



**MAKAI OCEAN ENGINEERING**

**Ocean Energy Expertise**

Hermann Kugeler

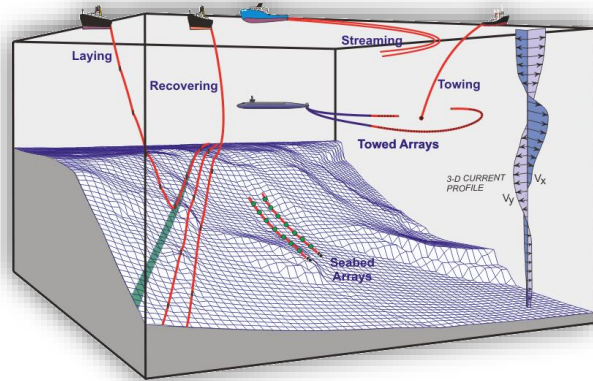
Sustainable Water and Energy Solutions Network Webinar

June 29<sup>th</sup>, 2021

# Makai is...

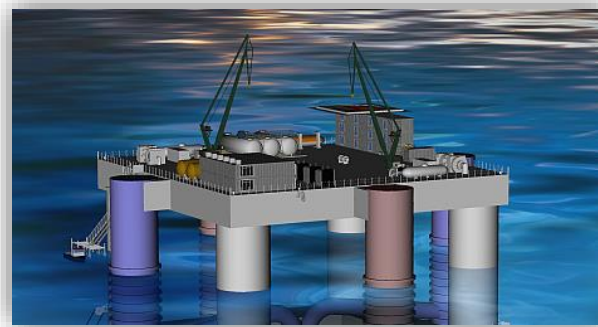


Innovative Ocean Technology Company • Founded 1973 • 37 employees



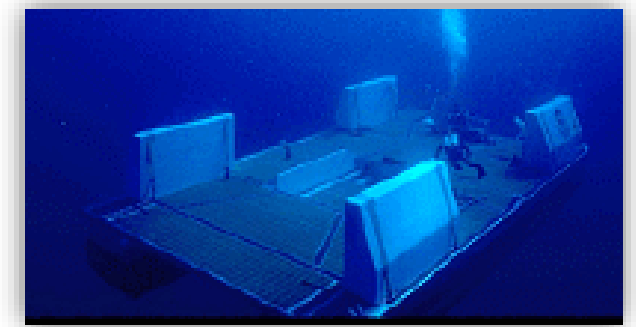
## Submarine Cable Software

- World's #1 cable software
- Installed +250k miles



## Ocean Energy

- Pioneers of SWAC/OTEC
- First US grid connected cc-OTEC plant



## Subsea R&D and Technology

- Naval architecture, vehicles
- Sensor & comms networks

# Seawater Air Conditioning (SWAC)

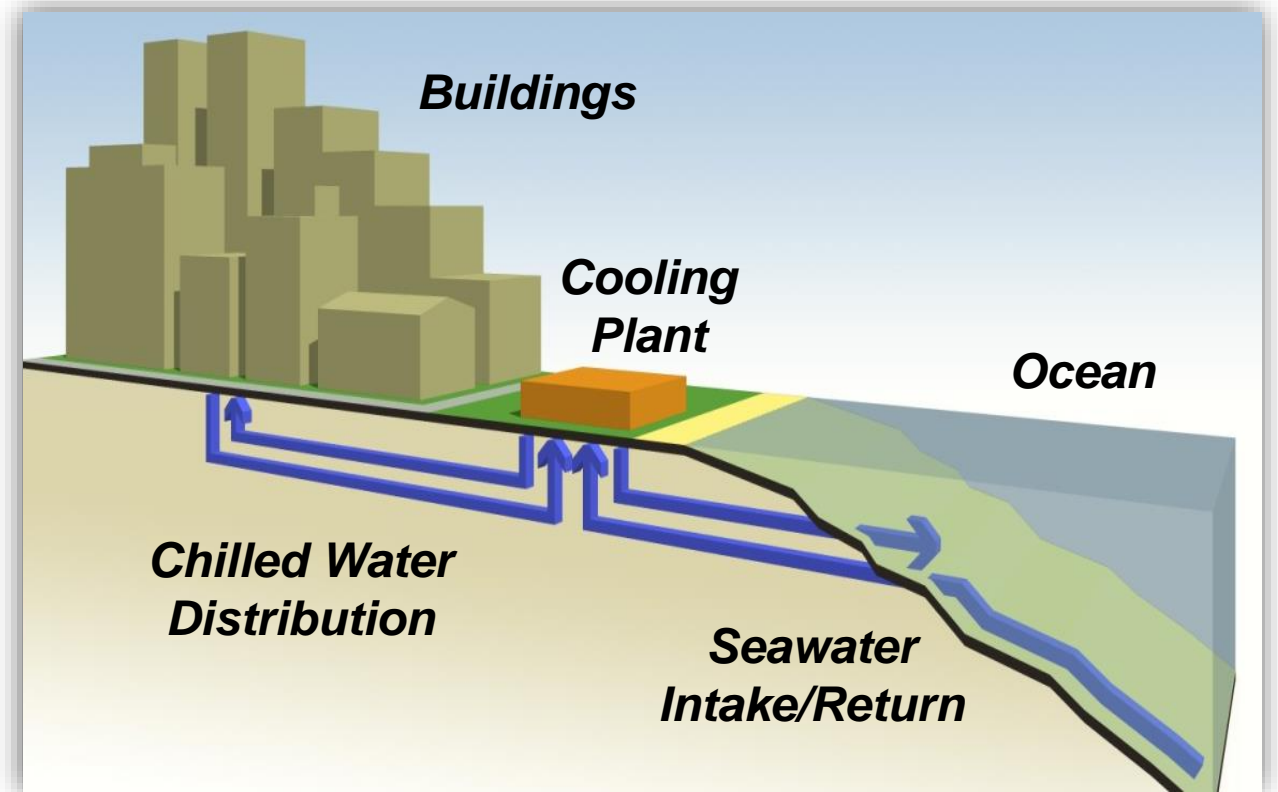
# SWAC: Seawater Air Conditioning

## Main Components

- Offshore pipes
- Chilled water loops
- Pumps
- Heat exchangers

## Benefits

- Economic payback can be <5 years
- Cooling energy reduced up to 90%
- Potable water use eliminated
- Long lasting, simple components
- Multiple commercial installations



**Economically viable technology today!**

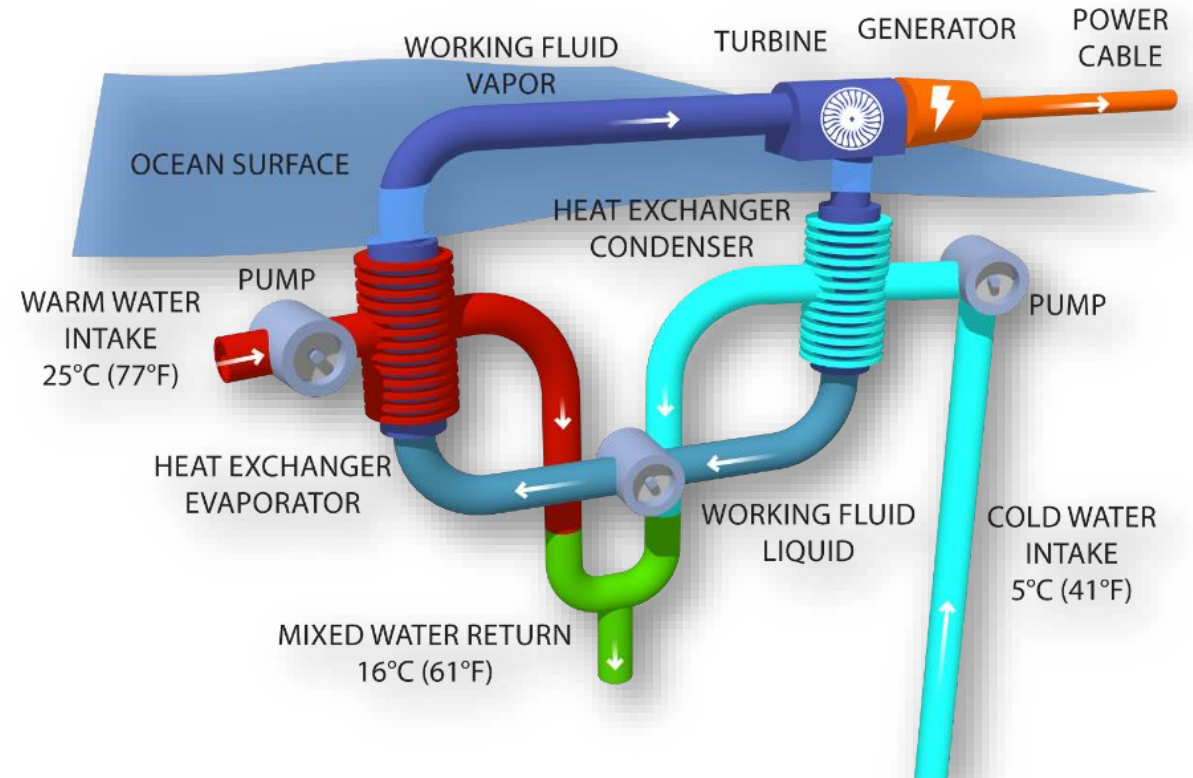
# Ocean Thermal Energy Conversion (OTEC)

# OTEC: Ocean Thermal Energy Conversion

- Leverages temperature differential between surface and deep seawater to power ORC
- Seawater temperatures remain near constant
- Provides baseload power unlike other VREs

## Simple Components

- Heat exchangers
- Turbine generator
- Seawater pumps and pipes
- Working fluid piping and pump



**24/7 baseload renewable energy resource**

# OERC: Ocean Energy Research Center



- First U.S. grid connected cc-OTEC plant
- Plant dedicated Aug 21st 2015

## Project Goals:

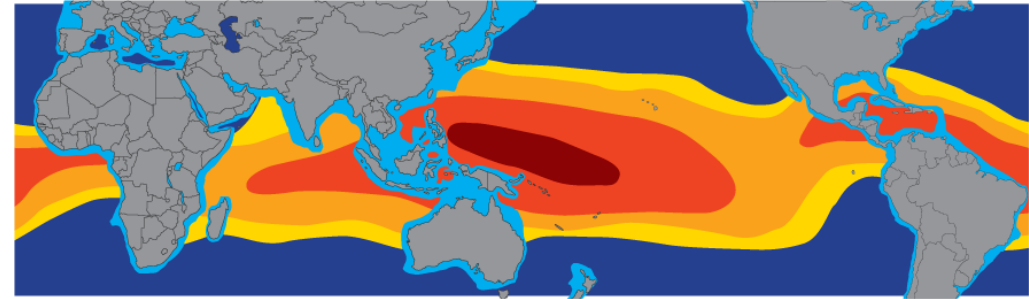
- Develop autonomous OTEC plant controls
- Produce utility-grade electricity
- Gain operational experience
- Improve commercial designs
- Raise visibility of OTEC

**Mission Statement:** To reduce the cost of ocean energy

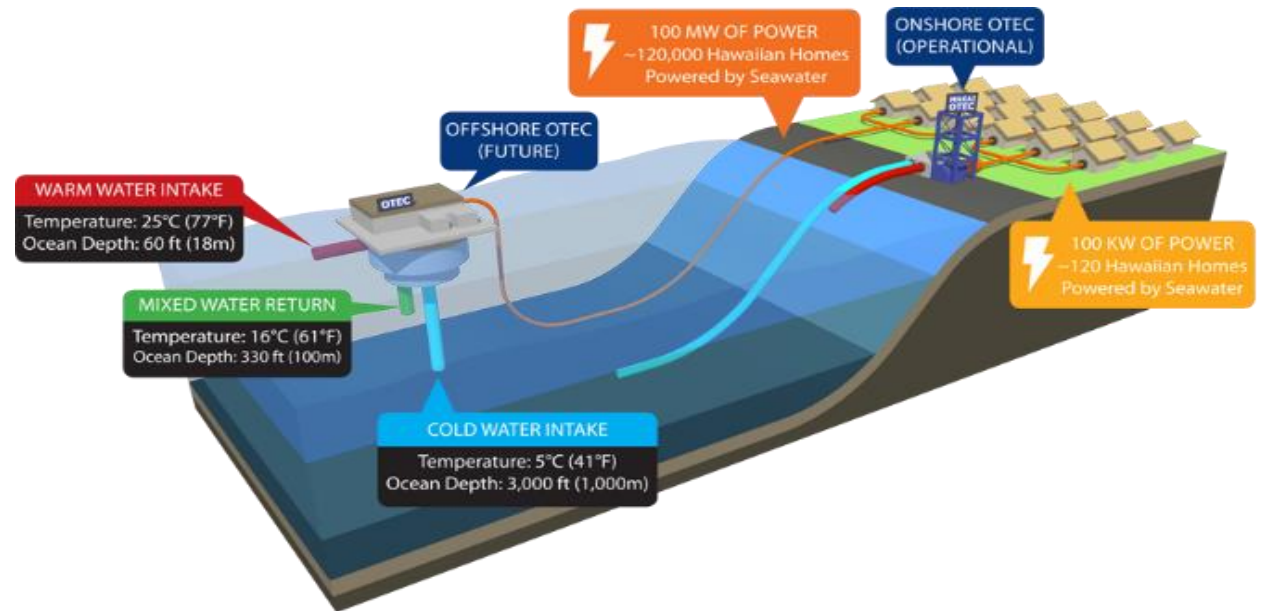
# OTEC's Challenges

- High CAPEX
- Vigorous economies of scale
- Has not been built at commercial scale
- Limited to locations with warm surface waters and cold deep seawater
- Onshore OTEC limited to small scale
- Offshore floating pilot plant needed

## OCEAN THERMAL RESOURCES



Temperature Differences Between Surface and 1000m Depth





# Marine Heat Exchanger Development & Testing

## Heat Exchanger Testing

- Funded since 2009
- Third-party & Makai's own designs

## OERC Facility

- ~45,000 liters/min seawater
- High accuracy instrumentation
- Fully automatic controls

**Takeaway:** No heat exchanger on the market meets OTEC's high demands.



# Makai's Thin Foil Heat Exchanger (TFHX™)

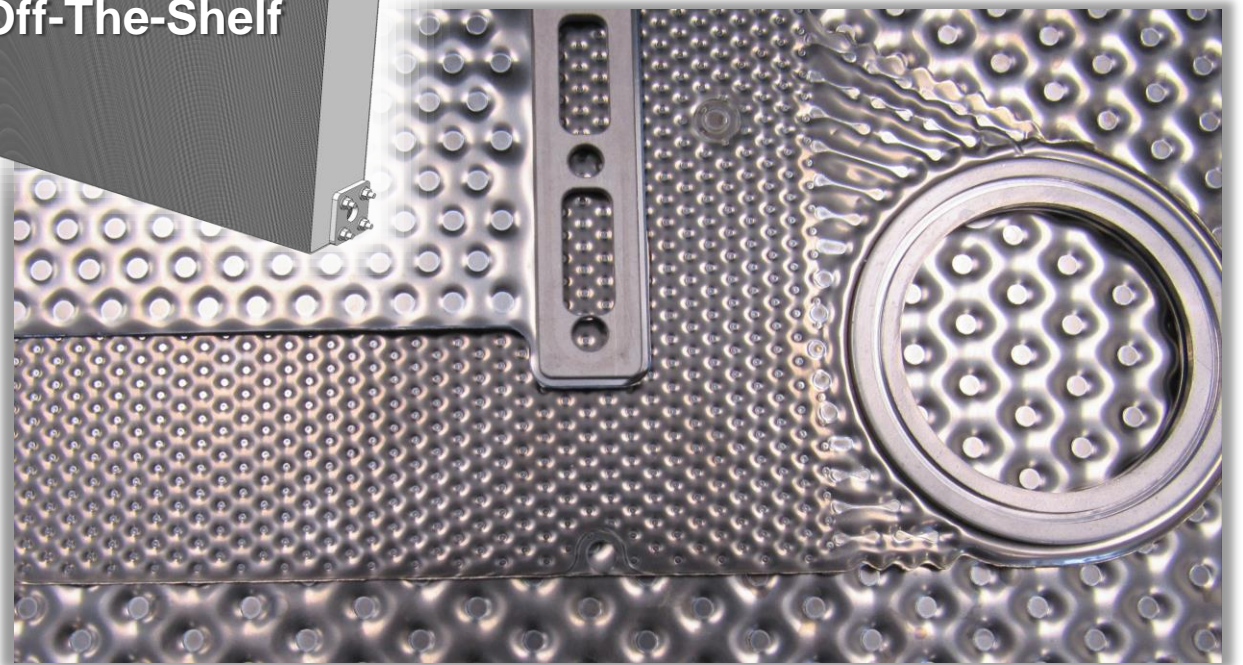
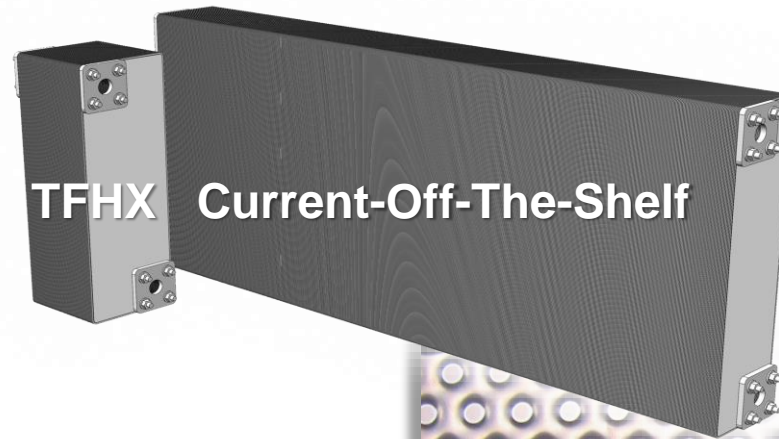
## Features

- Ultra-Compact
- Lightweight
- Corrosion Resistant
- Form Fitting

## Advantages

- Up to 5 - 8x more compact
- Reduced material costs
- Utilizes unused spaces

**True step-change improvement in  
heat exchanger technology!**





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***Mahalo!***

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