Water Reuse – Overview, Technologies and Constraints

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Great Challenges Facing Humanity

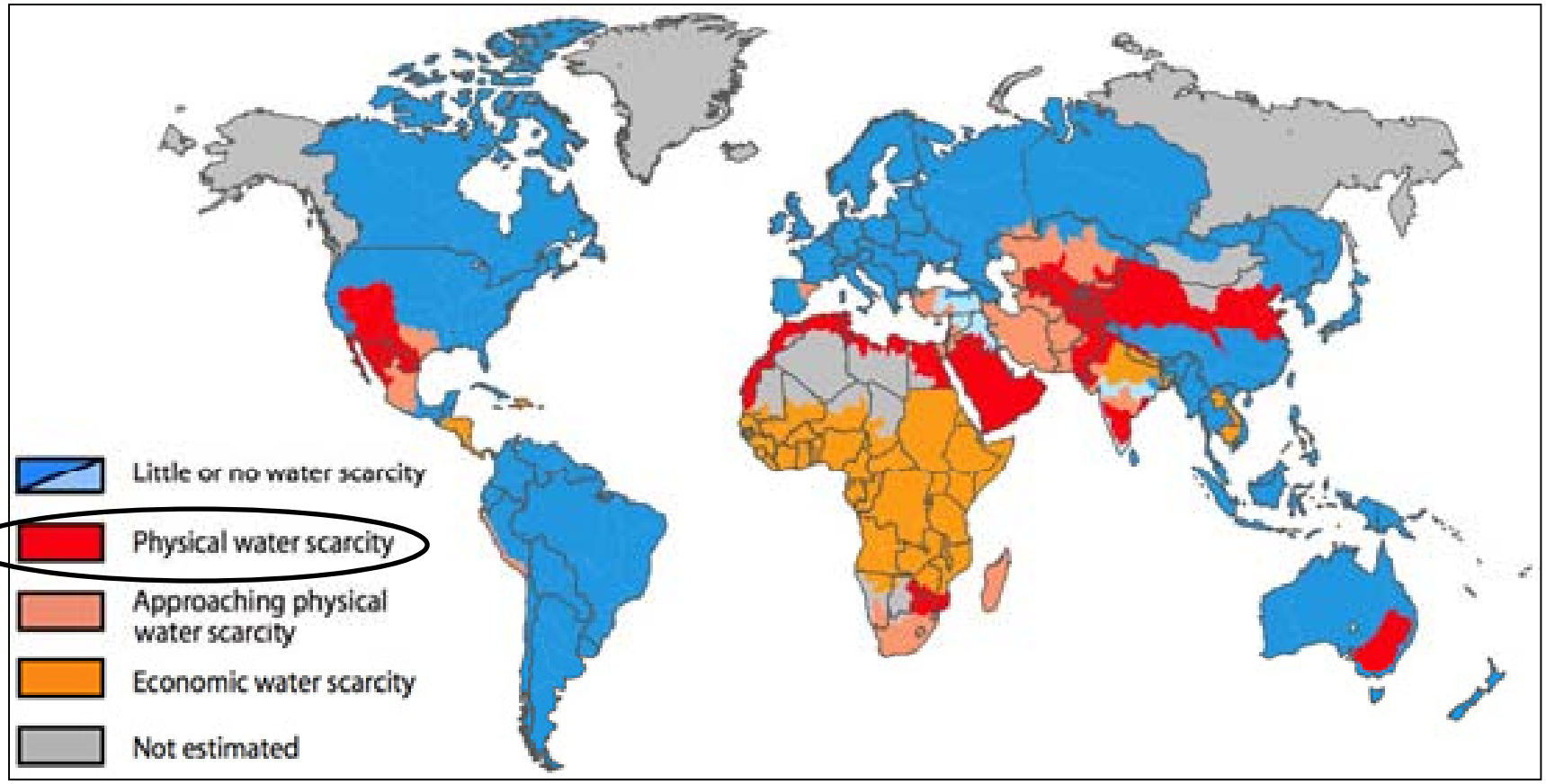
Agriculture

Energy

Health: emerging contaminants

Water

Water Scarcity – A Key Driver for Reuse

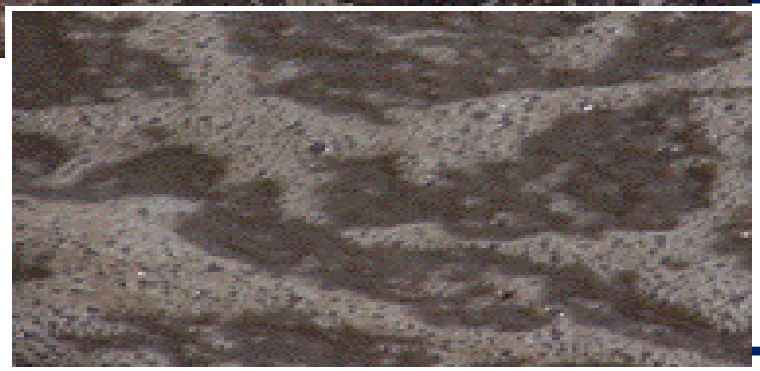


- **The MENA/GCC States are one of the driest and water scarce regions in the World**

Outline

- Emerging biotechnologies for sustainable wastewater treatment and reuse
- Natural treatment systems for wastewater reclamation and reuse
- Constraints limiting water reuse
- Final remarks

Environmental Biotechnologies for Sustainable Wastewater Treatment/Reuse



Water reuse
agriculture,
industrial,
recreational,
aquifer recharge

Energy

0.3 kWh/m³
for aeration

Nutrients (N, P)

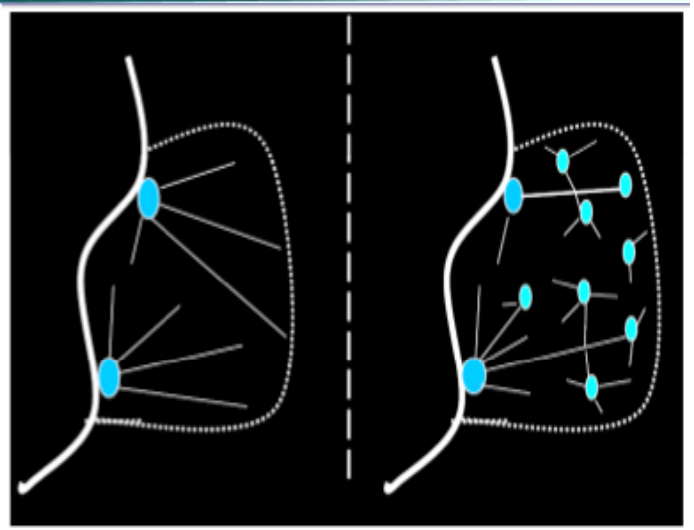
WDRC Mission: Development of innovative and sustainable wastewater treatment technologies for water reuse

Environmental Biotechnologies for Sustainable Wastewater Treatment/Reuse

- **Hybrid MBRs for tailored water quality and decentralized reuse**
  - **Aerobic granular sludge-MBR (AGS-MBR)**
  - **Sequencing batch reactor-MBR**

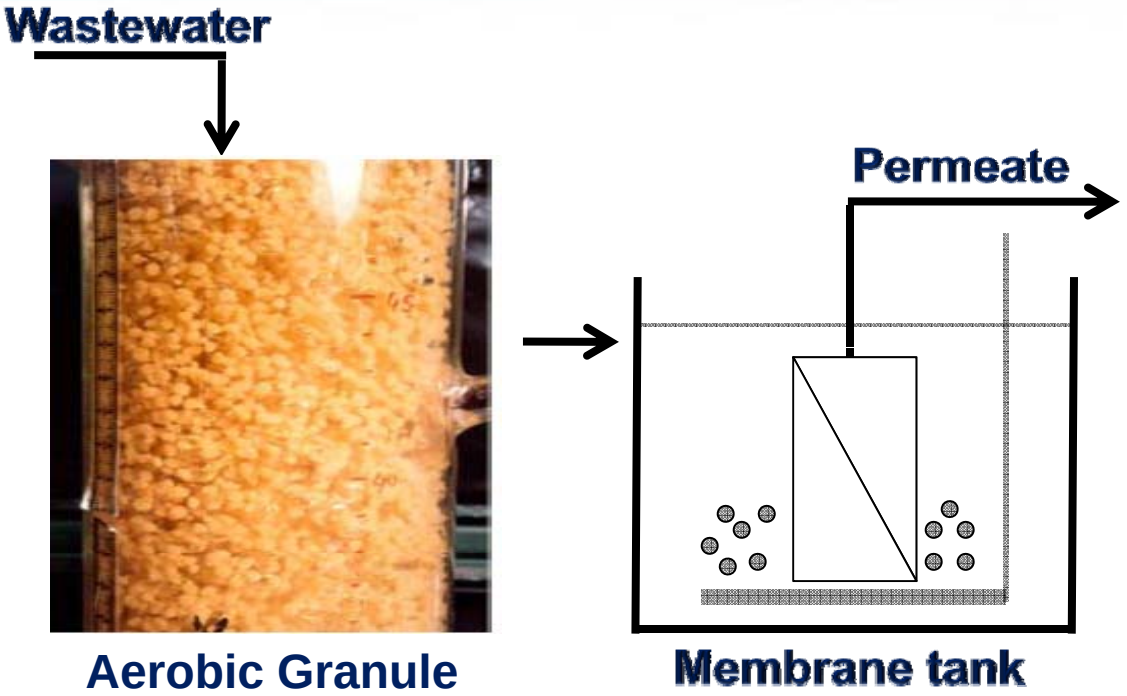
- **Bioelectrochemical systems for sustainable wastewater treatment, energy generation and desalination**

Moving from Centralized to Decentralized System

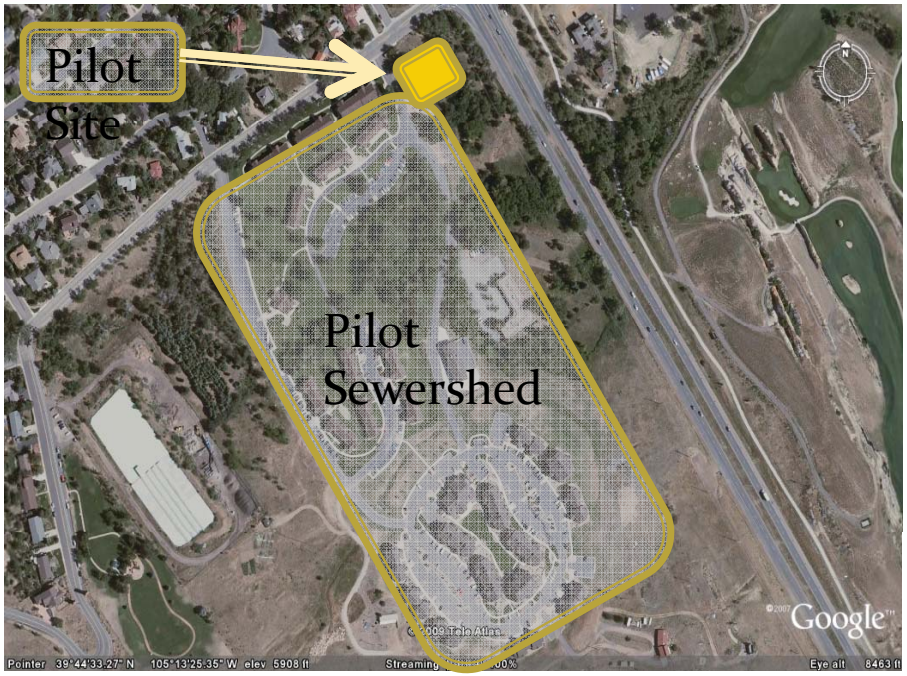


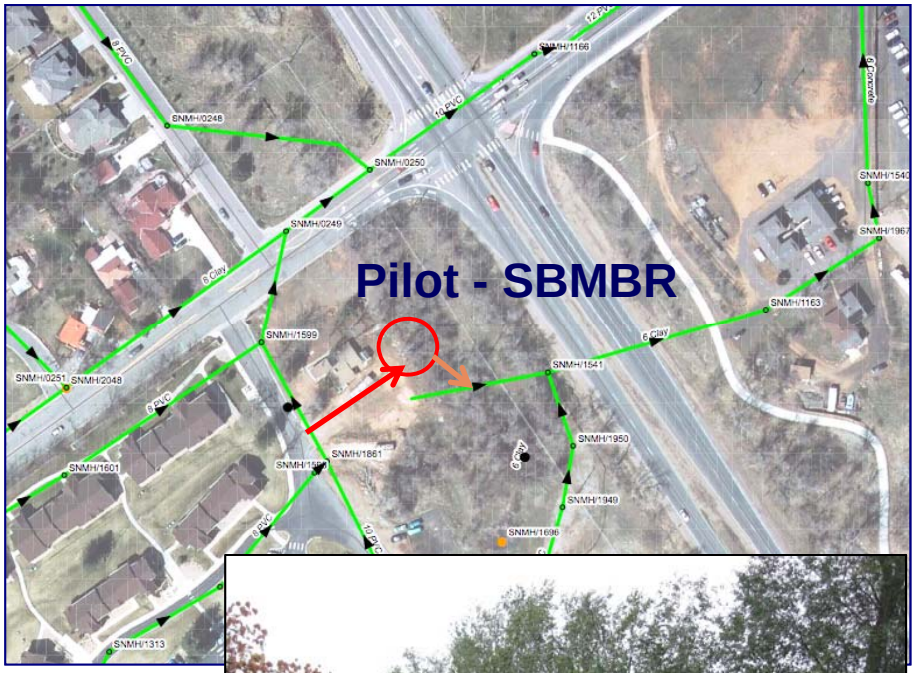
- Costs of supporting Infrastructure and transporting wastewater long distance - is reduced
- Energy needed to pump and transport reuse water back to community - is lowered
- Hydraulic load to centralized WWTP – is reduced
- Tailored water quality for local water reuse
  - ✓ Landscape, golf course irrigation, Groundwater recharge, etc.
- Automated system, to handle variation in wastewater loading and flow
- Decentralized approach to wastewater management and water re-use can help address both energy consumption and water scarcity

Hybrid AGS-MBR for Tailored Water Quality/Distributed Reuse



Case Study (SBMBR): Golden, CO, USA





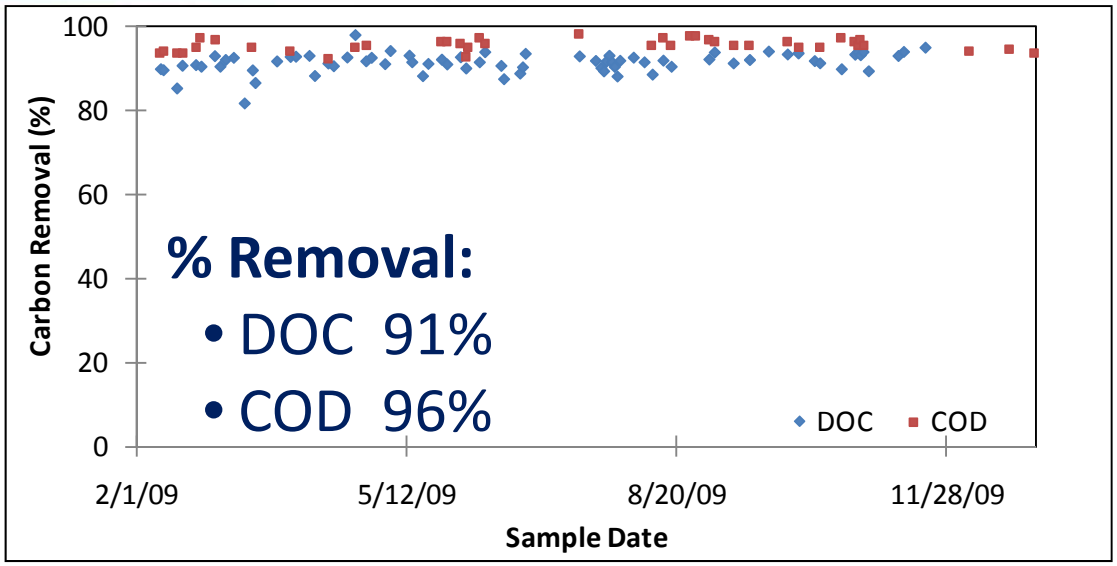
Source: 400 residents in a housing complex at CSM, Golden, CO

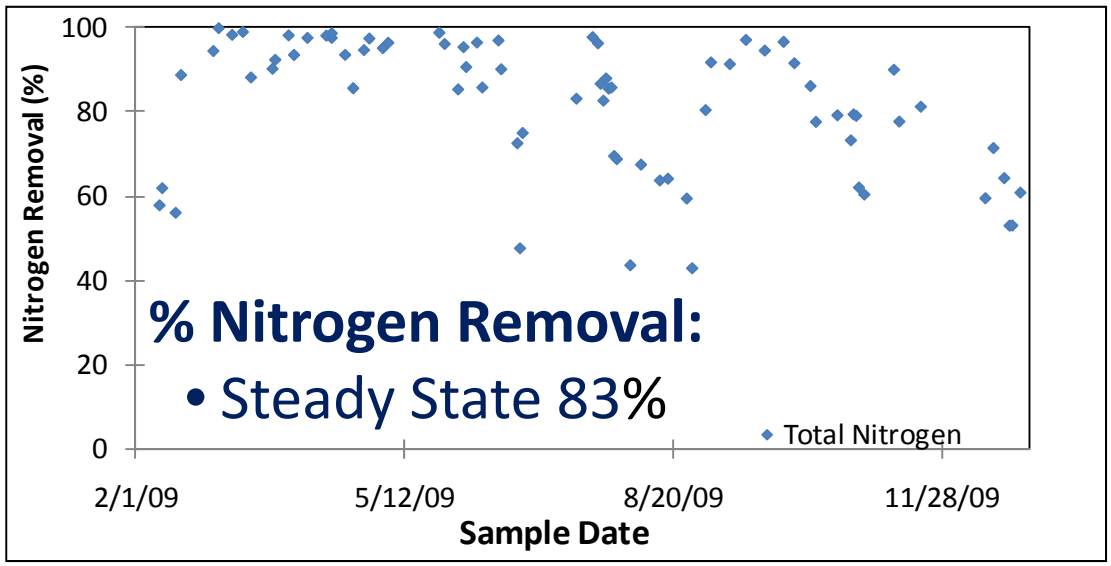
Pilot: SBMBR from Aqua-Aerobics, Inc.

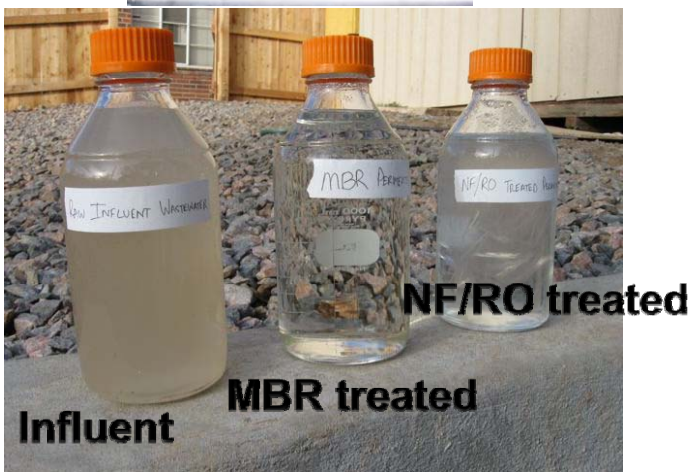
Design volume: 28 m^3/day

Fluctuation: 8.3 to 30 m^3/day

Carbon and Nitrogen Removal



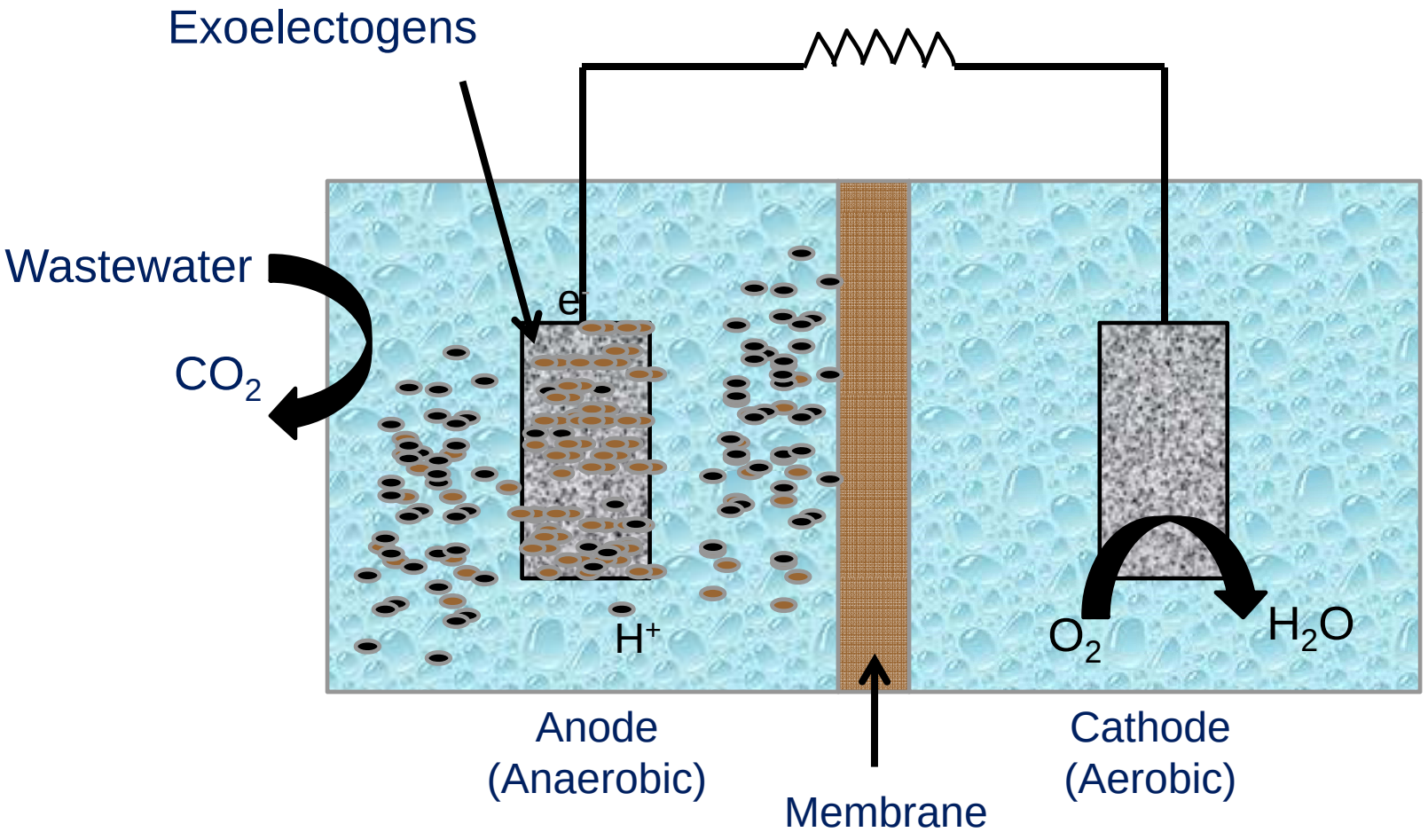




Improved water quality:

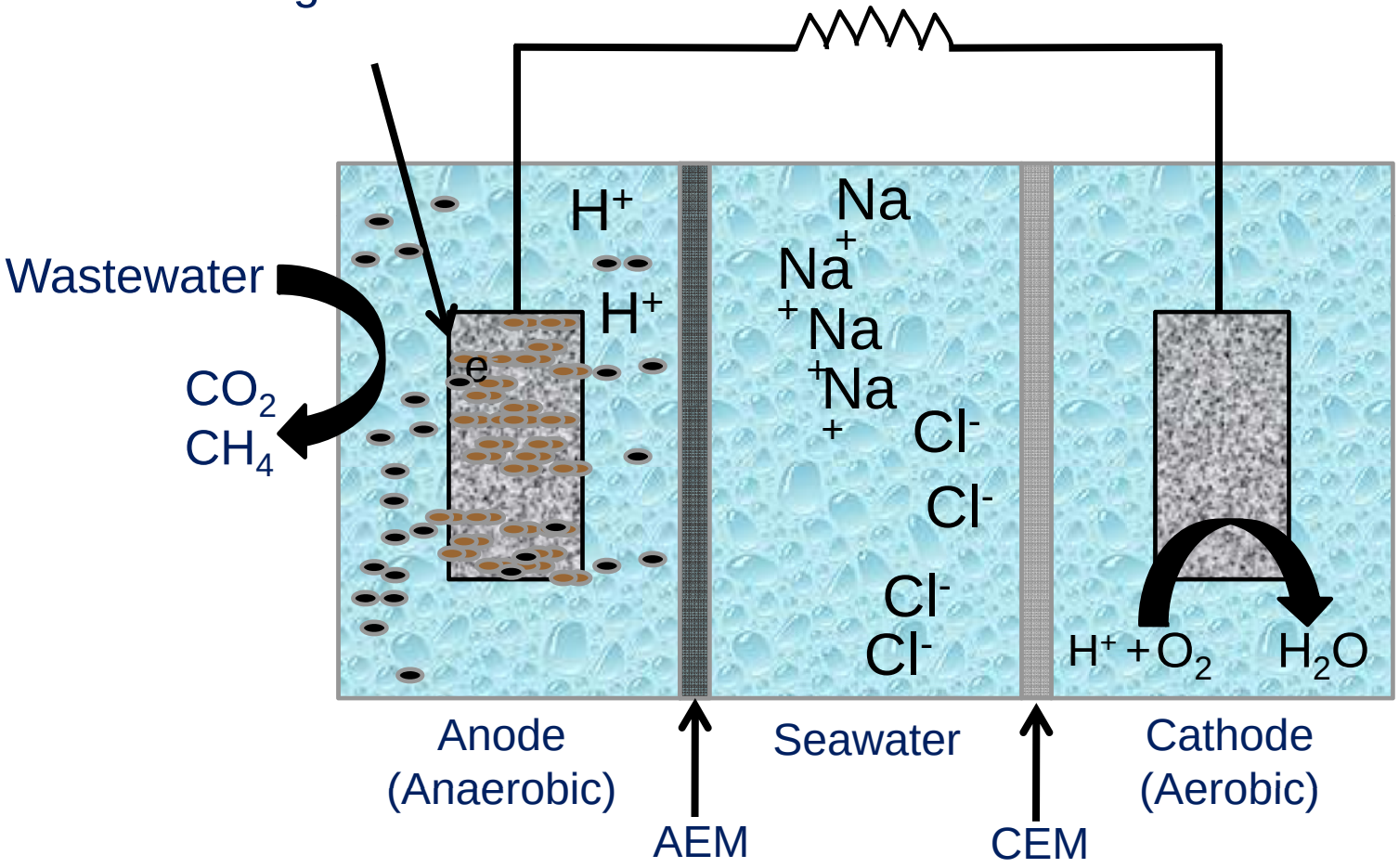
- Viable option for tailored water for reuse

Microbial Fuel Cells: Low Cost Wastewater Treatment Technology



Microbial Desalination Cells: Low-Energy Water Desalination

Exoelectrogens

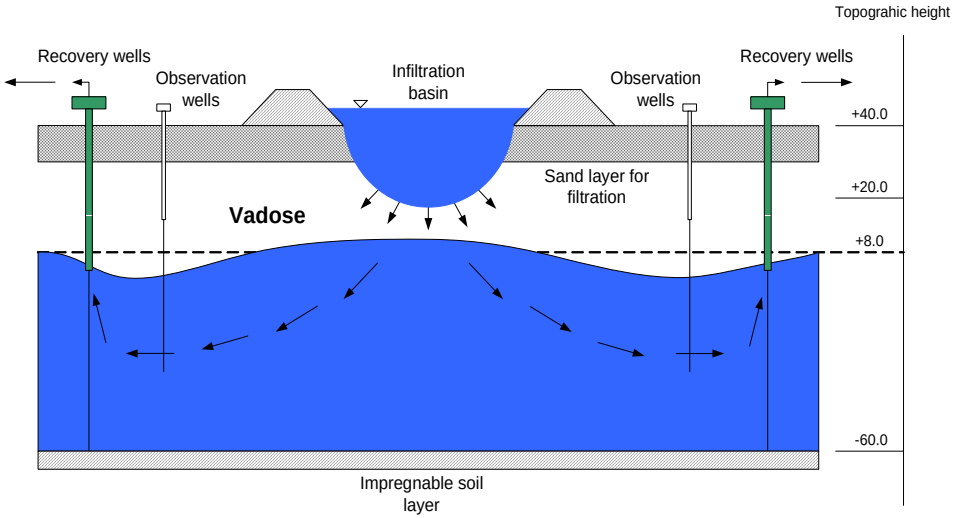


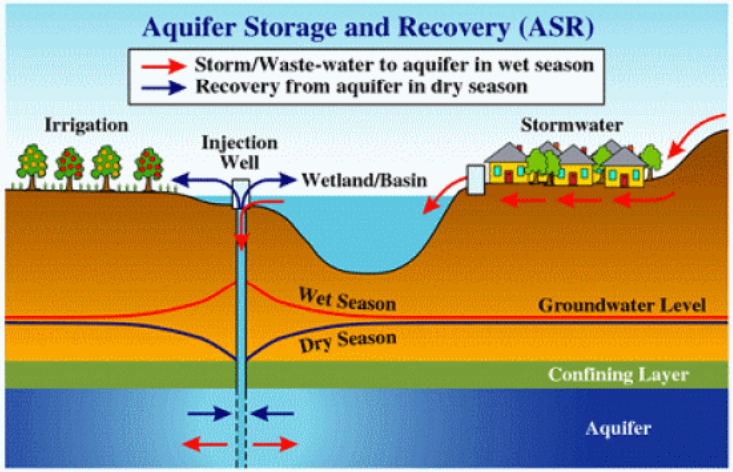
Natural Treatment Systems – Aquifer Recharge and Recovery (ARR)

ARR: Recharge of water into an aquifer and its later recovery for use with a primary goal of water treatment

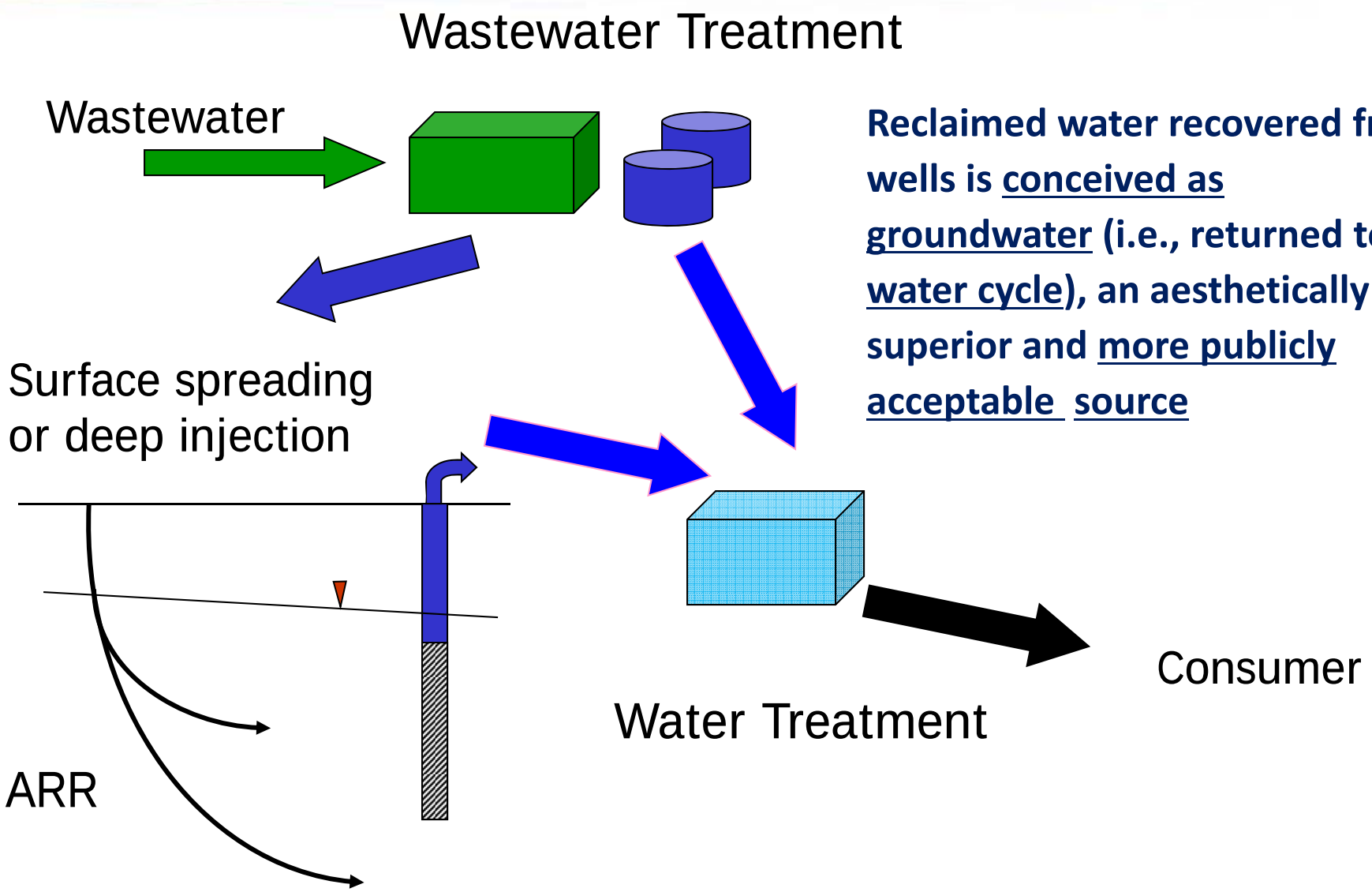
Attributes

- Low energy/cost
- Low carbon footprint
- Sustainable operation
- Provides storage without evaporation
- Avoids expensive tertiary treatment
- Provides additional treatment
- Reliable source of irrigation water and groundwater recharge
- Hybrid systems (membrane)





ARR in Indirect Potable Reuse (IPR)



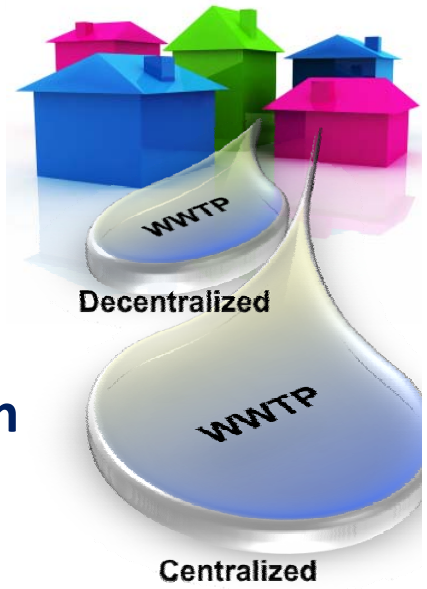
Reclaimed water recovered from wells is conceived as groundwater (i.e., returned to water cycle), an aesthetically superior and more publicly acceptable source

Constraints Limiting Water Reuse

- Lack of wastewater collection system
- Design and operation of appropriate wastewater treatment infrastructure
- Need for reclaimed water distribution system
- Unknowns about health risks (microbial & chemical)
- Public perception/acceptance
- Better understanding of economics (Business opportunities)
- Lack of political support
- More cost-effective technologies

Final Remarks

- Growing need to find alternative solutions to problems of fresh water supply in arid and semi-arid regions - water reuse could be one of the probable solution
- Need to push/update national water policies, institutional and policy reforms to promote reuse
- Low water tariffs are a significant limiting factor and reform of rate structures is needed to provide incentive for water reuse
- Plenty of opportunities to implement both advanced/innovative technologies and natural treatment systems that facilitate reuse
- Decentralized systems leading to tailored reuse are a viable option
- Comprehensive public education, outreach, and awareness program

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Thank You
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