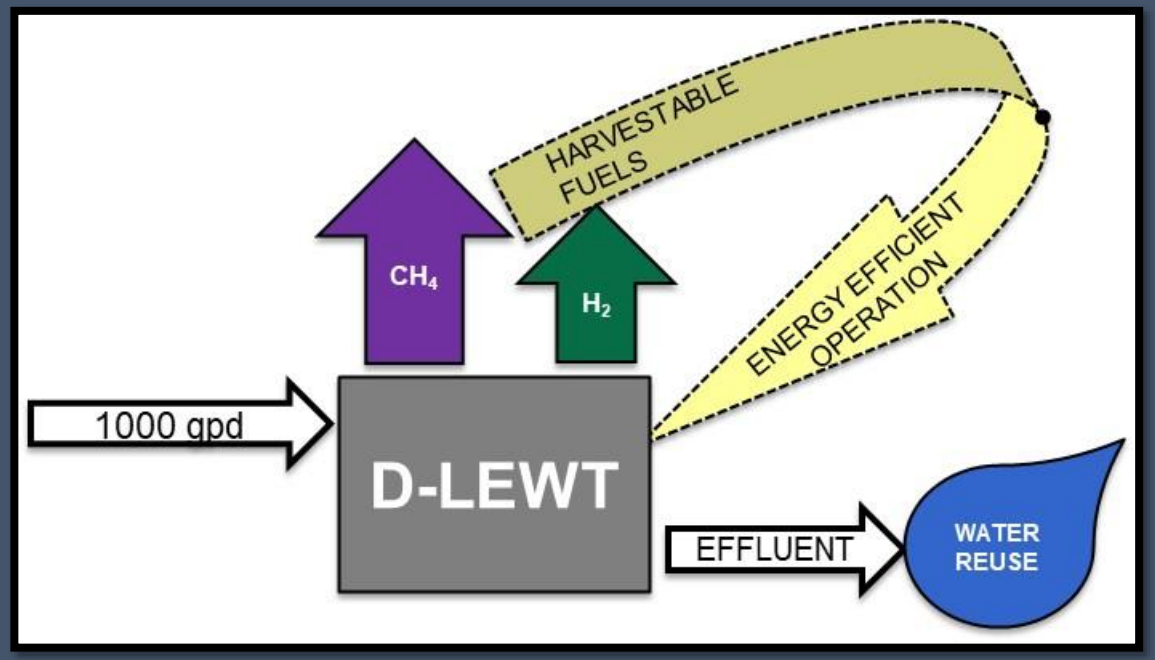
DISTRIBUTED LOW ENERGY WASTEWATER TREATMENT (DLEWT)

Dr. Kathryn Guy



Distribution A: Approved for public release.

DLEWT

Purpose

- Decentralized, low energy wastewater treatment process that generates methane and hydrogen fuels

Applications

- Remote locations without centralized wastewater treatment plants
- Disaster relief where treatment plants are inoperable
- Temporary need for wastewater treatment at a location
- Augment or retrofit of traditional wastewater plants

Impact

- Deployable wastewater treatment
- Clean water suitable for reuse
- Methane and hydrogen fuels for onsite power generation

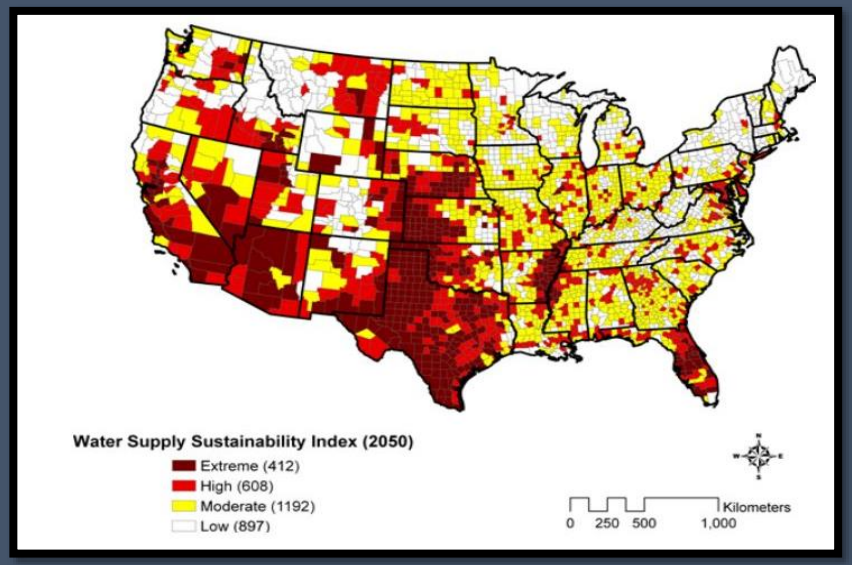
Status

- Demonstration of a 10,000 gallon per day unit slated FY23-24

Challenges - Resiliency, Security and Sustainability

Fixed Installations

- Access to freshwater is critical to national security
- Water shortages impact military readiness
- 40 out of 50 state water managers expect shortages by 2030
- DoD aims to diversify and expand energy supplies and sources, including renewable energy sources and alternative fuels
- Installation Energy and Water Plans could incorporate water reuse and energy harvesting to support resiliency



Multi-Domain Operations (MDOs)

- Energy and water dependencies tied to supply chains will be vulnerable and potentially cripple U.S. force projection and sustainment
- Liquid fuel and water are 80% of weight
- Extending the days of supply for energy will not reduce water needs or reduce the tether of water

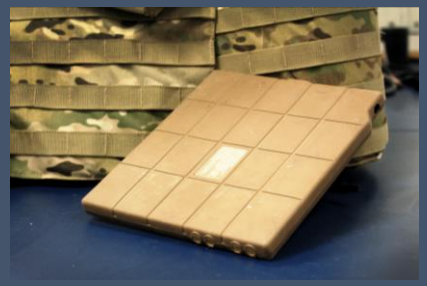
https://www.army.mil/article/97879/Lengthening_the_Tether_of_Fuel_in_Afghanistan/

What can we do with energy harvested from wastewater?

- 1,000 soldiers will produce ~6 therm equivalent per day, or…

~ 4.5 gallons of diesel

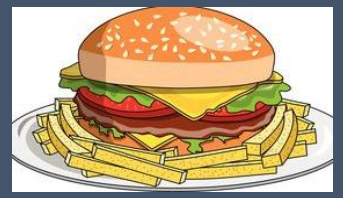
~ 8 hr run time for a 5 kW genset



~ 102 conformable batteries charged

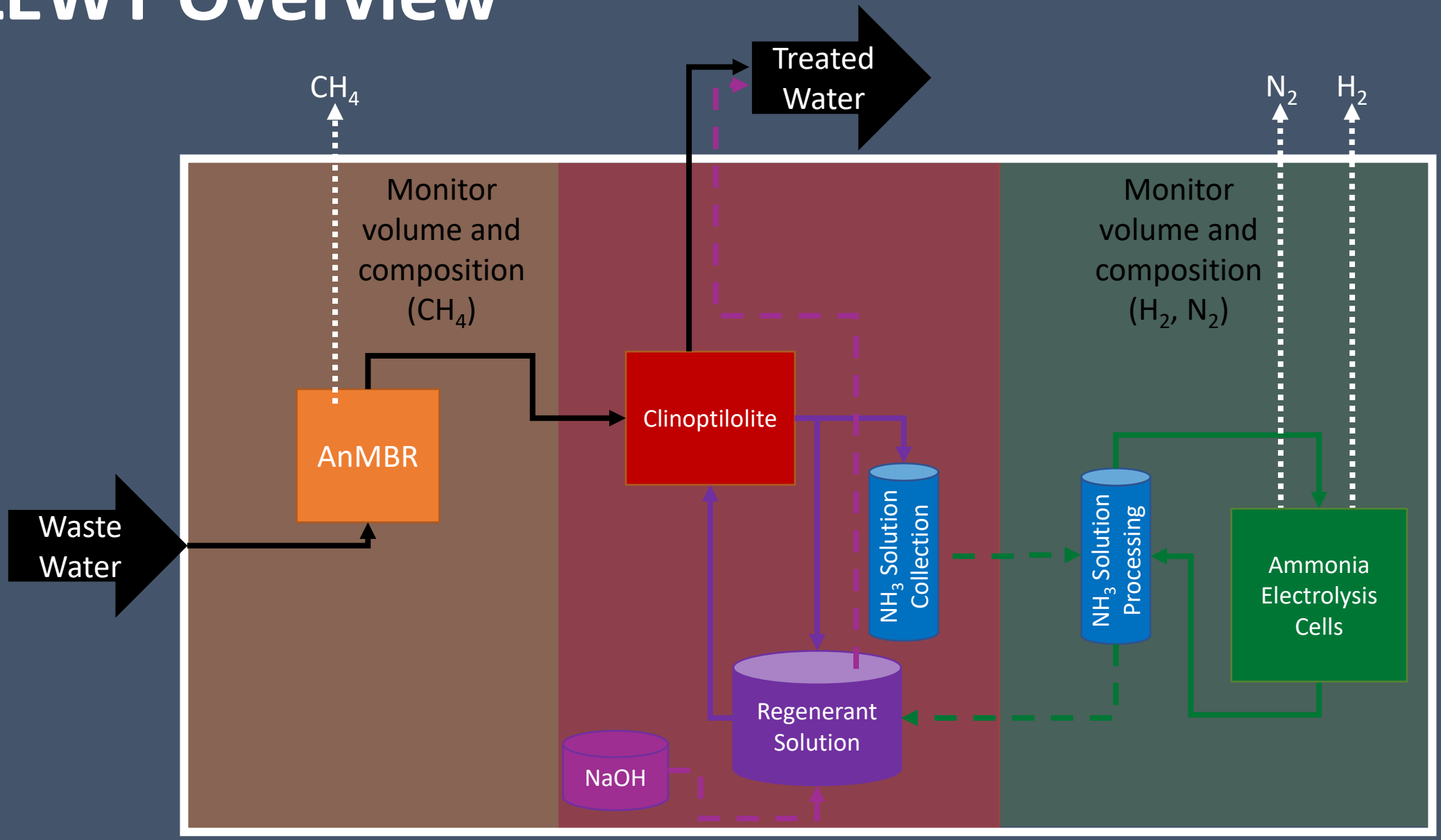
Heat one house for a day

Cook 22 Turkeys



Cook 360 Burgers

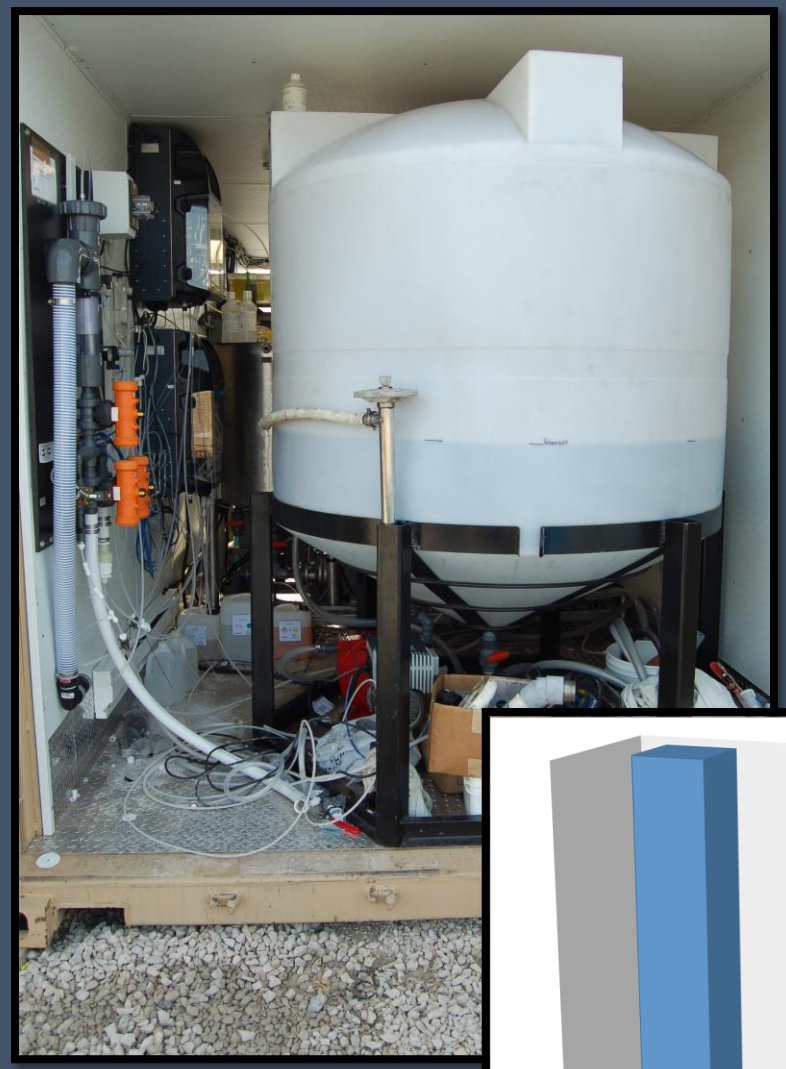
DLEWT Overview

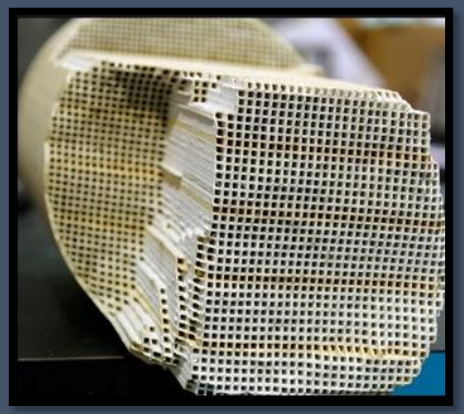


DLEWT: AnMBR

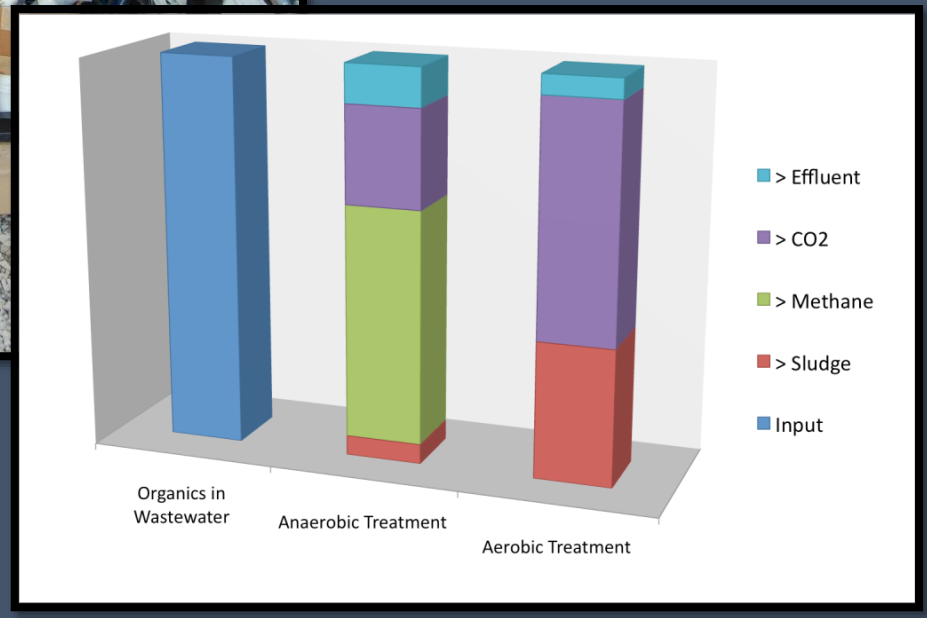
Anaerobic Membrane BioReactor

- Organics are converted into harvestable methane gas with low sludge production
- Retention of particulates with shorter hydraulic retention times
- Methane can be harvested for electrical and thermal energy
- Nitrogen species are converted into ammonia



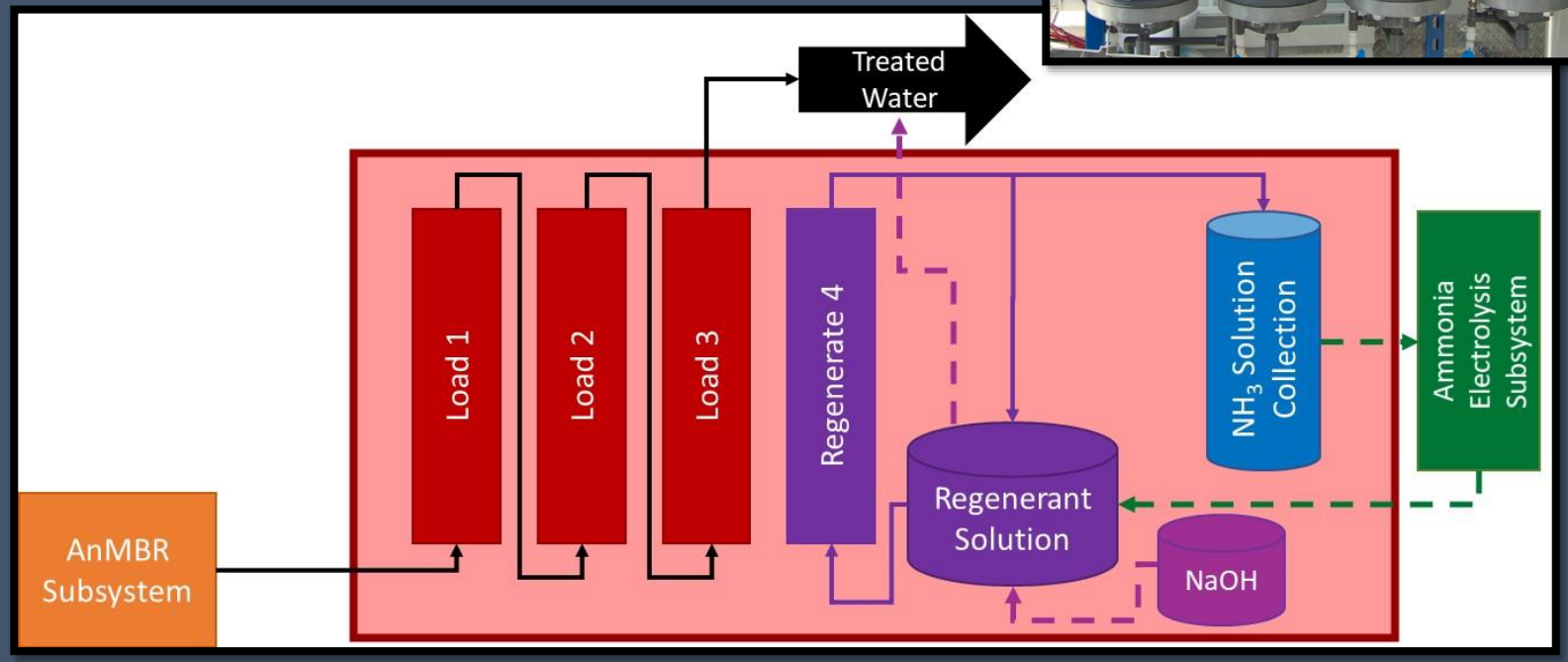


Ceramic membrane module for AnMBR



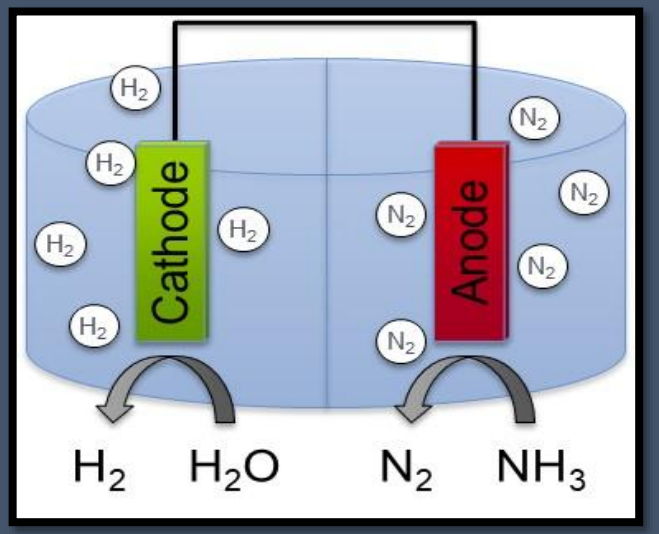
DLEWT: Ion Exchange

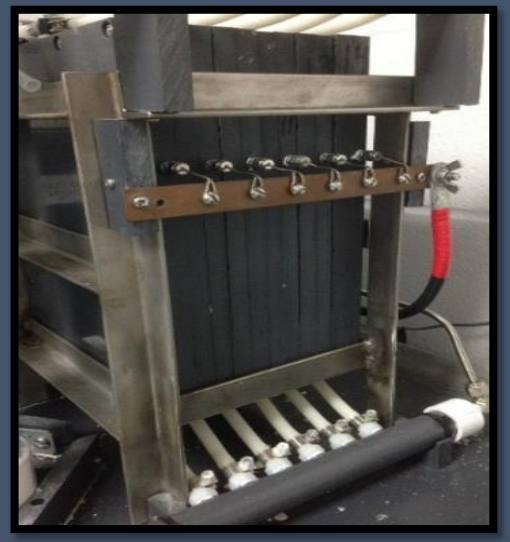
- Clinoptilolite, a natural zeolite, removes ammonia from AnMBR effluent
- Columns regenerated by NaOH to generate a concentrated ammonia solution

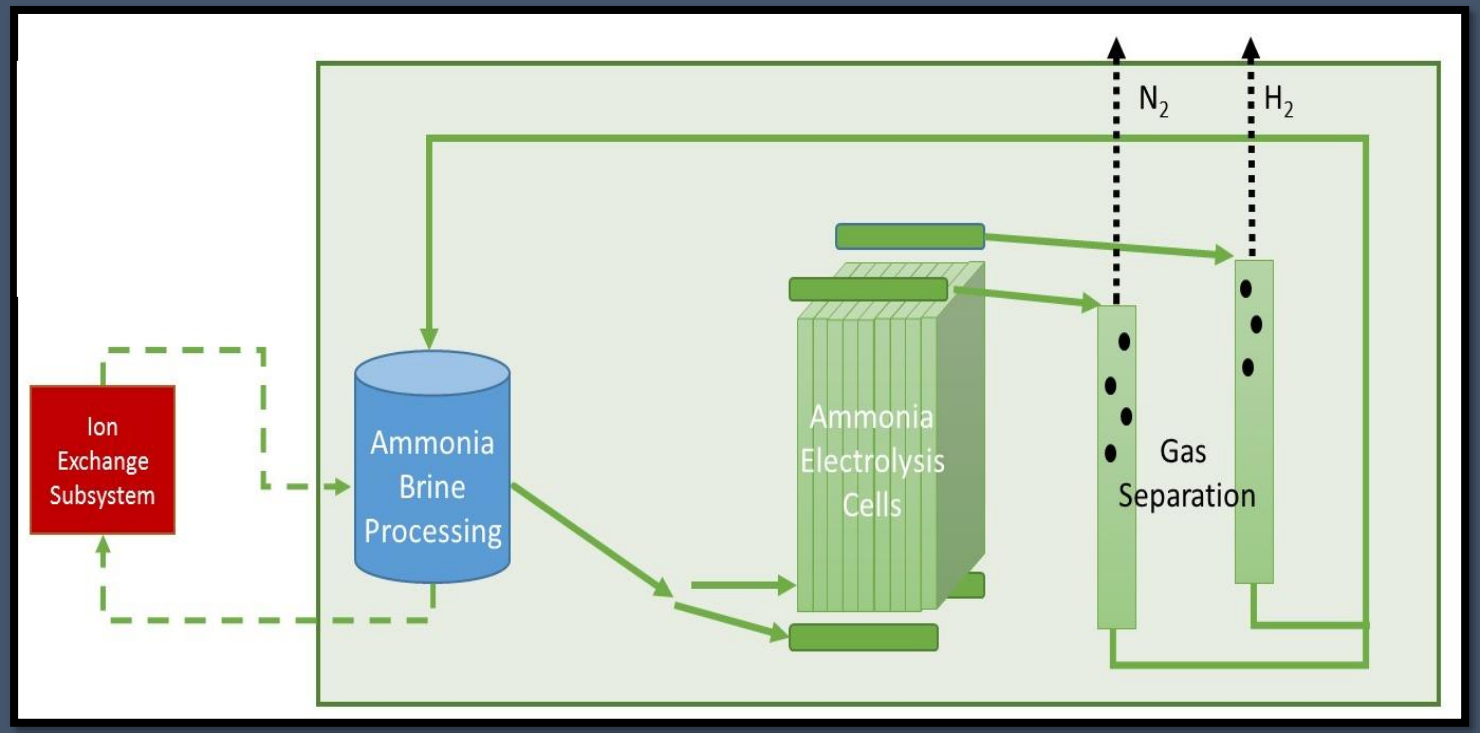


DLEWT: Ammonia Electrolysis

- Breaks down ammonia into nitrogen and hydrogen gases
- Clean hydrogen can be captured for use in fuel cells
- Ammonia concentrate from ion exchange regeneration treated in batches







DLEWT Benefits

- Low energy wastewater treatment with water and energy recovery
- Enhances energy and water resilience
  - Produces useable H_2 and CH_4 fuels
  - Self-contained and portable
  - Waste is a resource
- Multiple Applications
  - Remote training areas
  - Decentralized construction
  - Failing infrastructure
  - Deployed environments
- Flexible Design
  - Scalable
  - Adaptable to different waste streams

Parameter	Objective
Capacity	1000 gpd
Energy Consumption	$\leq$ 4.45 kWh/kgal
H_2 Yield	$\geq$ 0.017 kg/kgal
CH_4 Yield	$\geq$ 0.026 kg/kgal
Net Energy Consumption Reduction	$\geq$ 6.0 kWh/kgal
Sludge Reduction	> 60%
Water Re-Use Potential	> 75%
BOD	< 30 mg/l
COD	< 30 mg/l
NH_3	< 5 mg/l

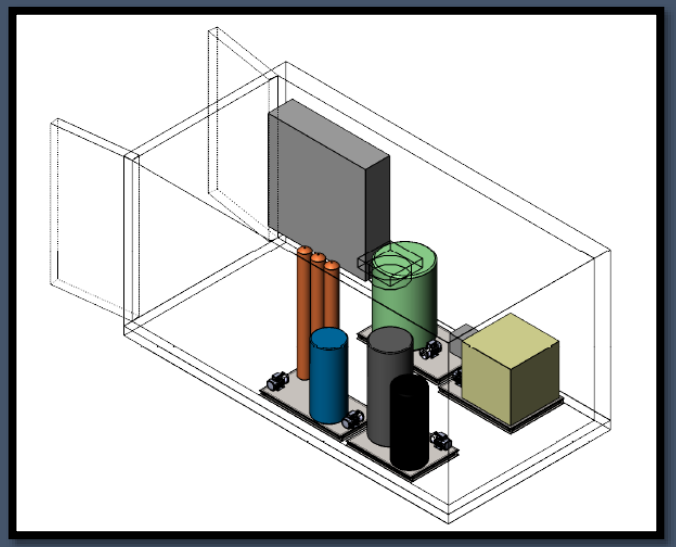
DLEWT 2.0 and Beyond

DLEWT 2.0 (FY23-24 demonstration)

- Capable of treating 10,000 gallons per day
- Cloth filter AnMBR
- Alternative ammonia electrolysis from Current Water Technologies Inc.
- 2022 TRL 6 → 2025 TRL 8 → 2035 TRL 10

Additional research projects

- Gas separation for dissolved methane and ammonia electrolysis products
- Electrolysis of mixed nitrate and amine streams including energetic waste streams
- Conversion of dirty biogas or mixed biogas/H_2 fuels to electrical power
- Optimization of clinoptilolite column design



EPIC W2 (Energy and Power Innovation Center – Waste and Water)

DLEWT technology reorients the view of wastewater, treating it as a resource instead of a burden that will enable the future force to increase water and energy security.

For more information on D-LEWT please contact:

Dr. Kathryn A. Guy
Kathryn.A.Guy@usace.army.mil
217-373-3378

Mr. Nicholas M. Josefik
Nicholas.M.Josefik@usace.army.mil
217-373-4436

Dr. Aaron C. Petri
Aaron.C.Petri@usace.army.mil
217-373-3377