Water and Natural Resources Interim Committee
July 14, 2026

Demonstrating Feasibility of Beneficial Reuse of Treated Produced Water In New Mexico

Dan Mueller, P.E.

1

Dan Mueller, P.E.

- Registered professional engineer (TX)
- 40+ years experience
  - All in water-related environmental issues
- Engaged on science-driven environmental advocacy
  - Produced water management issues for 12+ years
- Represent environmental interest in the New Mexico and Texas Produced Water Consortia
  - Have done so since they were both formed

2

Drivers for Beneficial Reuse of Treated Produced Water

- **Water is a big deal - there is a lot of produced water generated in areas that are water stressed**
- **Underground injection formations are pressuring up**
  - Potentially limiting continuing injection capacity
  - Increasing potential for well failures/blowouts from older/inactive wells

3

Challenges for Beneficial Reuse of Treated Produced Water

- **Relatively new waste stream**
  - Highly variable/complex
  - Contaminants of concern
  - Technology development/vetting
- **Viable beneficial uses/disposal options**
- **Sustainability**

4

Determining Beneficial Reuse Feasibility is a Process - With Multiple Parts

- **Technical Feasibility**
  - Constituents of concern
  - Treatment goals, monitoring requirements
  - Treatment process capabilities/limitations
- **Economic Feasibility**
  - All-in costs (treatment, waste management, power)
  - Viable markets for this treated effluent
- **Dependable/Sustainable Water Source**

5

Demonstrating Technical Feasibility

Produced Water characterization

- Knowns/Unknowns — **Progress made**
- Toxicity information — **Progress made**

Treatment process vetting

- Pilot testing
  - Lab-scale testing — **Progress made**
  - Limited size/duration field testing — **Progress made**
  - Scaled, longer-term field testing — **Limited progress**

6

Demonstrating Economic Feasibility

Current critical weak link

- If there is data based on scaled in-field pilot testing, it has not been publicly shared
    - Data based on scaled pilot projects
    - Need all-in treatment costs
    - Demonstrate treatment process efficacy and reliability
    - Power requirements – again, based on scaled field testing

7

8

Available online at www.sciencedirect.com

ScienceDirect

ELSEVIER

Current Opinion in Chemical Engineering

Economic feasibility of developing alternative water supplies for agricultural irrigation☆

Edirisooriya Mudiyanselage Nimanthi Thiloka Edirisooriya[1], Huiyao Wang[1], Sankha Banerjee[2], Karl Longley[3], William Wright[4], Walter Mizuno[2] and Pei Xu[1]

Cost estimates based on modeling/simulations

The treatment costs of produced water are highly variable depending on the presence of different types of contaminants and salinity, which may vary from \$0.09/m^3 (produced water with TDS < 500 mg/L in Kern County) to \$9.4/m^3 to \$12/m^3 treating hypersaline produced water (e.g. unconventional produced water in the Permian Basin) using waste heat and state-of-the-art low-temperature (e.g. < 70 °C) thermal distillation technologies [32–35]. It should be noted that the reuse of

32. Tidwell V, Gunda T, Caballero M, Xu P, Xu X, Bernknopf R, Broadbent C, Malczynski LA, Jacobson J: **Produced Water-Economic, Socio, Environmental Simulation Model (PW-ESEim) Model: Proof-of-Concept for Southeastern New Mexico**. Sandia National Lab.(SNL-NM); 2022.

33. Geza M, Ma G, Kim H, Cath TY, Xu P: **iDST: an integrated decision support tool for treatment and beneficial use of non-traditional water supplies – part I. Methodology**. *J Water Process Eng* 2018, **25**:236-246.

34. Ma G, Geza M, Cath TY, Drewes JE, Xu P: **iDST: an integrated decision support tool for treatment and beneficial use of unconventional water supplies – part II. Marcellus and Barnett Shale case studies**. *J Water Process Eng* 2018, **25**:258-268.

35. J. Boehs, K. Abrahamsson: **Waste to resource**, *Presented at Produced Water Society Technology Focus: Brine Management*, October 2020. (2020). Available from ⟨https://producedwatersociety.com/webinars/⟩.

8

9

Journal of Environmental Chemical Engineering 13 (2025) 117026

Contents lists available at ScienceDirect

Journal of Environmental Chemical Engineering

journal homepage: www.elsevier.com/locate/jece

ELSEVIER

Check for updates

A modeling framework for technical, economic, energetic, and environmental assessment of produced water pretreatment from oil and gas industry

Abdiel Lugo[a], Carolina Mejía-Saucedo[a], Punhasa S. Senanayake[a], Zachary Stoll[a], Kurban Sitterley[b], Huiyao Wang[a], Krishna Kota[c], Sarada Kuravi[c], Vasilis Fthenakis[d], Parthiv Kurup[b], Pei Xu[a,*]

Additionally, pilot-scale testing and field studies should be prioritized to validate model predictions and improve the scalability of pretreatment strategies. Further exploration of hybrid pretreatment systems, alternative adsorbents, and renewable-powered treatment solutions will be essential to developing more sustainable and economically viable PW treatment technologies.

5. Conclusion

This study provides a comprehensive framework for techno-economic-environmental assessment of high-salinity PW pretreatment, evaluating costs (LCOW), energy (SEC|CED), and carbon emissions (CO_2) across treatment infrastructure, operation, and waste management. The findings highlight that pretreatment selection is a key determinant of desalination efficiency and cost-effectiveness, yet it remains an underexplored area in PW treatment. Electrocoagulation (EC) and chemical coagulation (CC) offer cost-effective and lower-energy alternatives, while granular activated carbon (GAC) minimizes waste disposal but requires frequent regeneration, increasing costs. For the Permian Basin PW case study, EC + GAC was found to be the most effective combination for removing hardness, silica, and organics, while also reducing sludge disposal challenges. However, this approach had the second-highest LCOW, SEC, and CO_2 emissions, indicating a trade-off between contaminant removal efficiency and economic feasibility. Despite these limitations, EC + GAC remains a promising pretreatment option, particularly for cases where waste minimization is a priority.

The results of this TEA underscore the importance of identifying key cost drivers and strategically targeting research and development efforts to enhance the economic viability of PW treatment. High-cost processes, such as energy-intensive treatment systems, present clear opportunities for innovation. To advance research in this area, future work should focus on optimizing pretreatment configurations to balance cost, energy consumption, and environmental impact. Future research that involves Monte Carlo simulations or scenario-based cost analyses could provide a more dynamic understanding of economic variability, accounting for fluctuations in water quality, electricity prices, and chemical demand. Additionally, pilot-scale testing and field studies should be prioritized to validate model predictions and improve the scalability of pretreatment strategies. Further exploration of hybrid pretreatment systems, alternative adsorbents, and renewable-powered treatment solutions will be essential to developing more sustainable and economically viable PW treatment technologies.

9

Why is Economic Feasibility Important?

Fairmont Brine Processing

- In West Virginia was permitted to treat produced water. Numerous significant legacy environmental issues exist at the closed facility including TENORM and Resource Conservation and Recovery Act (RCRA) wastes. Per recent EPA documentation (Aug 2025), 46,200 gallons of RCRA mixed liquids and 62,747 gallons of TENORM liquids have been removed from the site.

Antero's Clearwater

- Facility in Doddridge County, West Virginia, claimed that it would turn produced water into fresh water and food-grade salts. The facility idled less than two years after beginning operations in 2017, citing a lack of cost effectiveness. Concerns over legacy environmental issues persist including radioactive and toxic waste.

10

Why is Economic Feasibility Important?

Eureka Resources

- Operated three produced water treatment facilities in Pennsylvania. They are now closed and the Pennsylvania Department of Environmental Protection has identified numerous environmental issues including unresolved wastewater leaks, tanks holding water without functional containment, and "state Solid Waste Management Act violations that remain open for waste on the ground and other violations of the permit.

Austin Master Services

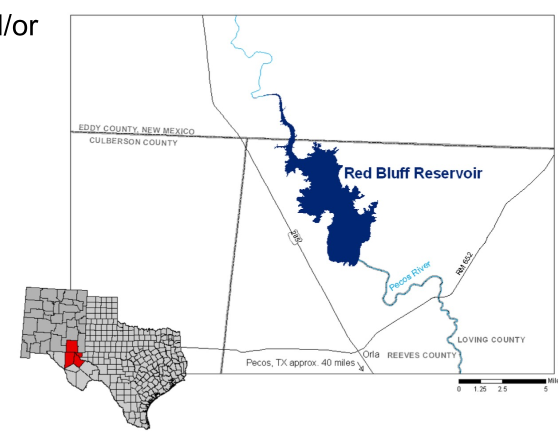
- Located in Martins Ferry, Ohio was permitted in 2014 to treat oil and gas wastewater. After concerns over illegally stockpiling wastewater and other oil and gas waste, leading to soil and water contamination. The facility shut down in 2022 and Ohio taxpayers eventually footed the bill for cleaning up the facility.

11

Status of Discharge Applications in Texas

Currently 6 discharge permit applications for treated produced water under review by TCEQ

- 5 propose discharge into Red Bluff Reservoir and/or tributary of the Pecos River
- Oldest application submitted December 2023
- To-date, no draft permit(s) issued



12

Final Points

- Continue the science
- Continue to develop and test treatment technologies
- Expand pilot testing of treatment technologies that have shown promise in achieving high quality effluents
- Field demonstrate feasibility
    - What are the actual all-in costs
- Consider the sustainability of this potential water soure

13

Thank You

DanMueller2001@gmail.com

14