CoWERC : U.S.- Israel Energy Center First Annual Event



Aaron Packman and Moshe Herzberg Co-Directors Diana Ferrando and Sanaiya Khatwani Program Managers Northwestern **Ben-Gurion University** of the Negev Current CYCLOPURE AECOM Yale TECHNION Israel Institute of Technology جمعية الدار fluence The Galilee Society Anaergia HRS

CoWERC's mission is to leverage recent advances in both the U.S. and Israel to reduce energy intensity and cost of water across the entire water spectrum.





CoWERC's approach is to target development and testing of critical new technologies using energy-water systems analysis and incorporate new materials and processes to improve pathways for **desalination water supply**, **wastewater reuse**, and **resource recovery**.

We link university, lab, utility, and industrial capabilities in Israel and the U.S. to scale-up promising technologies at places that need them.





Northwestern | CENTER FOR WATER RESEARCH

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Challenges: Energy-Efficient Enhanced Water Supply



High-Recovery Ion-Selective Desalination

- Concentrate disposal limits inland desalination
- Minimal liquid discharge is required to maximize water recovery and minimize energy intensity.
- Current desalination methods are nonselective, increasing facility size, energy intensity, and costs.



<u>CoWERC Desalination R&D</u> Improved selectivity and process trains for enhanced recovery of brackish waters and tailored water chemistry



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Lead Researcher

Jack Gilron Ben-Gurion University

Pilot testing facilities

Granot and Maagan Michael brackish desalination plants







Desalination R&D – 1st year key accomplishment

Methods for removing hardness and silica from brackish water are currently being tested and scaled up

Pilot testing facilities

Granot and Maagan Michael brackish





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Challenges: Energy-Efficient Enhanced Water Supply



Selective & Antifouling Materials

- Improved membrane and surface selectivity is required to improve recovery and energy intensity.
- Surface fouling degrades materials and increases energy intensity and lifecycle costs of desalination.



CoWERC Materials R&D

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Tailored material properties and manufacturing for enhanced separations performance at pilot



Lead Researcher

Seth Darling Argonne National Lab



- Argonne Manufacturing Engineering Research Facility
- DuPont prototyping and manufacturing capability







Materials R&D – 1st year key accomplishment

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Design is underway for a roll-to-roll system for coating membranes in parallel to fouling resistance and ion selectivity lab-scale studies.



- Argonne Manufacturing Engineering Research Facility
- DuPont prototyping and manufacturing capability



Challenges: Wastewater reuse & resource recovery



Biotechnology for Nutrient & Energy Recovery

- Current wastewater treatment is energy intensive.
- New approaches are needed to make wastewater an energy and nutrient resource.

Selective & Antifouling Materials

 Fouling control is needed to enable membrane separations for wastewater reuse and recovery.



<u>CoWERC Wastewater Biotechnology R&D</u> Integrating multiple strategies for enhanced nutrient and energy recovery

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Lead Researcher

Amit Gross Ben-Gurion University

- MWRD Calumet and Stickney Water reclamation plants
- Mekorot Shafdan wastewater treatment plant





<u>Wastewater Biotechnology R&D – 1st year key accomplishment</u>

Core Anaerobic Membrane Bioreactor technology is being linked with multiple processes for resource and energy recovery: Enhanced biological phosphorous removal, coupled aerobic–anoxic nitrous decomposition operation bioprocesses (MABR-CANDO), and sludge valorization.



- MWRD Calumet and Stickney Water reclamation plants
- Mekorot Shafdan wastewater treatment plant



Challenges: Wastewater reuse & resource recovery



Efficient Trace Organic Pollutant Removal

 No existing technologies reliably remove trace organic contaminants (such as PFAS/PFOS) from municipal or industrial wastewater, limiting safe reuse of these wastewaters.



<u>CoWERC Trace Organics Removal R&D</u> Highly efficient and scalable trace organics separations for wastewater polishing on multiple treatment trains



Lead Researcher

Will Dichtel Northwestern and CycloPure

Pilot testing facilities

- Mekorot Shafdan wastewater treatment plant (polishing)
- MWRD Calumet and Stickney water reclamation facilities



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<u>Trace Organics Removal R&D – 1st year key accomplishment</u>

A new class of adsorbents was developed for organic micropollutants.

Northwestern Image: CycloPure AECOM Image: Sen-Gurion University of the Negev Image: CycloPure Image: CycloPure

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- Mekorot Shafdan wastewater treatment plant (polishing)
- MWRD Calumet and Stickney water reclamation facilities



Challenges: Wastewater reuse & resource recovery



Low-energy Water Reuse

 Natural soil-based approaches reduce energy intensity of wastewater treatment, but are landintensive and difficult to control.



CoWERC Low-Energy Water Reuse R&D Integrating engineered aquifer recharge with wastewater treatment technology to reduce system-level energy intensity



Lead Researcher

Alex Furman Technion



- Mekorot Shafdan SAT system
- HRSD Swift facility as potential technology transfer partner







Low-Energy Water Reuse R&D – 1st year key accomplishment

Three soil aquifer treatment setups were completed and operational testing is underway (plant-SAT, Tuff-SAT, and air-SAT).



- Mekorot Shafdan SAT system
- HRSD Swift facility as potential technology transfer partner





Challenges: Energy-Water Systems



Energy-Water Systems Analysis

- CoWERC technologies can only be commercialized if they are cost-competitive. Capital costs, energy intensity, and materials replacement are all factors.
- Techno-economic and life-cycle analyses are required to demonstrate total costs of each new technology relative to existing technologies.

High-Recovery Ion-Selective Desalination

- High-recovery inland desalination can substantially reduce whole-system water costs.
- Ion-selectivity can enable new water systems by tailoring desalination to local sources and uses.

Enhanced Wastewater Reuse and Energy Recovery

• Integration of new wastewater technologies with soil-based treatment and energy recovery can be used to optimize the entire energy-water system.



CoWERC Energy-Water Systems Analysis Consistent, defensible, and transparent analyses of systems-level performance outcomes of new technology insertions



Lead Researcher

Jennifer Dunn Northwestern University

Pilot testing facilities

- Data from all labs & pilot tests
- Additional datasets provided by industry and utility partners



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Energy-Water Systems Analysis – 1st year key accomplishment

Data sharing between university, national lab, and industry partners to establish metrics and targets for performance of each CoWERC project and assess their ultimate energy and water impacts.



- Data from all labs & pilot tests
- Additional datasets provided by industry and utility partners



