

Jeffrey Huang, Abby Zahm, Akash Mattupalli, Maia Catterall, Sofia Loucks, Oscar Botia, Ali Naderi Beni, Sultan Alnajdi, Nikitha Sam, Janoah Darrow, Joel Aboderin

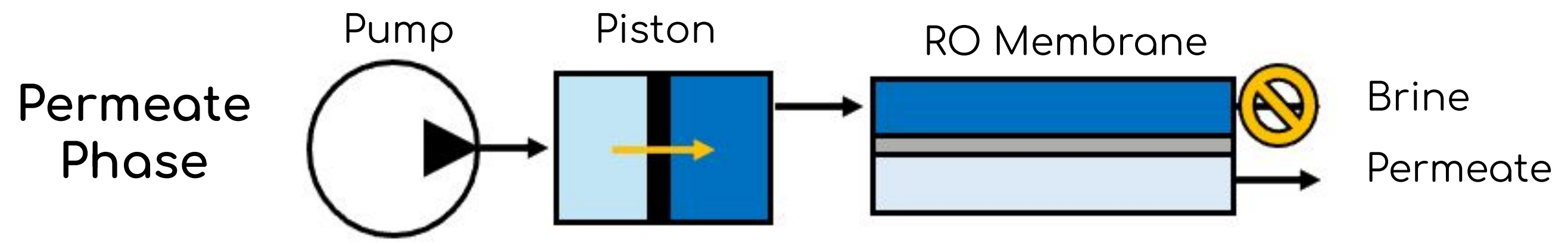
Problem Statement

Reinvent existing desalination techniques and meet disaster communities' need for clean water by developing a passive, purely mechanical device capable of filtering seawater using tidal wave energy.

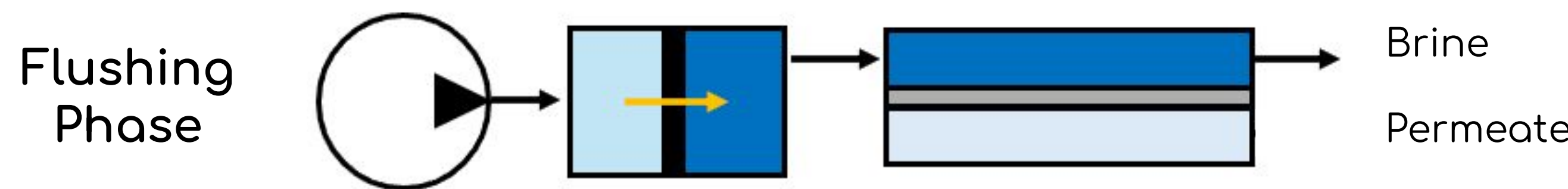
Reverse Osmosis (RO)

RO Type	Continuous	Pulse Flow	Batch
Complexity & Robustness	✓	✓	✗
Efficiency	least efficient	→	most efficient
Wave Energy Conversion Compatibility	✗	✓	✗

Pulse Flow (PFRO)

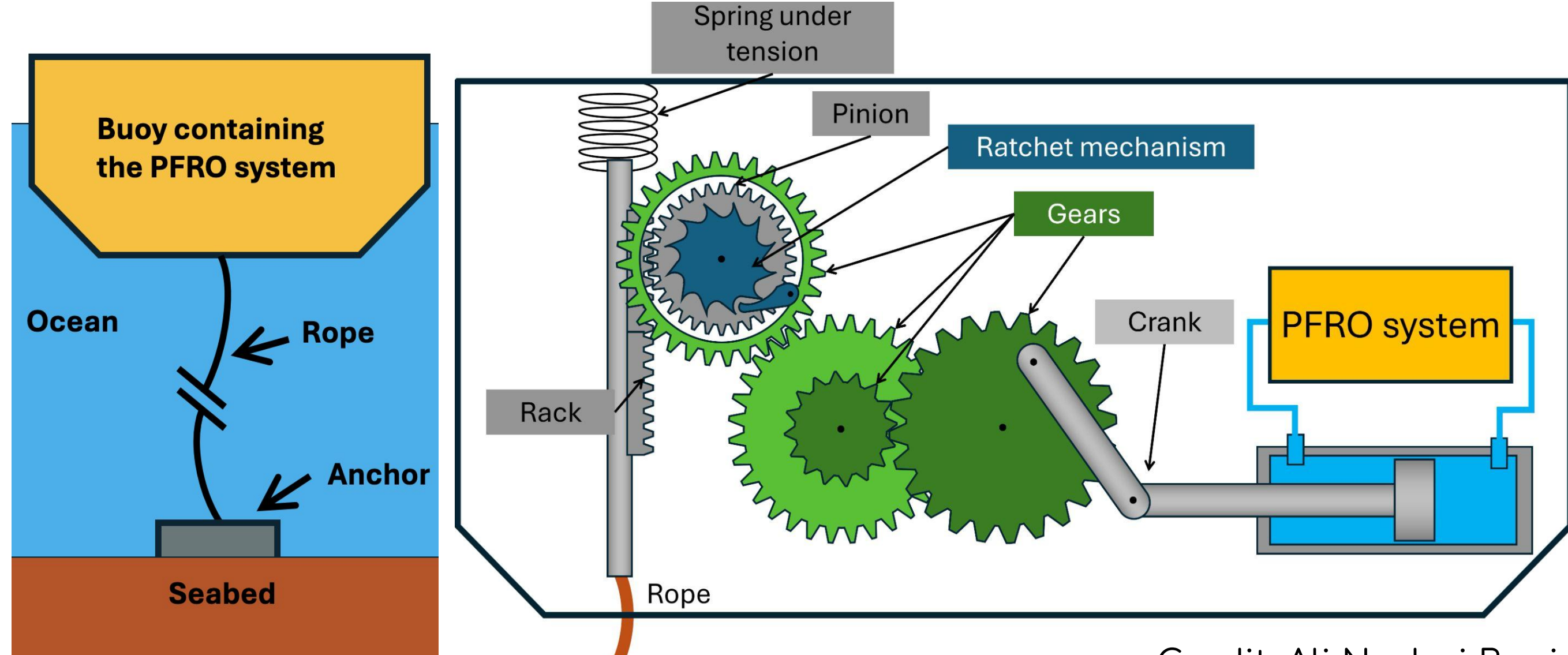


★ Brine output is blocked, forcing all the seawater to filter through the RO membrane and produce only fresh water (permeate)



★ Brine in RO membrane is flushed out and replaced with seawater

Wave Energy Converter (WEC)



Credit: Ali Naderi Beni

Benchmarks & Market

Oneka Technologies - IceCube

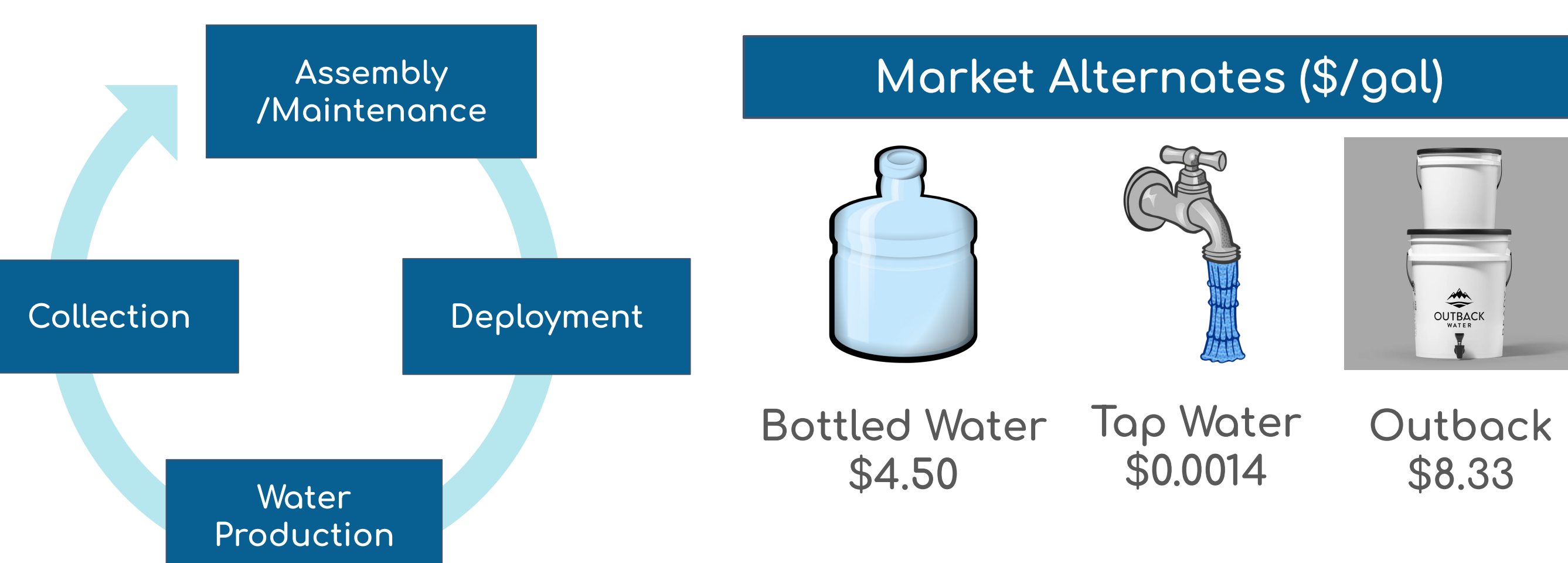
- ★ Continuous RO (265 gal/day)
- ★ Externally powered

Outback - Water Filtration System

- ★ Gravity Powered (24 gal/day)
- ★ Only fresh water

Market Growth
 ★ Marine energy market size will grow from \$914.2 million (2022) to \$6,226.78 (2032) - Precedence Research

Business Case

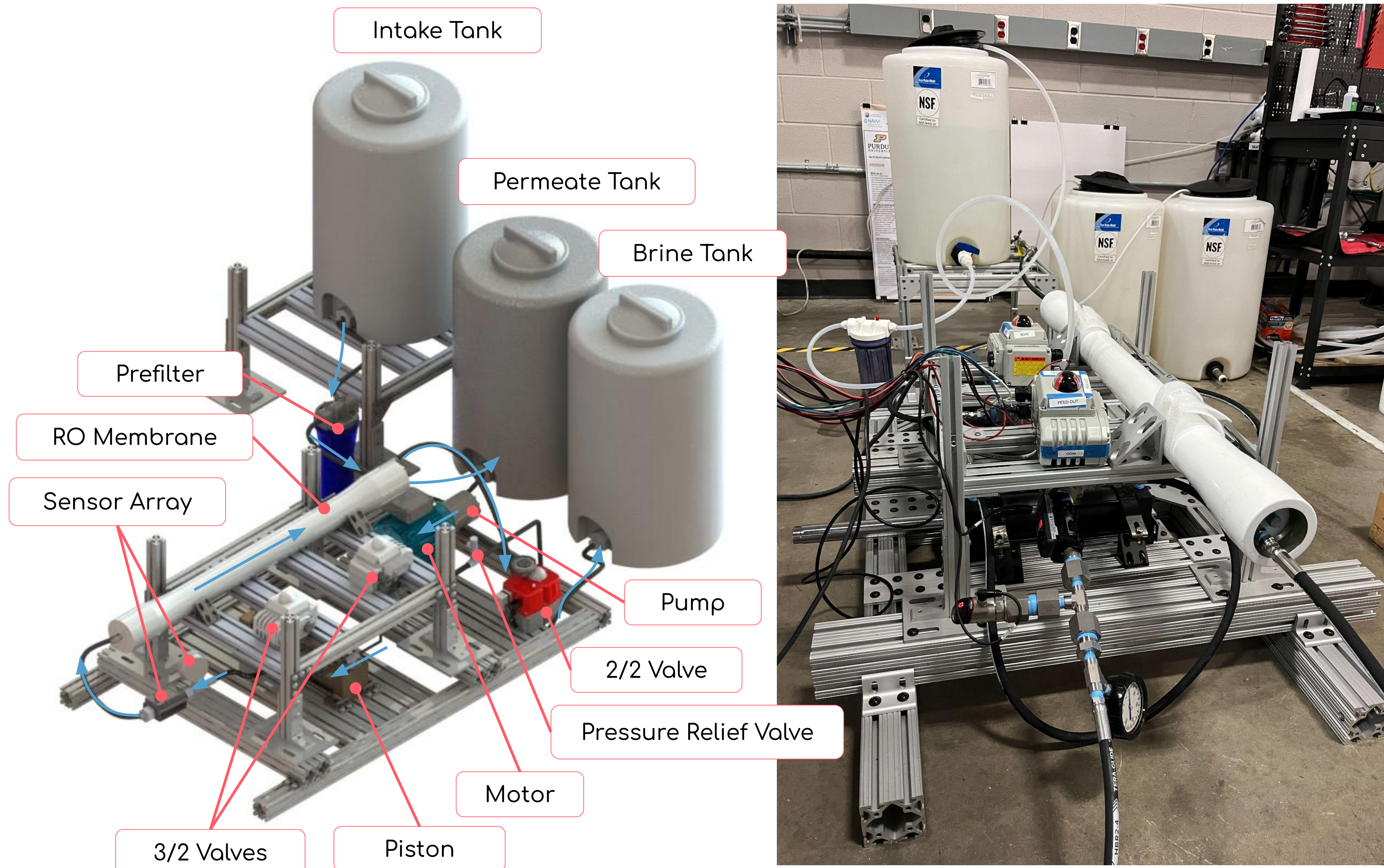


Our Solution		
\$/gal	Production Cost	Annual Revenues
\$0.02	\$5,870.59	\$28,461.02

Acknowledgements & Credits

- ★ Dr. David Warsinger & Dr. Jose Garcia
- ★ We want to thank Herrick faculty and staff, the Department of Energy, and the Warsinger Water Lab for their continued support.
- ★ CAD Credit: 80/20 for supports and Valworx for 3/2 and 2/2 valves

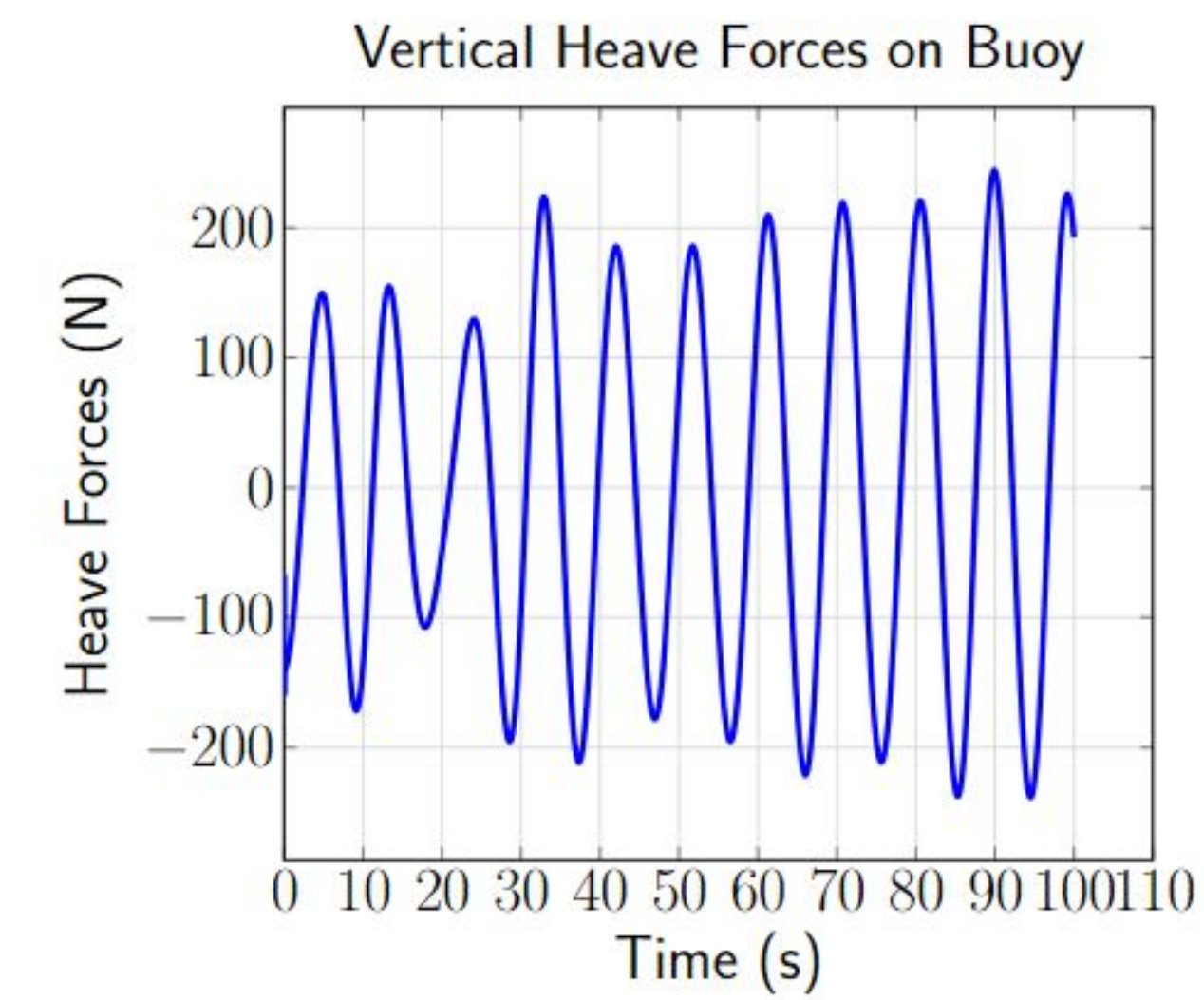
Final Design & Test Bench Build



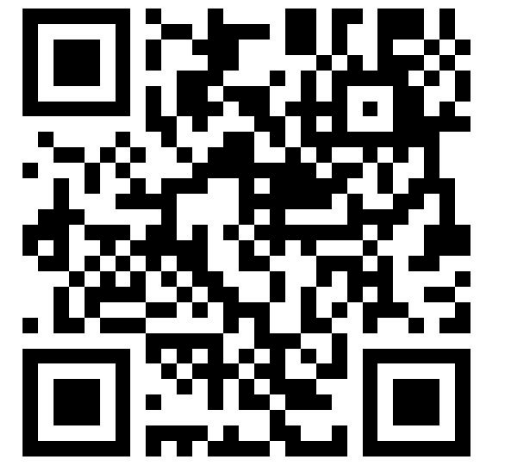
Design Metrics

- ★ Impact a "Blue Economy Market" → Desalination in Coastal Communities
- ★ Due to commercial membrane specifications, the most efficient pressure is 950 psi → System Operating Pressure
- ★ Produce a consistent flow rate of fresh water → 1 L/min

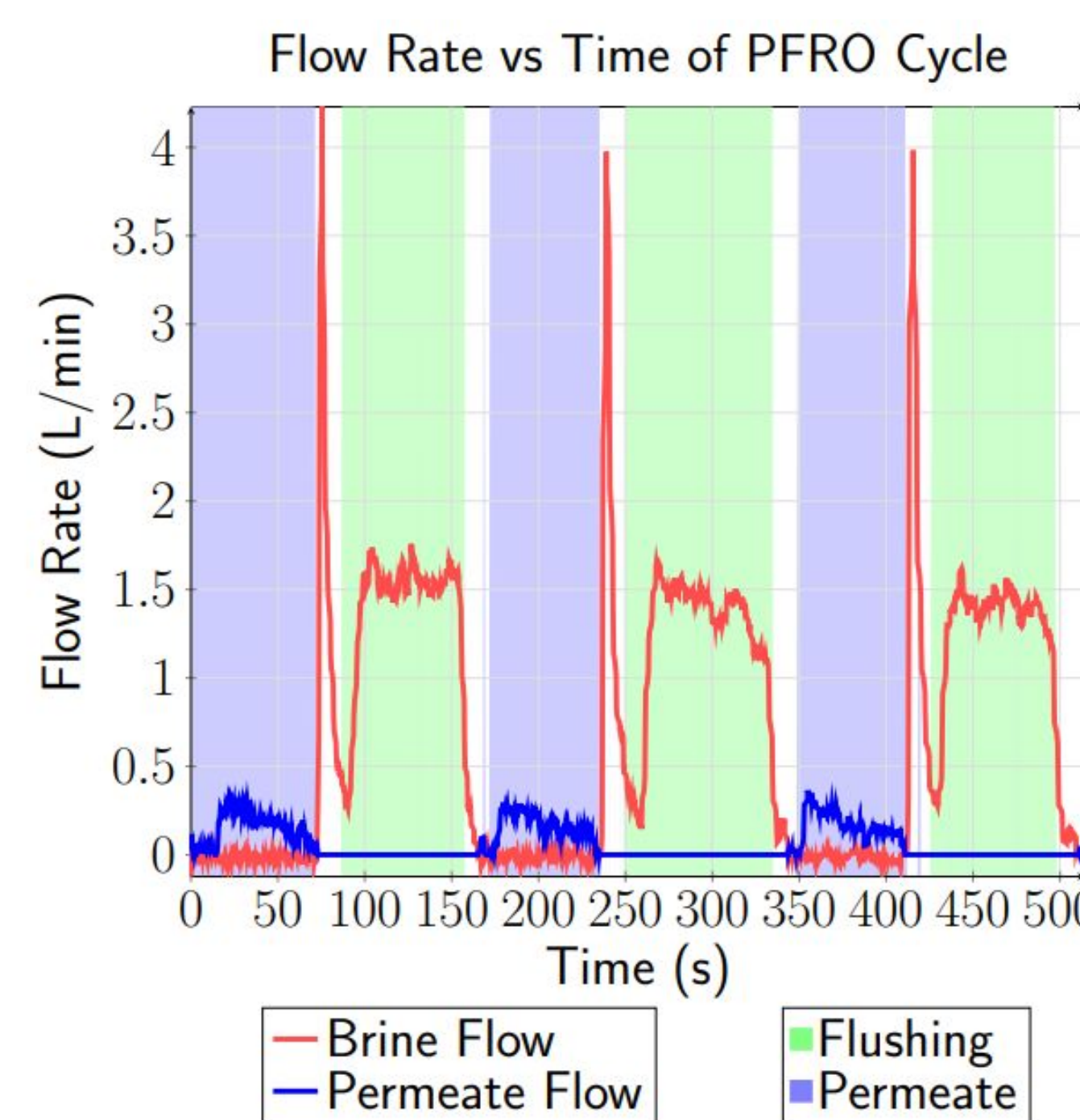
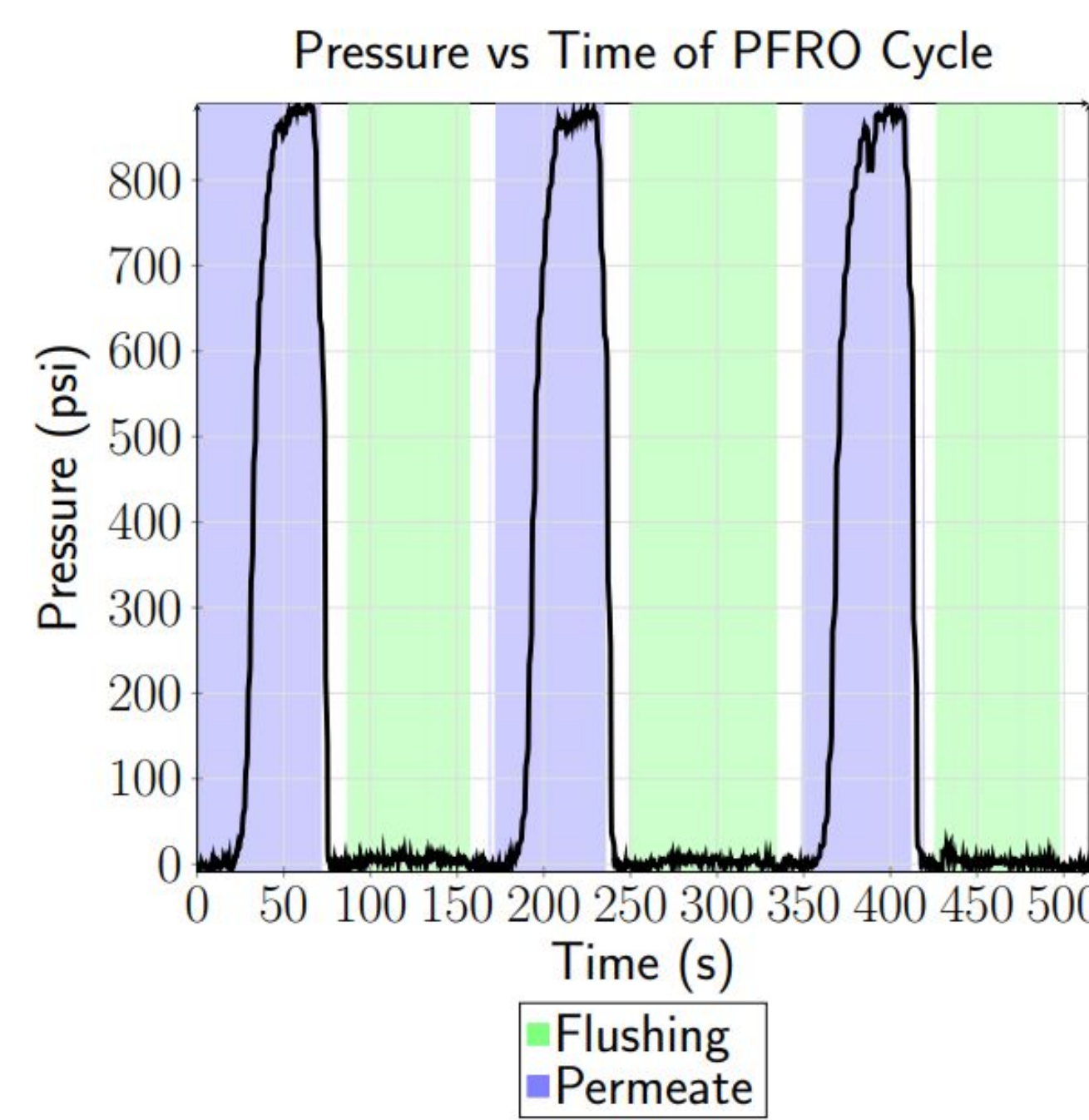
WEC-SIM Analysis



WEC-SIM simulation of buoy to obtain heave force calculations, with 3 DOF



Testing & Results



System Data

- ★ Peak Pressure - 890 psi
- ★ Peak Permeate Flow - 0.45 L/min
- ★ Peak Brine Flow - 4 L/min
- ★ SEC - 1.06 kWh/m³ (constant) and 1.03 kWh/m³ (irregular)
- ★ Second-law efficiency - 45%

Salinity Data

- ★ Feed Salinity: 29 g/L
- ★ Brine Salinity: 34.9 g/L
- ★ Permeate Salinity: 2.9 g/L

Future Improvements

Existing Prototype	Final Product
★ Stable operating pressure of > 950 psi	★ Purely mechanical system
★ Increased flow rate for higher permeate output	★ Buoyant shell & Anchor mechanism
★ Run continuously to improve permeate salinity	★ Pressure exchanger between permeate and brine
	★ Permeate is piped to land

PFRO System Schematic

