

Unconventional Water Treatment



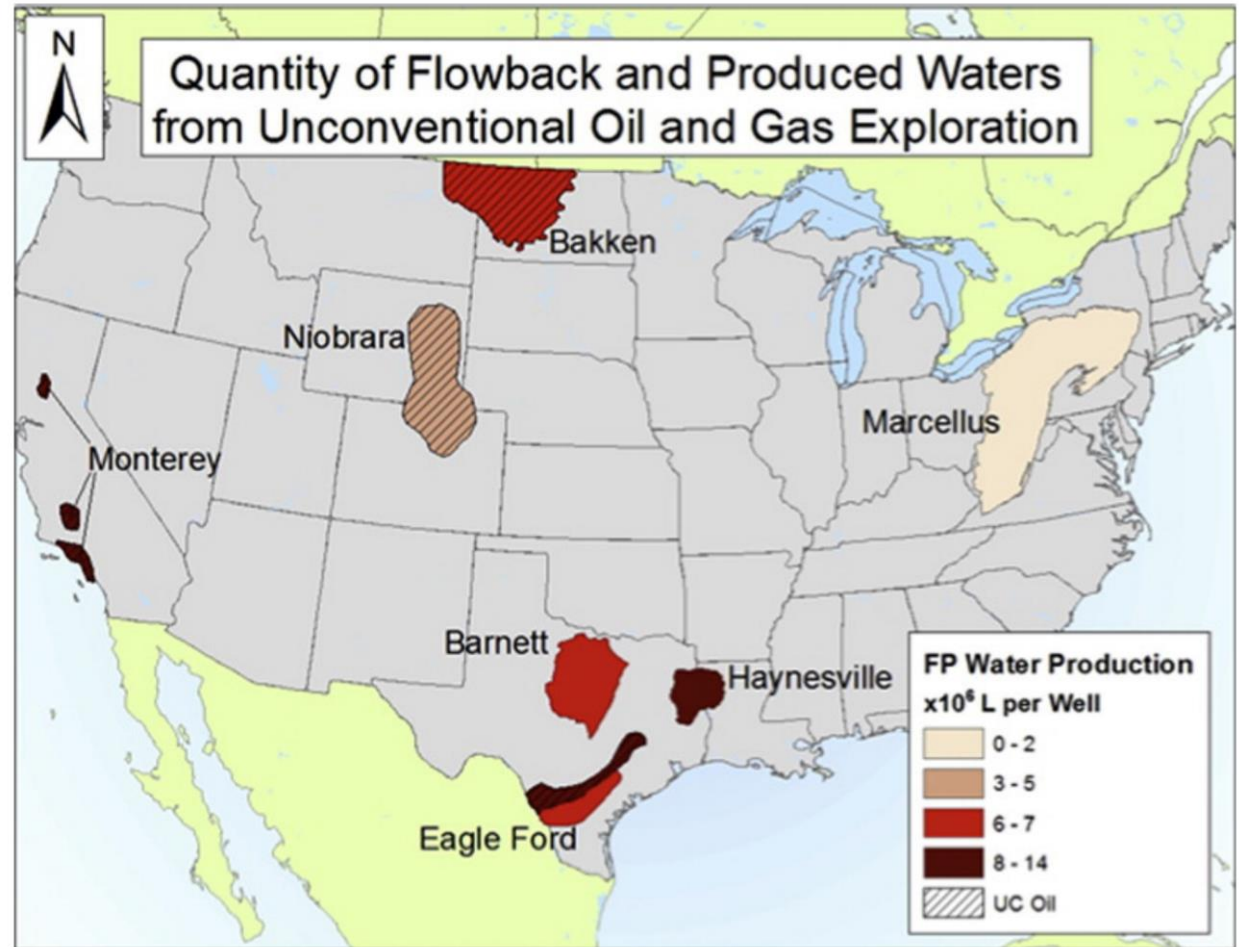
Oregon State
University

Espiku

- **Espiku was formed to commercialize technologies from OSU's Water Energy Technologies Laboratory**
 - Selective Condensation and Evaporation using Precise Temperature Regulation (SCEPTER)
 - Zero Liquid Discharge Water Desalination Using Thermally-Actuated Humidification-Dehumidification
 - Thermally-actuated pump and compressor

Wastewater Problem

- Unconventional oil & gas wells generate 0.5 – 3.8 million gallons of wastewater over their first 5 - 10 years
- Total Dissolved Solids (TDS) of unconventional wells are 75,000 - 300,000+ mg/L



1) Data and figure from <http://dx.doi.org/10.1016/j.scitotenv.2016.09.069>

2) https://www.epa.gov/sites/production/files/2018-05/documents/cwt-study_may-2018.pdf

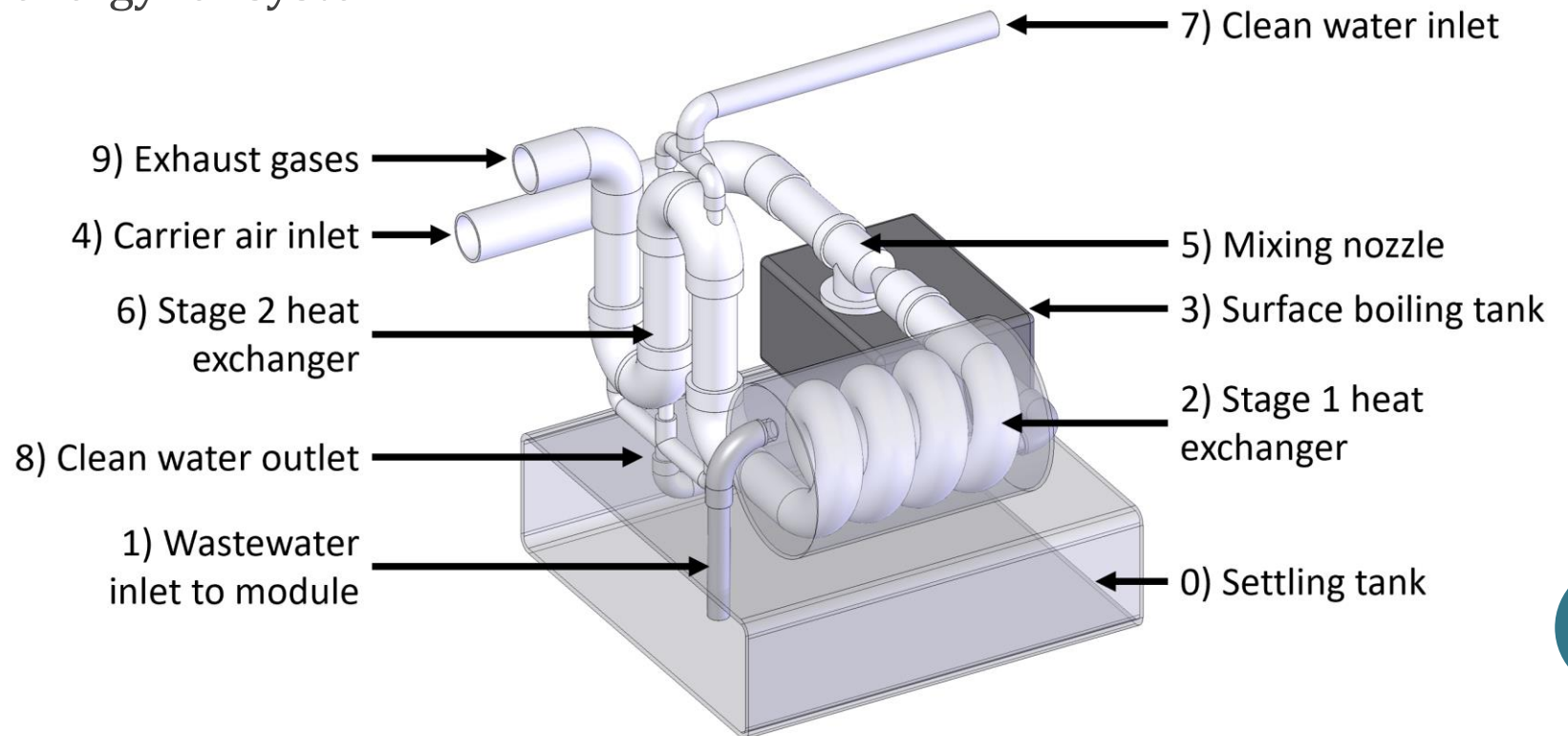
SCEPTER Technology

- Our technology extracts clean water from wastewater (as opposed to extracting waste) in a once-through process
- System is modular, scalable, and portable (fits in 40' container)
- Treatment cost of \$0.46 - \$0.62/bbl
- Each container is capable of producing 630 bbl/day of clean water
- Well-suited for oil/gas flowback and produced water with 30%+ contaminants, including suspended and dissolved solids, heavy organic compounds, and VOCs



SCEPTER Technology cont.

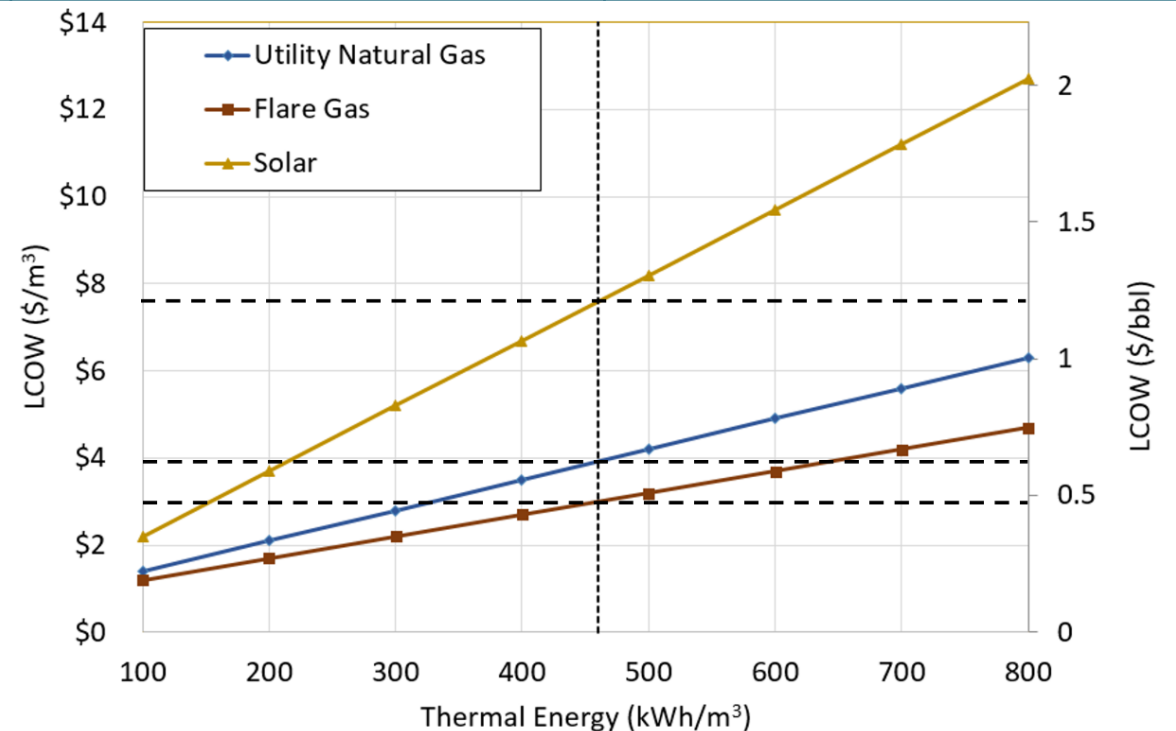
- Our system vaporizes water and VOCs while leaving suspended solids and suspended contaminants to settle
- Heat exchangers recover heat and selectively condensate only water
- Dry air exiting heat exchanger contains VOCs that can be mixed with flare gas or natural gas and combusted to provide thermal energy for system
- System has been demonstrated to remove the salts and 98.7% of organic contaminants with maximum water recovery in a once-through process
- Zero liquid discharge



Competitor Technologies

	SCEPTER	Membrane-based (RO and hybrid RO-ED)	Thermal (MSF, MED, VC, HDH)
Acceptable TDS of water (ppm)	20,000-Saturation limit	20,000-50,000 (RO) 20,000-330,000 (hybrid)	20,000-235,000
Zero liquid discharge	Yes	No	No
Operating pressure/temperature	Low/Low	High/Low	Low to high/high
Cost (\$/bbl)	\$0.46-\$0.62	\$1.75-\$4.38	\$2.00-\$6.50

- Our thorough technoeconomic analysis predicts \$0.62/bbl when operated with natural gas (NG) and \$0.46/bbl when operated with flare gas (FG).

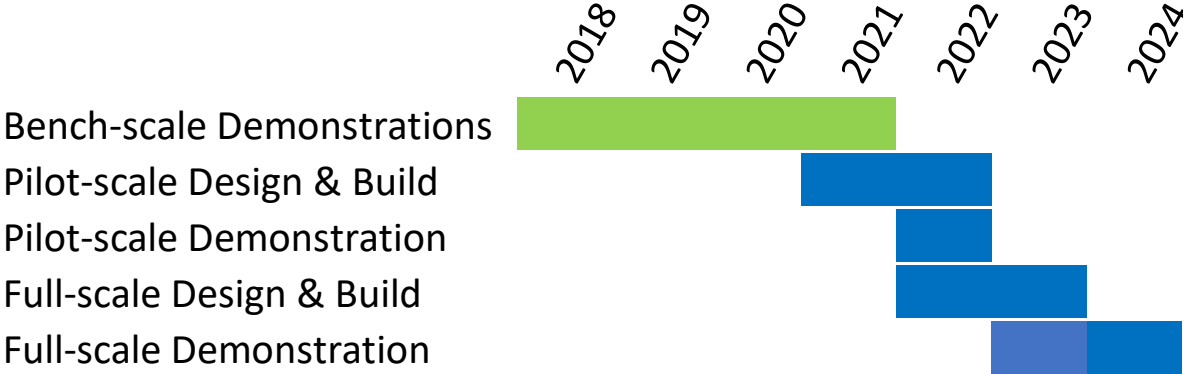


Road to Commercialization

- Technology developed using \$5M+ of DOE, state of Oregon, and private foundation funding
- Created company to commercialize technology: [Espiku](#)
 - 2 patent applications submitted: 16/985,020 and 16/985,043
- Part of business incubator: [OSU Innovation Co-Lab](#)
- Quarterfinalist in [desalination challenge](#) to design and build pilot plant
 - Potential for \$2M in funding

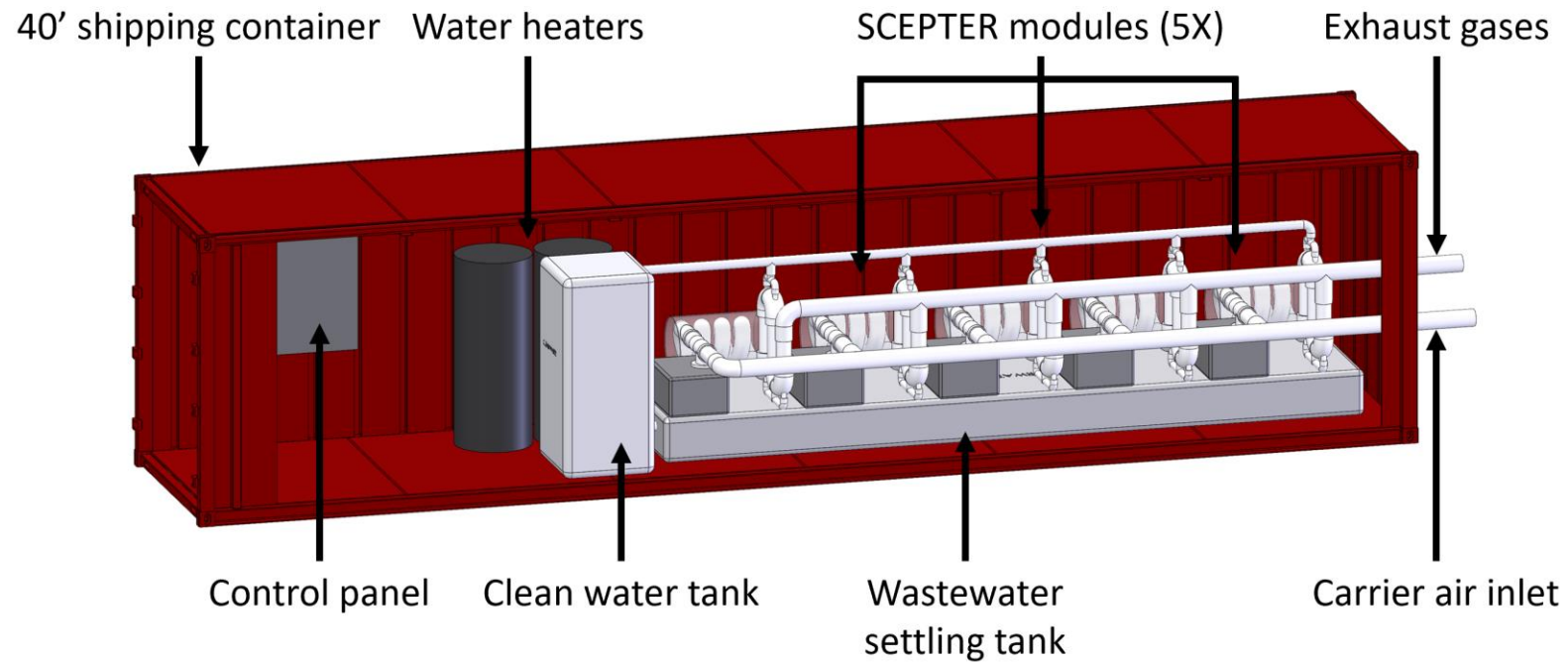


OSU-Cascades
Innovation Co-Lab



Next Steps

- Assemble team including designer and commercial partner
- Design, build, and test pilot plant (630 bbl/day)



Team

- Dr. Bahman Abbasi – abbasi@espiku.com
 - [Espiku website](#)
 - [WET lab website](#)
- Tyler Hudson – tyler.hudson@espiku.com



Oregon State
University



MICHIGAN STATE
UNIVERSITY



University of Nevada, Reno



Potential for Collaboration

We are looking for industry partners to:

1. Help refine our Techno-Economic Analysis (TEA)
2. Learn best/current practices with respect to wastewater generation, treatment, and disposal
3. Become an early adopter of our technology
4. We expect the development of our full-scale plant to require \$7M in new investment