Water 4.0
The Past, Present, and Future of The World’s Most Vital Resource
David Sedlak
The Great Acceleration
Water for the Wealthy
Water for the Many
Water for the Poor
Water for Health
Water for Food
Water for Ecosystems
A Water Reuse Revolution

Full Advanced Treatment (FAT)
- Reverse Osmosis
- UV/H₂O₂
- Drinking Water Supply

Treated Wastewater

Managed Aquifer Recharge

When
6:00 to 7:15 pm MST, October 12, 2022

Where
Zoom

Speaker(s)
William M. Alley
Director, Science and Technology, National Ground Water Association

Brown Bag Webinar: The Water Recycling Revolution: History and Lessons from Four Western States

Physical/Chemical Treatment
- Advanced BNR
- Lime clarification
- Multimedia filtration
- GAC/BAC
- Ion exchange & breakpoint chlorination
- Chlorination
- Reservoir
- Ozone
- GAC

KWR
Scenario 1: The Ideal Net Zero Water Building

Net Zero Water

DOE 2021
Halfway to Net Zero in New York

Battery Park City
Projects in Our Backyard

- Uber Mission Bay at 1455 and 1515 Third Street – San Francisco, CA
- Chase Center – San Francisco, CA
- San Francisco Public Utilities Commission Headquarters — 525 Golden Gate Avenue
- Fifteen-Fifty at 1550 Mission Street – San Francisco, CA
- Mission Rock at Third and Mission Rock Street – San Francisco, CA
- Salesforce Tower – San Francisco, CA

SFPUC (2022)
Costs: Techno-Economic Analysis

Percentage of CAPEX and OPEX with respect to the total building cost*

* According to EME DOS and CONSTRUC and adapted to EU-27 construction cost indexes of new residential building (European Commission 2021).

$1.5-2.7/m³

Garrido-Baserba et al. (2022)
Beyond Big Projects in Wealthy Cities

Single Family Dwellings

Rural Communities

Emerging Megacities

Rabaey et al. (2020)

How Africa can leapfrog the world’s stagnant water paradigm

Africa has an unprecedented opportunity to embrace widespread water innovation. IWA is poised to help catalyse this, and to share the lessons globally in a two-way exchange with its African partners, writes Kala Vairavamoorthy.
Water for Food
The First Green Revolution

The First Green Revolution


![Graph showing trends in corn yield from 1860 to 2000](image)

![Graph showing irrigated acres and applied water use in the Western States from 1984 to 2013](image)
Advanced Water Technology for Agriculture

Brackish Water Desalination

Modular Small-Scale Treatment
Eastern Municipal Water District (EMWD)

Brackish Water Desalters

Source: 12 groundwater wells  
Capacity: 8.7 MGD  
TDS$_{\text{initial}}$: 2,300 mg/L  
Cost: $37 million  
LCOW*: ~$1000 /acre-ft

*LCOW=Levelized Cost of Water; the overall cost of equipment, operations and financing.

Brine Management

Installed: 1990s  
Cost: $28 million  
Pipelines: $10 million
Zero Liquid Discharge (ZLD) or near ZLD

Tong and Elimelech (2016)
Alternatives to Brine Lines

Xu et al. (2022)

ZLD = Zero-Liquid Discharge
A: Evaporation pond/landfill
B: Concentrator/pond/landfill
C: Concentrator/crystallizer/landfill
Technology Diffusion: Solar PV

PV module experience curve
Historically, module prices have decreased as a function of cumulative global shipments (blue dots reflect historical data, red dots reflect extrapolated prices for 1 TW and 8 TW based on the historical trend line). See supplementary materials for data sources.
Technology Diffusion: Desalination

Caldera and Breyer (2017)

The World Bank (2019)
Reuse/Desalination Pairing in Agriculture
CATCHMENT RESTORATION INCREASES WATER SUPPLY AT THE LOWEST UNIT COST

- Removal of IAPs in 7 Priority Sub-Catchments
- Desalination
- Groundwater Exploration
- Water Reuse
- Voelvlei Storage Scheme
- Cease Forestry Steenbras

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<th>Unit Cost (URV in Rand/m³)</th>
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Berkeley UNIVERSITY OF CALIFORNIA

Greater Capetown Water Fund (2019)
Thayer (2013) reports on the Mississippi River watershed in the context of the hypoxic zone in the Gulf of Mexico. The map shows the hypoxic zone and the Mississippi River watershed, with the corn belt highlighted in the central region of the United States. The hypoxic zone is indicated in gray, covering a significant portion of the Gulf of Mexico, particularly along the Mississippi River and its tributaries.
The Right Things to Do
Achieving the Human Right to Water in California, OEHHA 2021
Takeaways

The six global water crises are likely to be more prominent in coming decades.

No single solution will solve the world’s water crises.

Experience gained in local water crises can be adapted to new locations.

The costs of technological solutions is likely to decrease.

Shared stewardship of water is the only viable path to Water for All.