# Using Ocean Thermal Gradients to Desalinate Water for Remote Islands via Membrane Distillation

POWERING the BLUE ECONOMY
Marine Energy Collegiate Competition
U.S. DEPARTMENT OF ENERGY

Marine EnergY & Oakland University


## Marine EnergY & Oakland University (ME & YOU) Team

*"Because Clean Water and Clean Energy Should be for Everyone"*

*Students*: Matthew Brauer, Gerard Griest, Saber Khanmohammadi, Lance Markowitz, Sanjana Yagnambhatt, Mike Zheng. *Faculty Advisor*: Prof. Jonathan Maisonneuve


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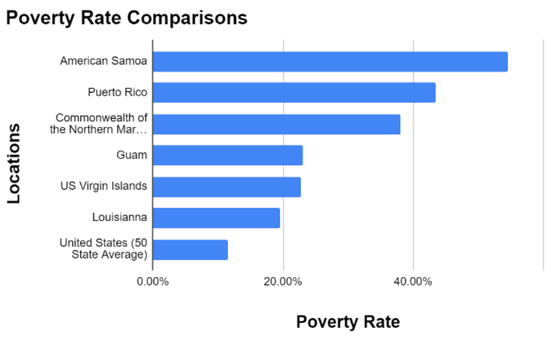
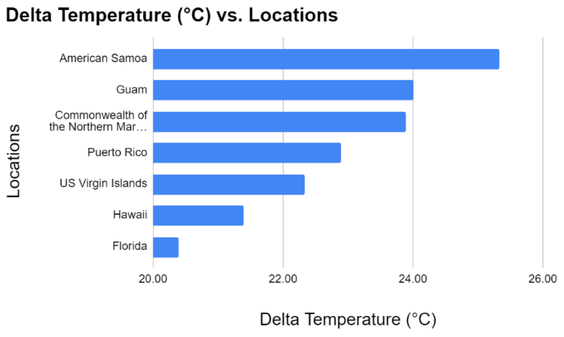
MAY 20-23, 2024 — Ocean Renewable Energy Conference & MARINE ENERGY COLLEGIATE COMPETITION — WORLD FORESTRY CENTER PORTLAND, OREGON

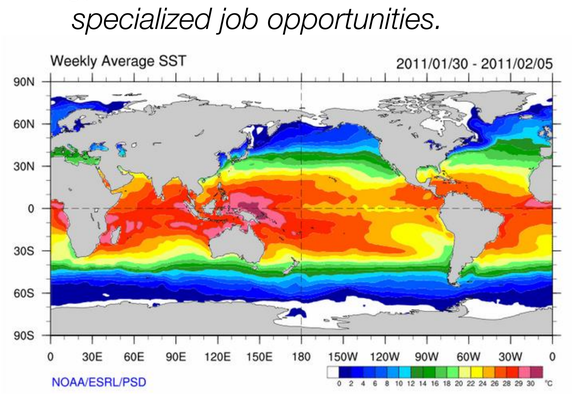
## Remote islands need freshwater and have access to large ocean thermal gradients



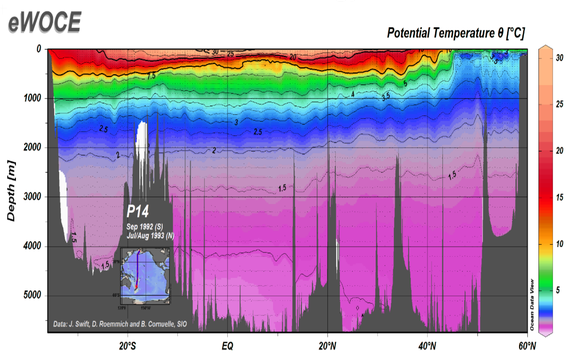

*We used poverty rates to identify remote islands that could benefit most from lower energy and water costs and increased specialized job opportunities.*




*A larger change in temperature between surface water and deep ocean water increases the efficiency and cost effectiveness of our technology.*

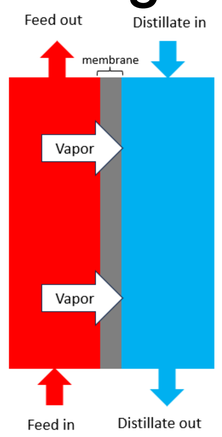



Average temperature difference between surface and deep ocean waters can reach up to 30 ℃ in some locations.

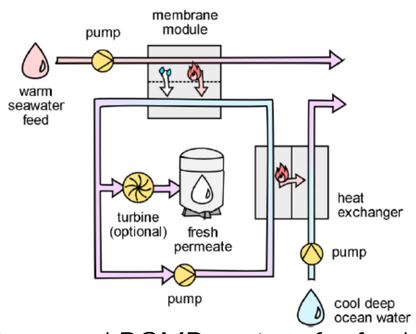



Location near American Samoa with large temperature difference between surface and deep water

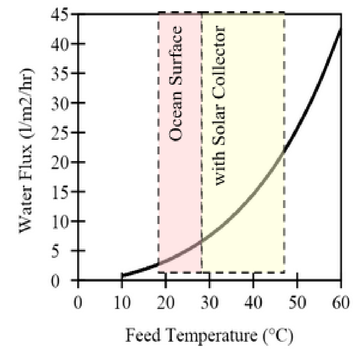
## Membrane distillation (MD) can use ocean thermal gradients to produce clean water



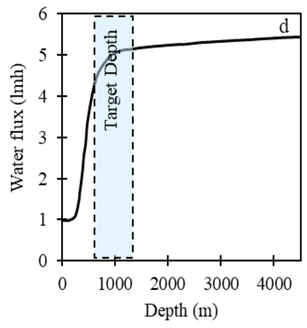

*MD is a thermal desalination process where water vapor passes through a porous hydrophobic membrane. Heating to one side of the membrane creates a vapor pressure difference, facilitating the purification of water.*




*Proposed DCMD system for fresh water production*

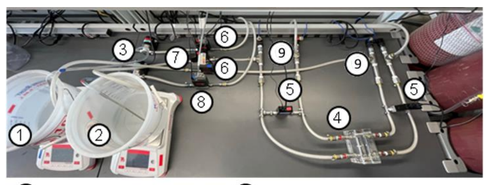



Rate of desalination depends on the temperature difference across the membrane. Additional solar energy increases the temperature difference.

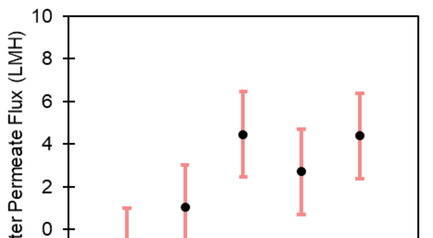



Desalination rates increase at deeper depths for cooler water but require larger pumping and piping costs.

## We successfully demonstrated seawater desalination using low temperature MD

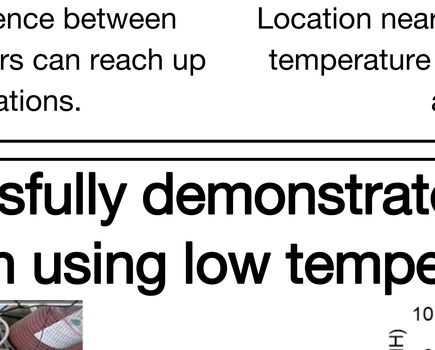



*We designed and built a thermally driven DCMD test system at Oakland University.*







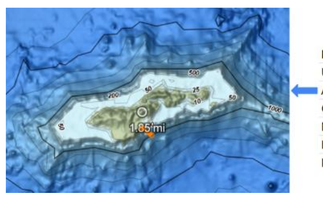



*Test results of the prototype system suggests MD using ocean thermal gradients is a viable option to produce potable water*




*The system includes pressure, flow and temperature and sensors/controllers. In addition to a custom PID temperature controller.*

## Ocean thermal driven MD can provide water at competitive prices and aligns with the goals of stakeholders




| Locations | km from shore for 1000m |
|---|---|
| US Virgin Islands | 1.45 |
| American Samoa | 3 |
| Guam | 4.8 |
| N. Mariana Islands | 5 |
| Hawaii | 9.6 |
| Puerto Rico | 11 |

*We identified American Samoa as a great candidate for our proposed system based on environmental, social, and economic opportunities*

### *Industry Professionals*

Dr. Jörg Vogel

Tim Bodell

Katrina Mariner

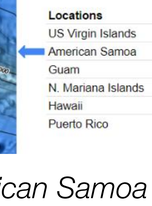
Fonoti Perelini Perelini



Kelley Ruehl

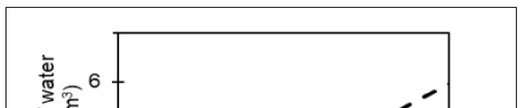


Peter Stricker



Hossam El Rafie

Dr. Carlos Michelén Ströfer







*We estimate the cost of water produced from our system would be between 1.30 and 25.00 $/m3, which compares favorably with the current cost of water in American Samoa, which is 1.17 $/m3.*

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