Reuse Action Plan ([Action 3.1](#)).



Select the state, sources of water, and/or reuse application of interest using the available drop-down menus. No selection will display all available results. If no results are available for multiple selections, the search will yield "no results available." The results do not include laws and policies under development.

State:

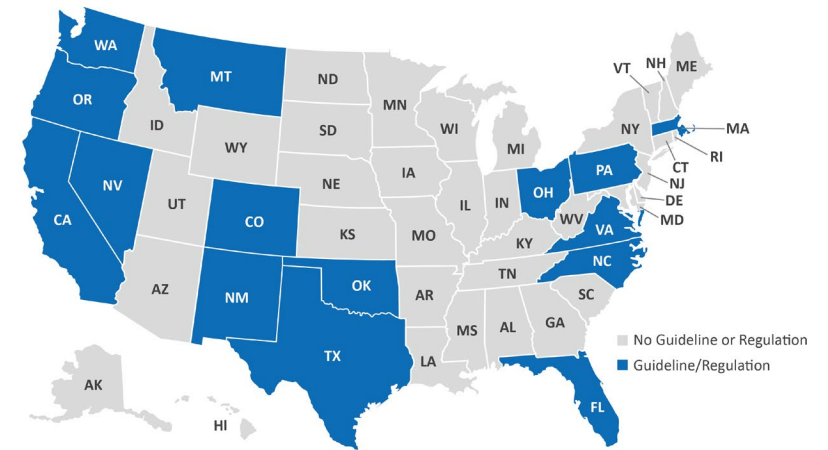
Sources of Water:

Reuse Application:

[Search](#)

<https://www.epa.gov/reuseexplorer>

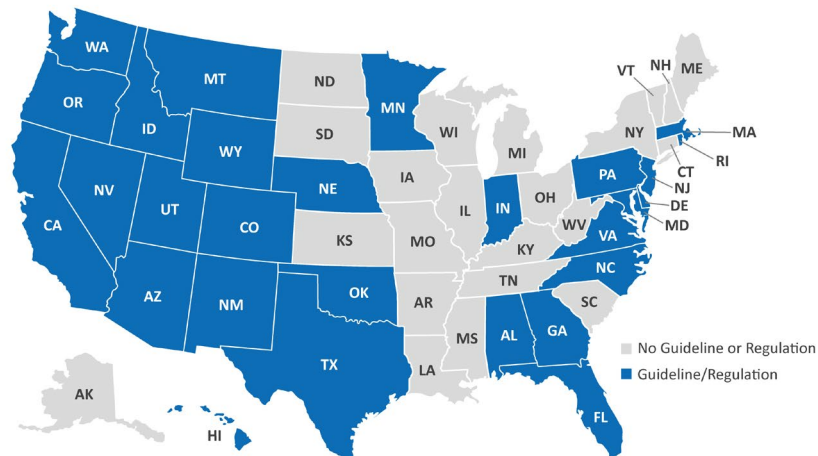
States with Potable Water Reuse Regulations or Guidelines



Date created: March 2023

Find more information at www.epa.gov/reuseexplorer

States with Water Reuse Regulations or Guidelines for Agriculture



Date created: March 2023

Find more information at www.epa.gov/reuseexplorer

WRAP Year 3 Activity Highlights: *Policy and Regulations*



2023 State Water Reuse Regulator Summit

WRAP Year 3 Activity Highlights: *Research Funding*



The screenshot shows the EPA website's news release page for the article 'EPA Awards \$6.4M for Research to Support National Water Reuse Efforts'. The page includes the EPA logo, navigation menu, and the full text of the news release, including contact information and a list of award recipients.

EPA Awards \$6.4M for Research to Support National Water Reuse Efforts

October 5, 2022

Contact Information
EPA Press Office (press@epa.gov)

WASHINGTON - Today, the U.S. Environmental Protection Agency announced research grants totaling \$6.4 million to Iowa State University and the Water Research Foundation for research to support national efforts to reduce technological and institutional barriers for expanded water reuse.

"Safe and reliable water is critical to protecting public health, and innovative solutions for reusing water can improve water availability and access across the nation," said **Chris Frey, Assistant Administrator for EPA's Office of Research and Development**. "These research projects will help advance water reuse applications so communities, local and state governments, and Tribes can provide alternatives to existing water resources."

Water reuse is the practice of reclaiming water from a variety of sources, treating it, and reusing it for beneficial purposes. It can provide alternative supplies for potable and non-potable uses to enhance water security, sustainability, and resilience. These research grants will help accelerate water innovation, information availability, and engagement. The funding will advance clean and safe water reuse goals, promote a better understanding of the nation's water and wastewater treatment and infrastructure, and enhance the availability and efficient use of water resources through water reuse.

The following institutions are receiving awards:

- *Iowa State University, Ames, Iowa*, to integrate technological, institutional and regulatory decision-making processes to accelerate water reuse adoption by addressing issues in water quality and availability in small, underserved communities.
- *The Water Research Foundation, Denver, Colo.*, to quantify water reuse potential across the nation while aiming to reduce biological and chemical health risk and provide stakeholders with user-friendly tools and materials to advance water reuse in communities both technologically and organizationally.

[Learn more information about the projects.](#)

Learn more about [EPA research grants.](#)

Water reuse-related grants since WRAP launch in 2020



THE
**Water
Research**
FOUNDATION

WRAP Year 3 Activity Highlights:

Engagement, Communications, and Education

Water Reuse Resource Hub by End-Use Application

[Water Reuse Home](#) | [WRAP Online Platform](#) | [REUSExplorer](#) | [Information Library](#) | [Latest Quarterly Update](#)

This page is organized by water reuse application, reflecting the recycling of an alternative source of water that is adequately treated for its intended use. Each end-use page compiles resources such as state policies, webinars, information about typical source waters, and publications. Collectively, these materials inform, document, and share stories of approaches taken by communities to initiate and implement water reuse.



Potable

Highly treated water that is reused for drinking water and meets or exceeds federal Safe Drinking Water Act standards.

[Learn about potable applications](#)



Onsite Non-Potable

Water that is collected, treated, and reused at single district or building scale for non-potable applications such as toilet flushing or dust control.

[Explore onsite non-potable uses](#)



Centralized Non-Potable

Water which is generated and treated in one location and then reused in another for non-potable applications, including snowmaking or street cleaning.

[Learn more about centralized non-potable uses](#)

<https://www.epa.gov/waterreuse/hub>

Key Resources

The following are a sampling of the key water sector resources that are freely available to support water practitioners interested in developing non-potable water reuse projects. Visit the [Water Reuse Information Library](#) for additional water reuse materials.

- [Using Recycled Water for Firefighting \(2021\)](#) - Recycled water can be used to supplement fire supply systems and is becoming more common in states like California that are experiencing prolonged drought. This report describes regulatory oversight of tertiary-treated recycled water use, precautions for drinking water supply protection, quality and safety of recycled water produced in LA County that can be used for firefighting, and best management practices for use of recycled water by fire departments in LA County. This report was created by Los Angeles County Sanitation Districts in collaboration with others for the Los Angeles Chapter of the WaterReuse Association.
- [Making Snow with Recycled Water in Montana \(2018\)](#) - This Sustainable Water article describes the benefits associated with making snow from reclaimed water for Arizona's Snowbowl ski resort, such as reducing river discharges and restoring water supplies.
- [Technical Information Street Sweeping Guide \(2011\)](#) - The San Diego County Water Authority created this guide to provide information about using recycled water for street sweeping to municipalities, cities, water purveyors, and agencies.



Call for resources!

Please help us identify key resources for this page. Email your suggestions to waterreuse@epa.gov.

State Water Reuse Regulations and Guidelines

The following states developed guidelines and/or regulations for other centralized non-potable reuse applications. Click the links from the [REUSExplorer](#) to review summary documents, which include the state regulations authorizing the use of recycled water for centralized non-potable reuse applications, water quality and treatment specifications, definitions, and more!

- [Arizona](#)
- [California](#)
- [Minnesota](#)
- [Montana](#)
- [Pennsylvania](#)
- [Texas](#)

Additional EPA Webpages

- [Water Reuse Research](#)
- [Onsite Non-Potable Water Reuse Research](#)

Engagement with Disadvantaged and Rural Communities on Water Reuse (Action 8.5)

To advance outreach and education about recycled water usage, for the purpose of adopting reuse as a strategy to enhance resilience to communities that are typically underserved and under resourced.

Effort Goals:

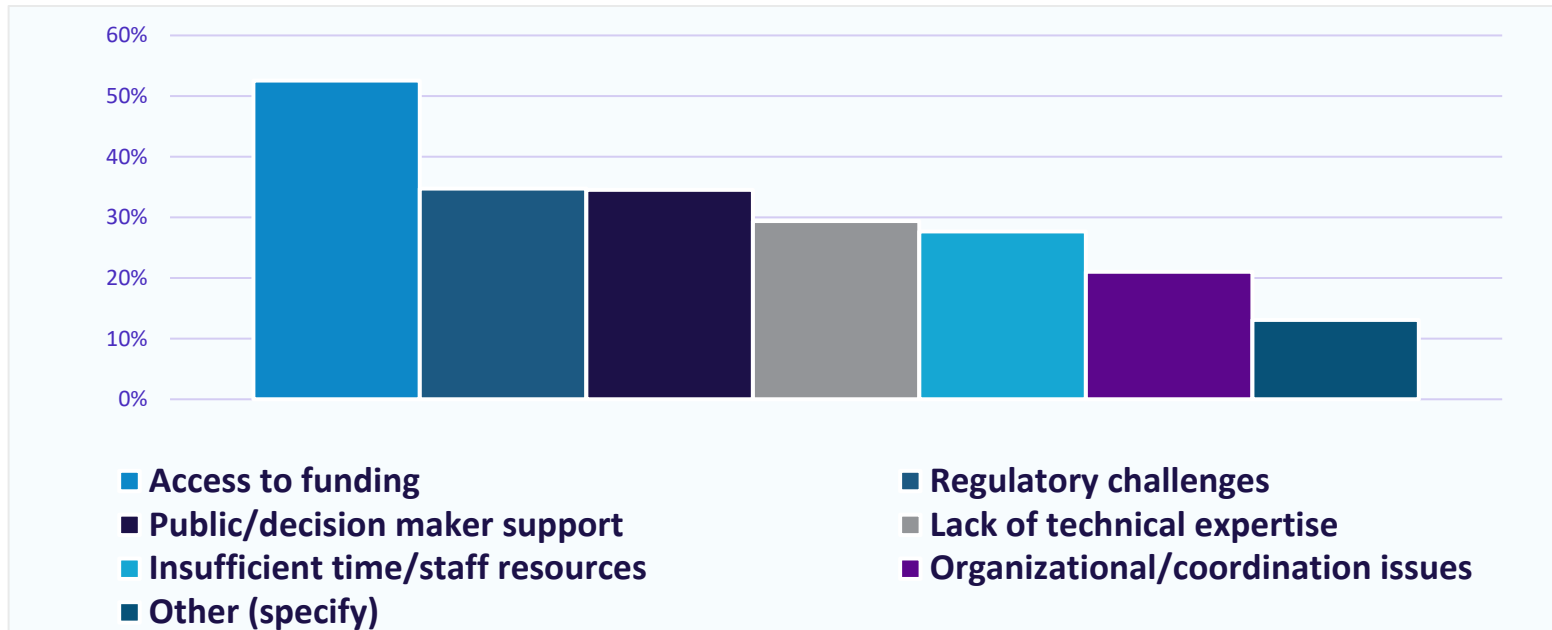
1. Engage underserved communities in rural areas to evaluate needs and opportunities to improve water security, sustainability, and resilience through water reuse.
2. Develop and deliver “fit-for-community” training addressing water recycling opportunities and implementation obstacles tailored to the unique challenges of disadvantaged and rural communities.
3. Based on the initial outreach and training, pilot technical assistance to support reuse project development in a few communities.



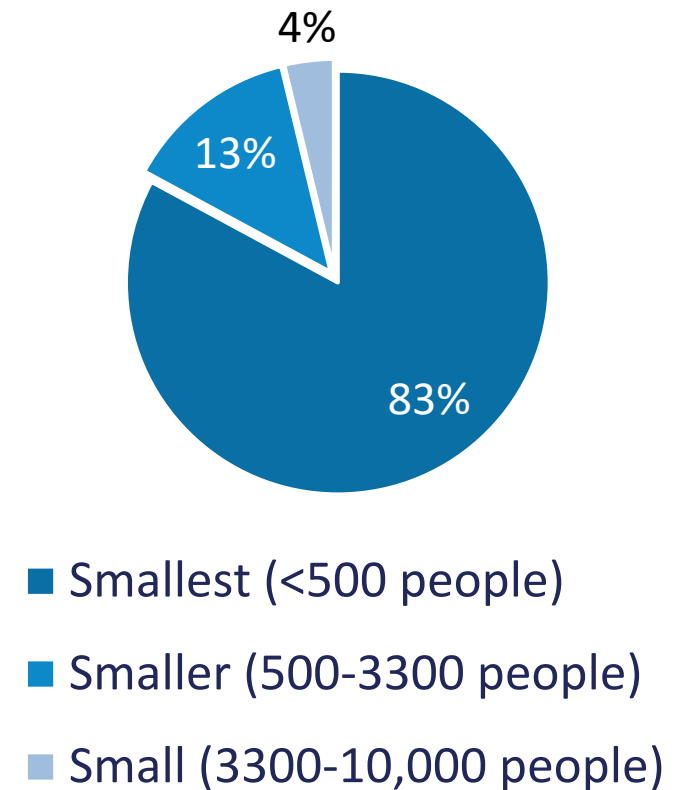
Small Water Systems and Support Needs

“Small water systems” serve 10,000 or fewer

- **Most** are 500 or fewer
- More than 97% of US nation’s 145,000 public water systems are “small”



Small Water Systems by Community Size



WRAP Year 3 Activity Highlights: *Hot Off The Press*

WATER RECYCLING FOR CLIMATE RESILIENCE THROUGH ENHANCED AQUIFER RECHARGE AND AQUIFER STORAGE AND RECOVERY



FEBRUARY 2023

Community Rainwater and Stormwater Capture and Use

Capture

Capturing and using rainwater and stormwater in a community reduces demand for potable water and decreases stormwater discharges that cause combined sewer overflows, stormwater pollution, and aquatic and riparian habitat degradation. The use of infiltration basins, injection wells, large cisterns, and other elements can be used to capture rainwater and stormwater to replenish groundwater or for later use.

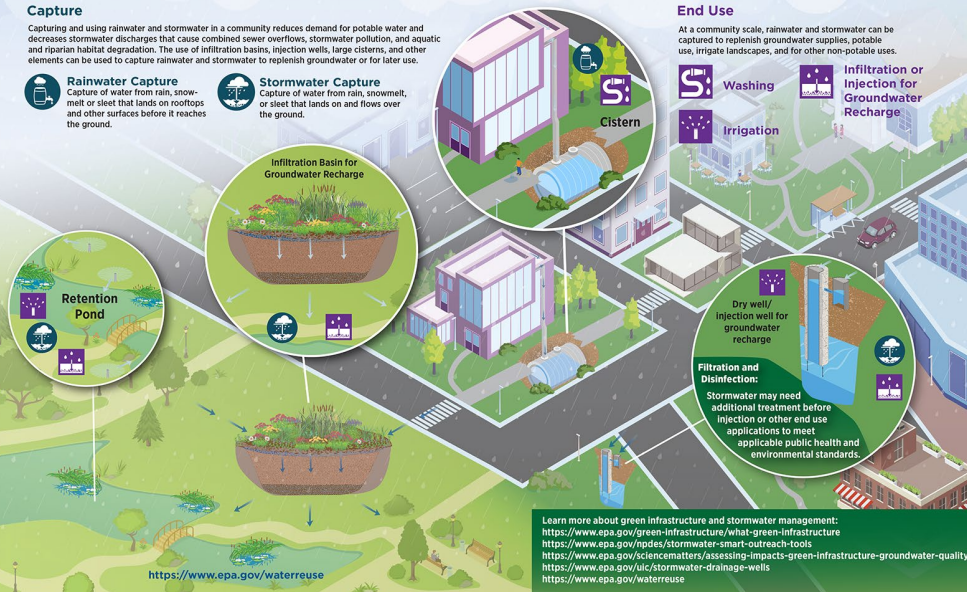
Rainwater Capture
Capture of water from rain, snowmelt or sleet that lands on rooftops and other surfaces before it reaches the ground.

Stormwater Capture
Capture of water from rain, snowmelt, or sleet that lands on and flows over the ground.

End Use

At a community scale, rainwater and stormwater can be captured to replenish groundwater supplies, potable use, irrigate landscapes, and for other non-potable uses.

Washing
Irrigation
Infiltration or Injection for Groundwater Recharge



From Water Stressed to Water Secure: U.S. Lessons from Israel's Water Reuse Approach



2022 DELEGATION SUMMARY
March 2023



The WRAP Collaborative

- 135 organizations and growing
- Federal, state, tribal, local, and water sector partners
- Helping to build capacity for water reuse
- Join us!



Sign up for EPA's water reuse email updates to learn about the latest activities and find opportunities to get engaged.

RN
ICC
NPS
SAWS
Volcan!
EDF | MoEI
Commerce
NGWA | NMSU
WSWC | NACWA
Parker Groundwater
WaTr | AMWA | HUD
Reclamation | MoEP | FDA
Wright Water Engineers | TTU
GHD | NDRP | GCE | CA SWRCB
NMED | AHA and ASHE | ECOS
IWA | USAID | ASTHO | **CESPM** | Purdue
GWPC | MWD | **BIER** | DOT | **CILA** | USGS | IWMI
U.S. Water Alliance | SBIR Programs | RTOCs
FEMA | **Water Innovation Services** | WW | SCCWRP
One Water Econ | Valley Water | JCI | USWP | NSU
NTWC | Groundwork USA | DOD | WTA | AWWA | **SRE**
Rice University | NYC DEP | NREL | EPA | USACE | SWAN | DOI
Conagua | WRF | **SEPROA** | NTC | NSF | Penn State | **CWCB**
USGBC | **Northwest Biosolids** | EPRI | University of California
NAWI | **Trussel Technologies** | USDA | Austin Water Utilities | CDC
WEF | NeoTech Aqua | CIFA | **Cambrian Innovation** | CSO | Tyson
GSA | Pacific Institute | GreenBiz Group | CDPHE | DOS | **CESPT**
Stantec | UWFP | ASHRAE | **IBWC** | The World Bank | ACWA
Veolia | Jacobs | Columbia Water Center | **NADB** | LADWP
NRWA | RCAP | ORNL | JFW | Wahaso | DOE | NM-PWRC
LACSD | IAPMO | Design Aire | **PepsiCo, Inc** | CDM Smith
Embassy of Israel | **APHC** | GCCI | NMSA | ASDWA | ISPE
NBRC for ONWS | WaterReuse | NWRI | ReNUWit
UPenn Water Center | Xylem
University of Arizona

WaterSense Program

- WaterSense seeks to preserve water supplies by offering people simple ways to use less water with water-efficient products & services.
- WaterSense partners with manufacturers, retailers, local/state government, utilities, builders, non-profits, and trade associations to extend the reach of the program
- *Since 2006, WaterSense and its partners have helped consumers save more than **6.4 trillion gallons** of water, **\$135 billion** in water and energy bills, and avoided **288 million metric tons** of GHGs*



epa.gov/watersense

WaterSense Resources

- Specifications for WaterSense labeled products for residential indoor, outdoor, and commercial uses – include criteria for efficiency AND performance and are third-party certified
- Specifications for WaterSense labeled homes
- Best management practices for commercial and institutional water efficiency and outdoor water use
- Consumer campaigns and resources to help engage the public (e.g., Fix a Leak Week)



Water efficiency and reuse opportunities for enhancing sustainability and resilience in Africa

Prof. Akiça Bahri

Harnessing the Power of Water Efficiency and Reuse

Pacific Institute - UN 2023 Water Conference

20 March 2023



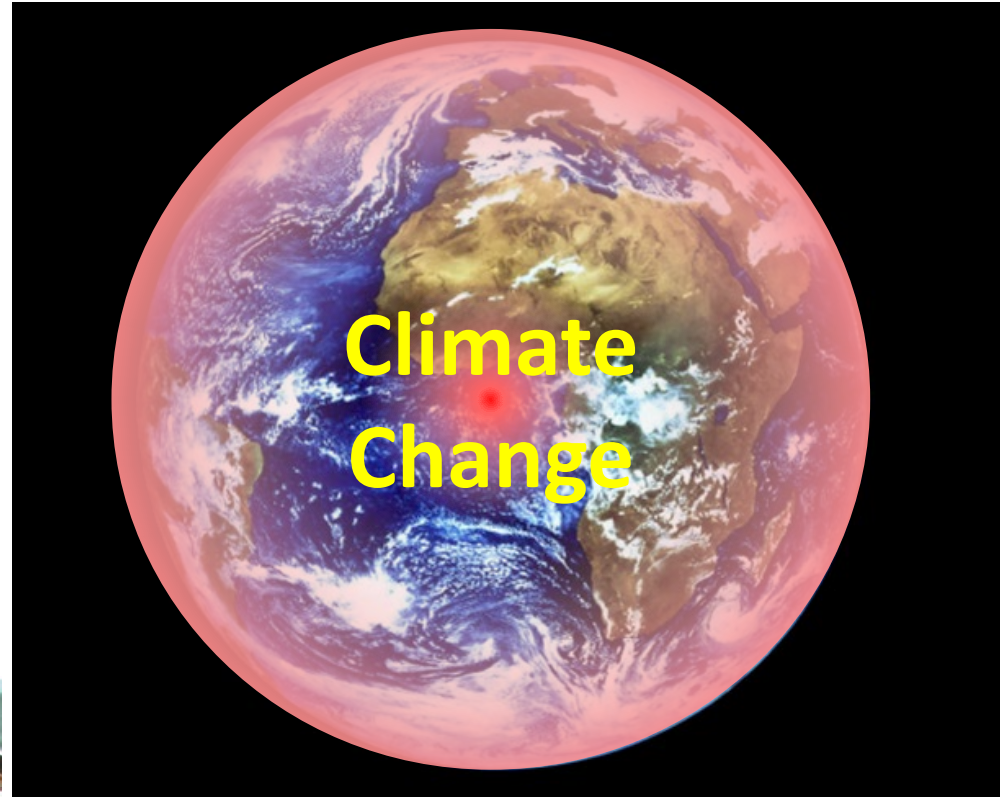
Water



Food



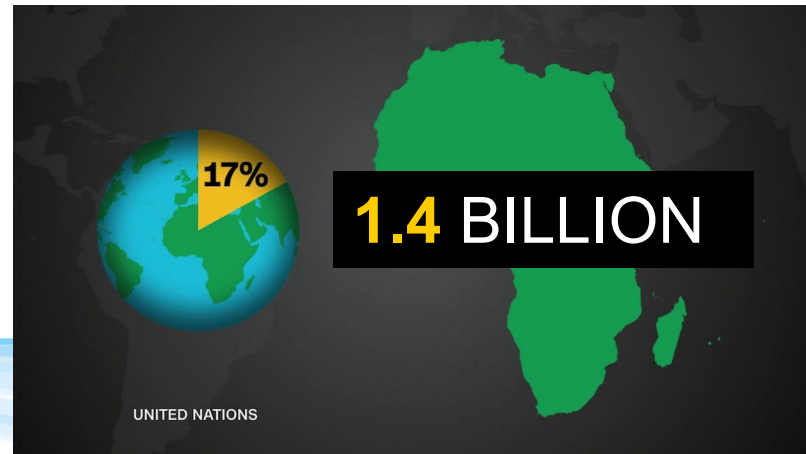
Grand water challenges



Sanitation



Energy



African cities are growing fast and, with them, water, energy and food needs



“Growing Blue”

Ensuring improved management of water resources

- 💧 Build resilience to increase water security**
- 💧 Maximize water use efficiency
– Do more with less**
- 💧 Minimize water pollution and waste**

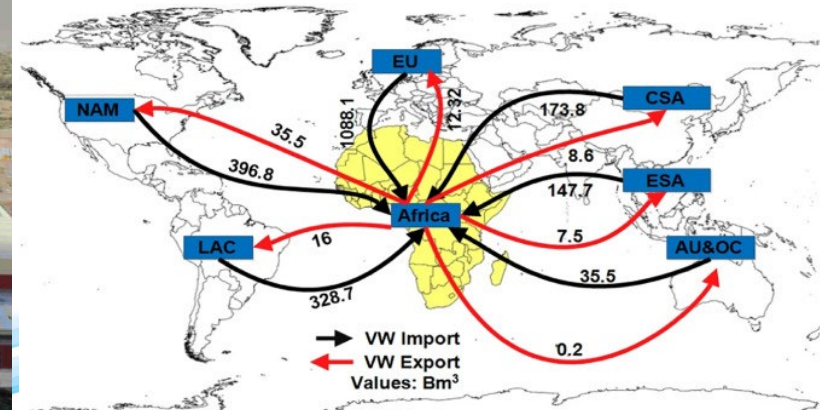
“Growing Green”

Ensuring high quality growth

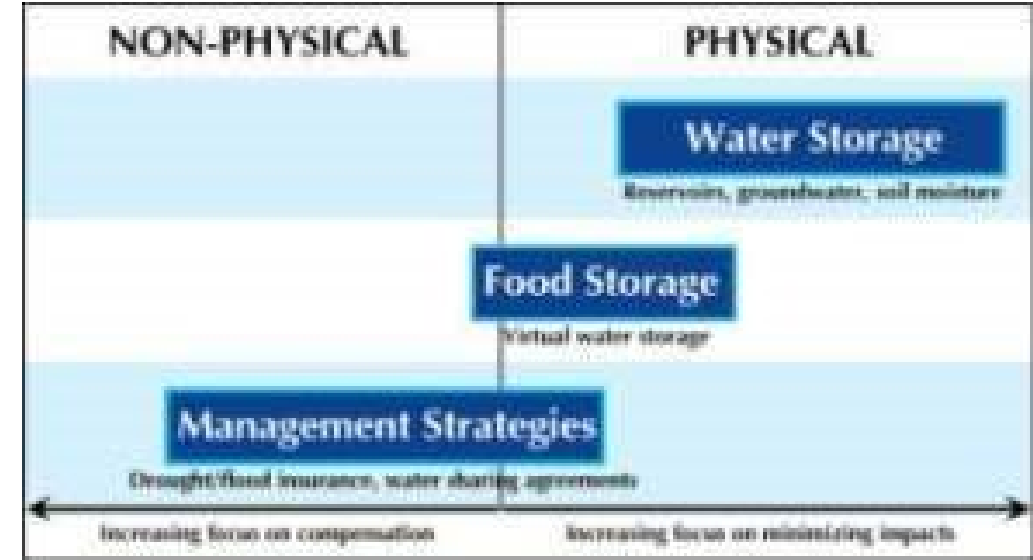
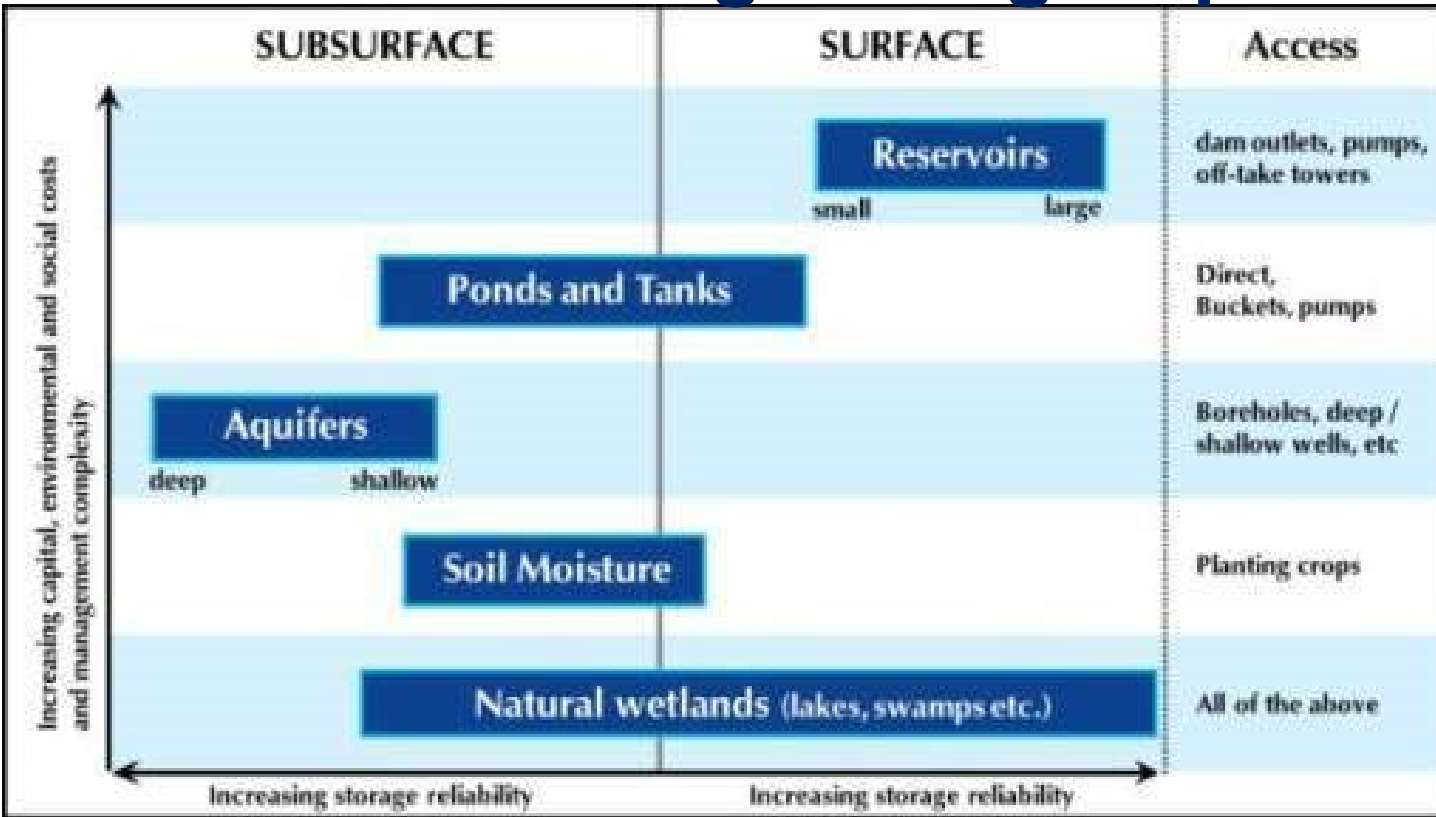
- 🌱 Maximize natural resource use efficiency**
- 🌱 Minimize pollution and waste**
- 🌱 Strengthen resilience to increase water security**



IMPROVING WATER SECURITY



Re-Thinking Storage Options: Storage Continuum



Improving water efficiency and productivity - 'more added value per drop'

Continuum of Water Control & Development, Lifting, Conveyance & Application



Desalination and solar powered field irrigation

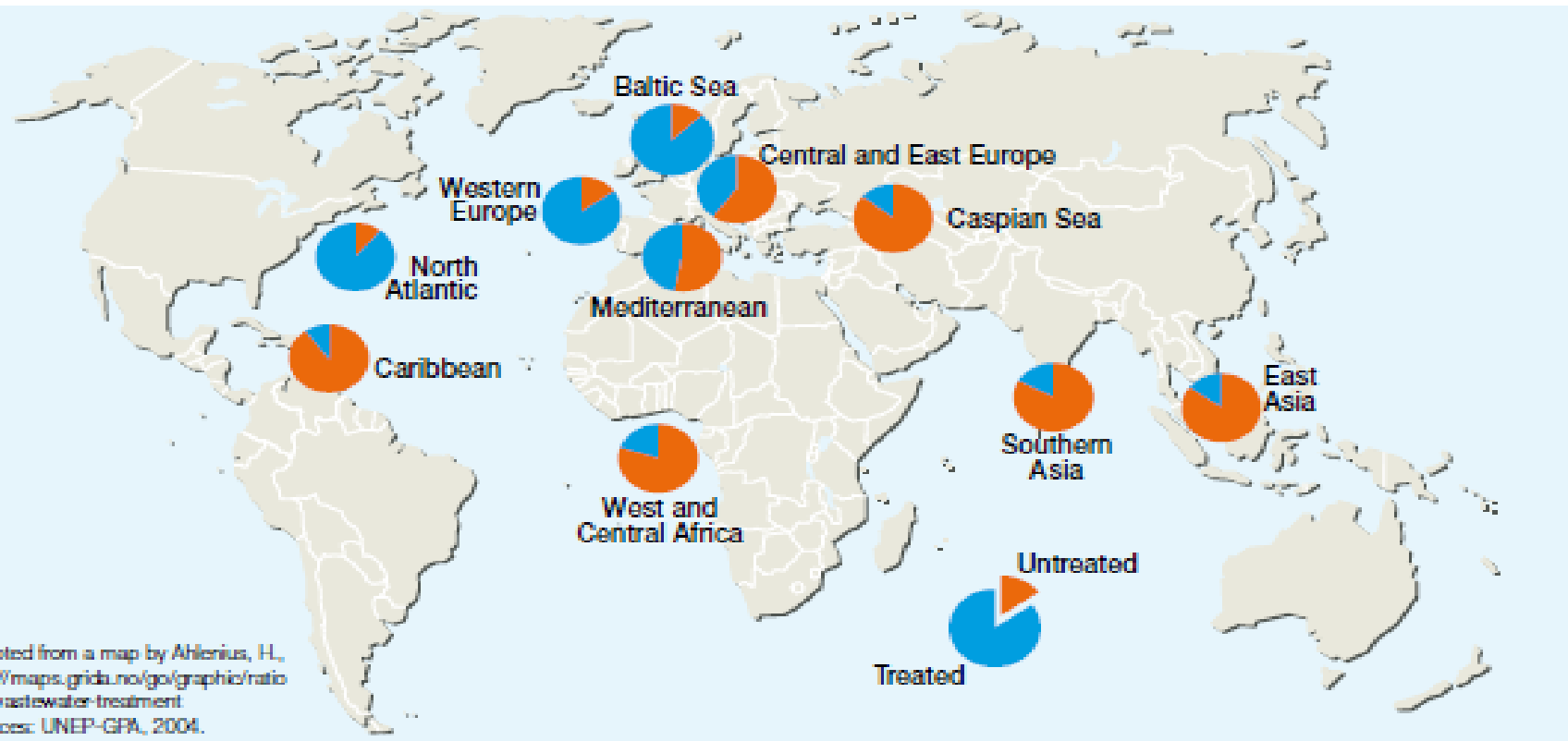


Managing Water at the Urban-Rural Interface

Making cities
more resilient to
climate change
through IUWM



Ratio of wastewater treatment (treated to untreated wastewater)



- **330 km³/year** of domestic WW generated in the world (Flörke et al., 2013)
- Over **80% of wastewater worldwide** not collected or treated (WWAP, 2012)
- Current **capacity to treat WW** to advanced levels is **only 7% of the total volume** of generated WW (GWI, 2009)

Planning for City-Wide Inclusive Sanitation (CWIS) an unusual business

Equity in service – Inclusive planning – Contextual solutions – Environmental and social justice

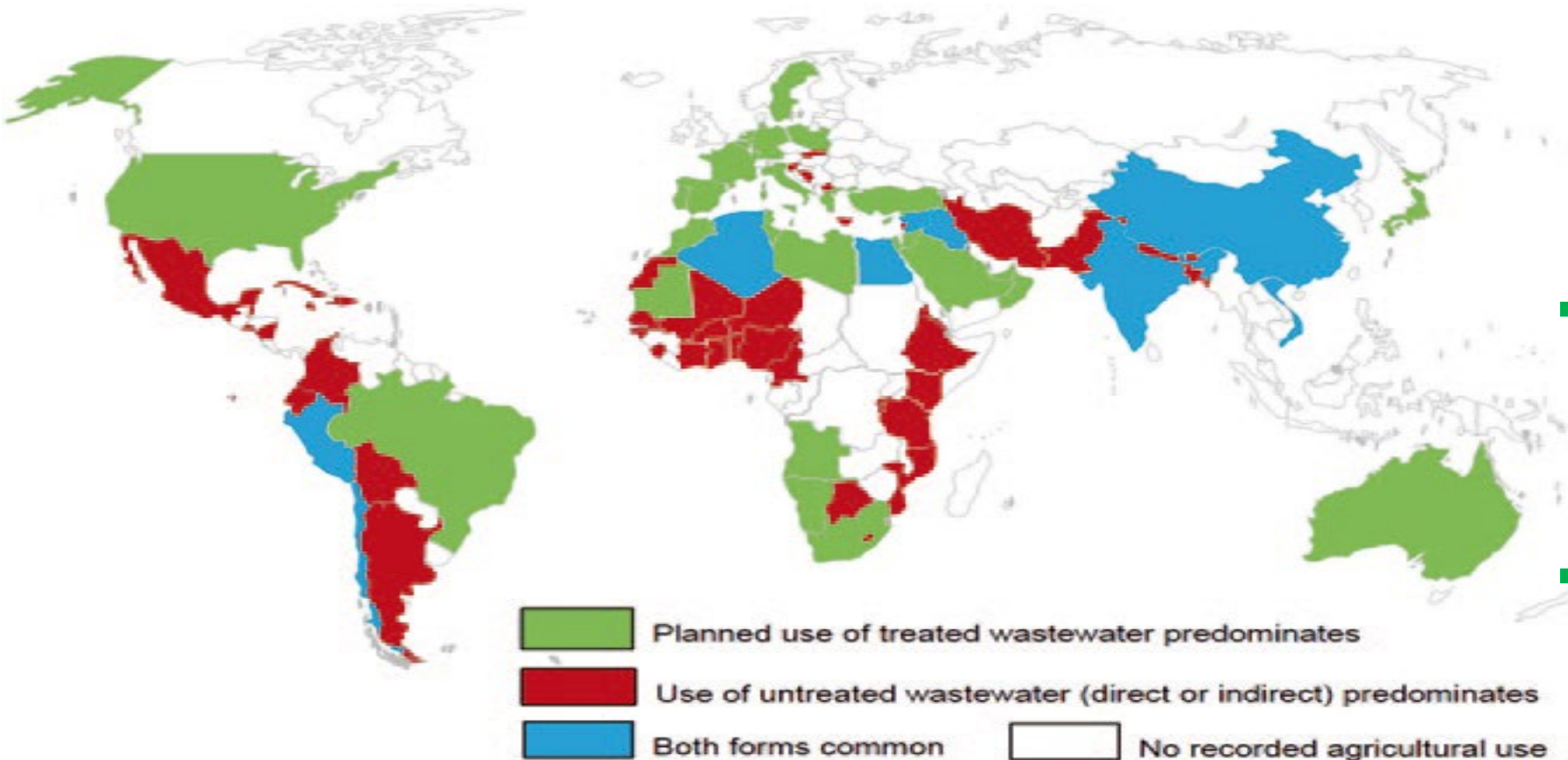


Untapped potential for resource recovery and reuse from wastewater (Wichelns et al., 2015)

330 km³ of municipal wastewater could theoretically:

- Irrigate more **than 40 million hectares** (8000 m³/ha/yr) (FAO 2012)
- Provide 'free' fertilizer application in the order of **322 kg N/ha/yr and 64 kg P/ha/yr**
- Provide **electricity for about 130 million households** (3500 kWh/HH) (World Energy Council 2013)

Countries with recorded water reuse for irrigation



- ≈ 50 million m^3/d (18 km^3/yr) of WW are reused (5-7% of the amount) - 58% is used untreated for irrigation (Jiménez and Asano, 2008)
- ≈ 20 million ha (6% of the global irrigated area) in 50 countries irrigated with mostly raw wastewater
- Crops produced from irrigation with raw wastewater $\approx 10\%$ of global agricultural production from irrigation (Scheierling et al., 2010; Drechsel et al., 2010)

Benefits of water reuse and wastewater use

Water reuse

Wastewater use

Social benefits

- Protect human health and ecosystems
- Increased prosperity and resilient communities

- Reduce rural-urban poverty
- Improve nutrition and food security
- Support many livelihoods
- Increase farmers' income
- Build climate resilient communities

Economic benefits

- Drought-proof alternative resource
- Reliable water supply
- Cost savings: new supply, disposal
- Reduce conflicts over water due to scarcity
- Recover water, energy, nutrients, sludge, C
- Increase of crop production
- Increase in land and property value
- Preserve economic and leisure activities

- Maintain agricultural activity
- Increase crop yields
- Supply > 90% of the perishable vegetables needed in the cities
- Contribute to reduction of food import

Environmental benefits

- Environmental protection
- Local ecological benefits
- Reduce energy costs and GHGs
- Improve water quality and flows and contribute to GWR

- Recycle water, OM and nutrients to soils

A Business Approach for Improved Sanitation in Ghana

Organic Fertilizers and Energy as Drivers (Ashaiman – Ghana)



Organic waste delivery from the markets



Generator container and grid switchboard



Mixing pit (fecal and organic waste) + macerator + digester



Meter and grid connection

Partners: Safi Sana Ghana Ltd, ASHMA

Project funding by AWF, Dutch Gov't and Safi Sana

Treatment FS & SW: 12,600 T/yr

Outputs (at full operation)

- ✓ Bio-fertilizer: **640 tons/yr**
- ✓ Electricity: **585,000 kWh/yr**
- ✓ 125,000 beneficiaries

TARGET => 7 Factories in 2023

Desert Joy and Hicha Joy Projects



The Durban Water Recycling Project: Creating shared values between Municipalities and Industry



PRIVATE SECTOR

- First BOT to treat ≈10% of the city's WW to potable standards, and sell it to industrial customers

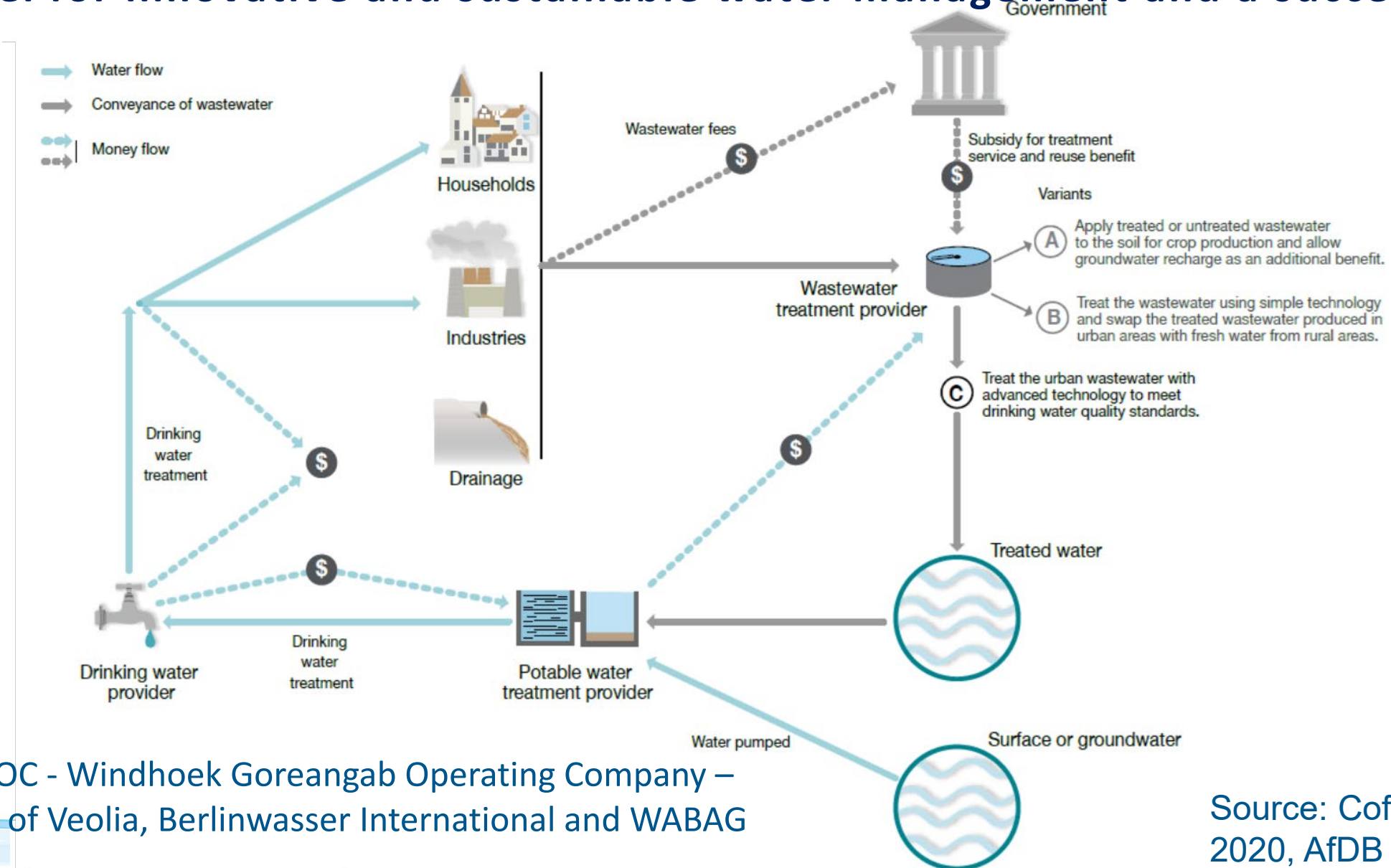
23% of the city's RW reused by local industries

BENEFITS

- Reduced demand for potable water by 7%
- 10% less effluent discharged into the environment
- Additional 300,000 people served with potable water
- Industrial users pay RW 50% less than conventional water

WINDHOEK, NAMIBIA - THE WORLD'S FIRST DIRECT POTABLE REUSE PLANT

A model for innovative and sustainable water management and a successful PPP

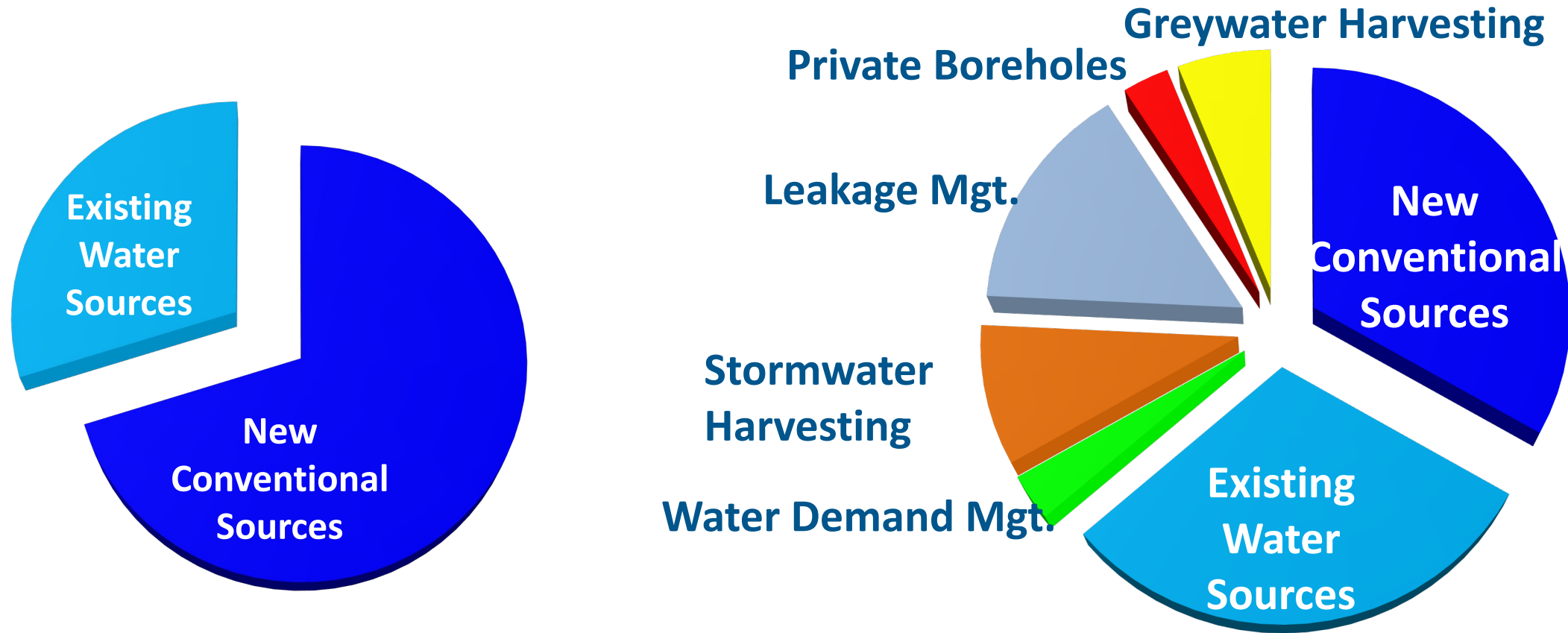


PPP: WINGOC - Windhoek Goreangab Operating Company – consortium of Veolia, Berlinwasser International and WABAG

Source: Cofie and Nikiema, 2020, AfDB et al., 2020

Investing in the Cities of the future

Need a systems perspective of the urban water cycle - Nairobi Portfolio of viable options



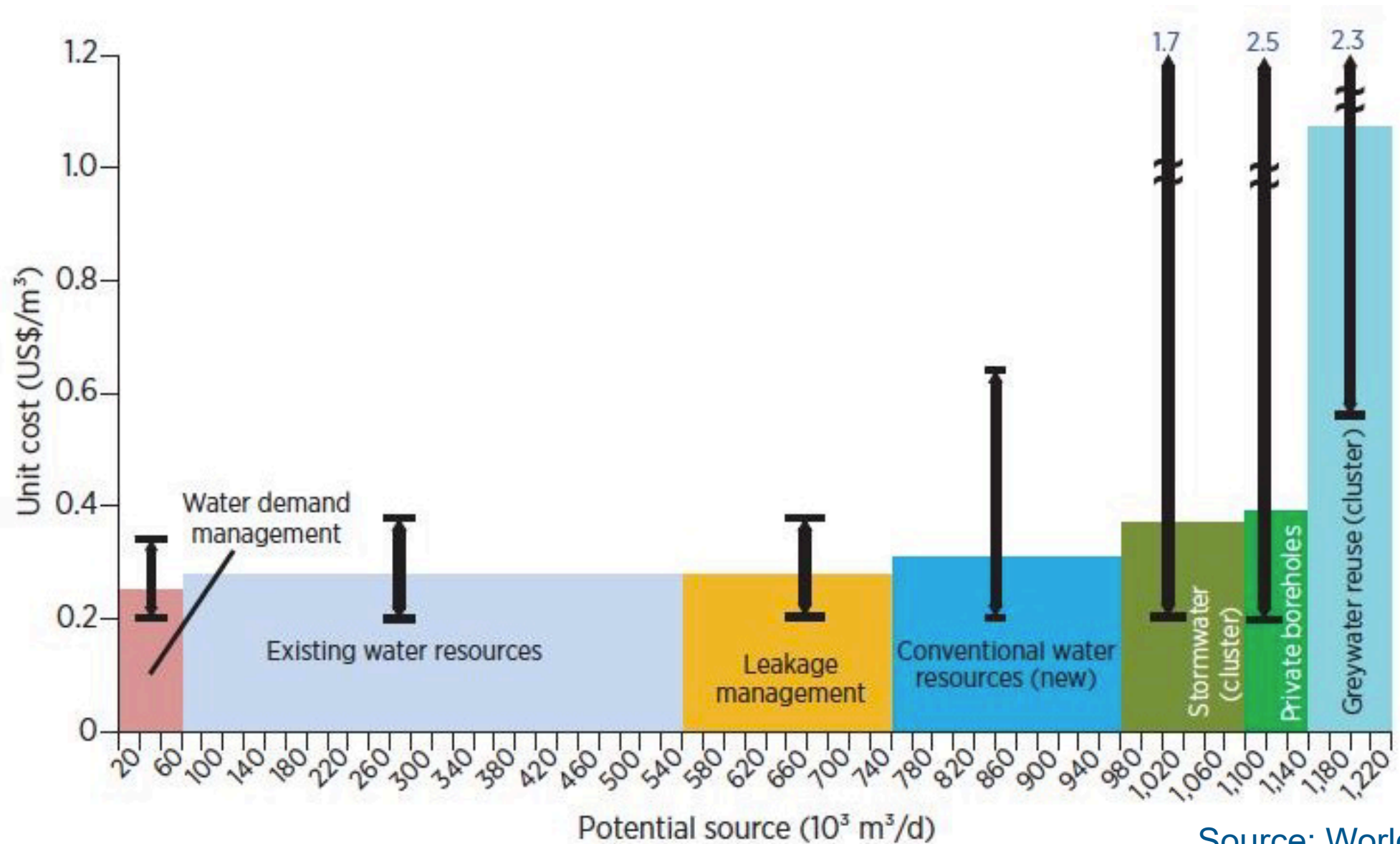
Conventional Approach

Unit costs US\$ 0.36/m³

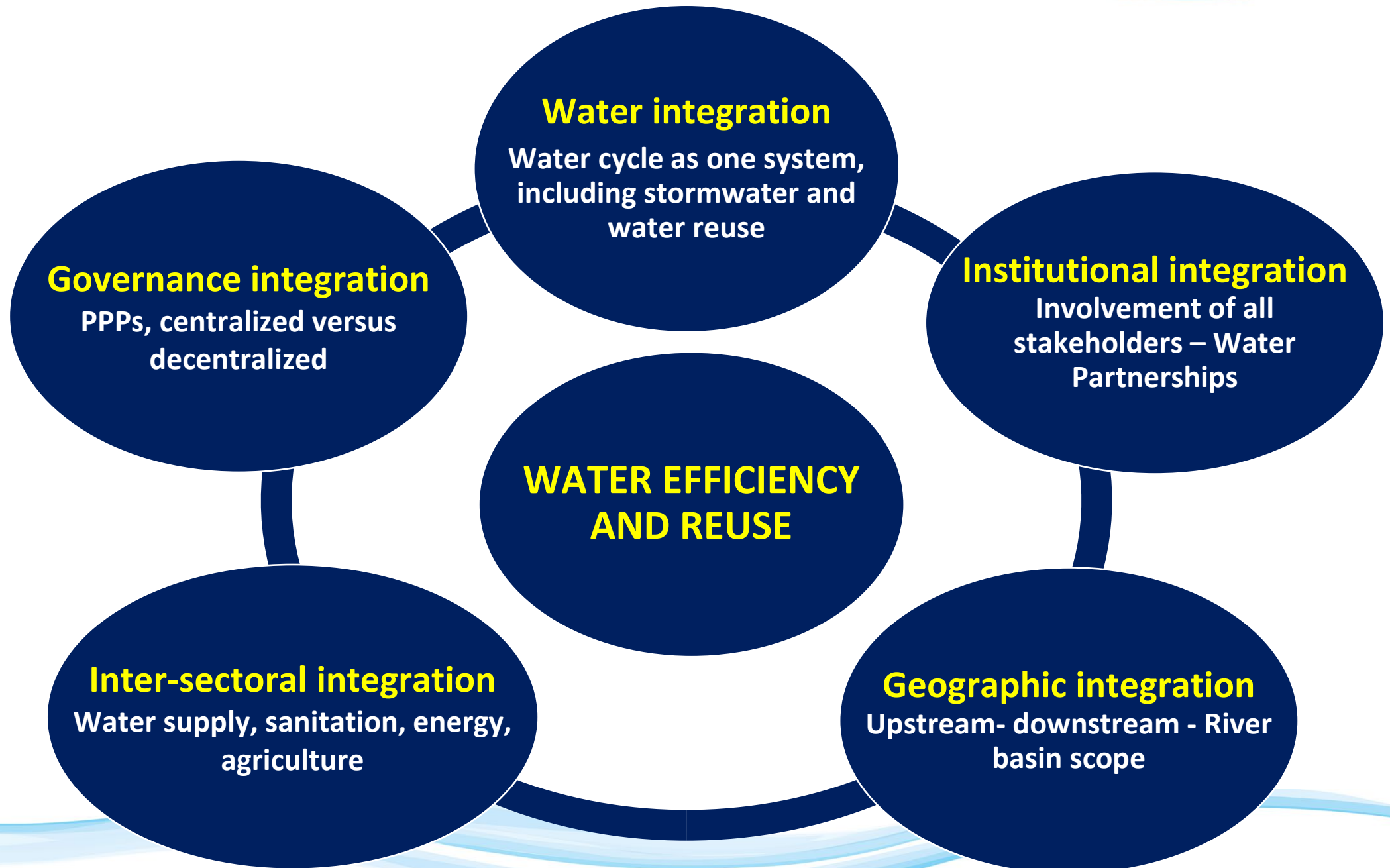
IUWM Approach

Unit costs US\$ 0.29/m³

Economic analysis of IUWM and conventional options for water supply in Nairobi, Kenya



Towards Water Security





Thank you for your attention



Q & A Session



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Director of Research
Pacific Institute



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National Program Leader for
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Professor, Researcher, and
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