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SubSeaSail

SubSeaSail Capabilities for MHK Energy

OREC 2023
AOS – SSS

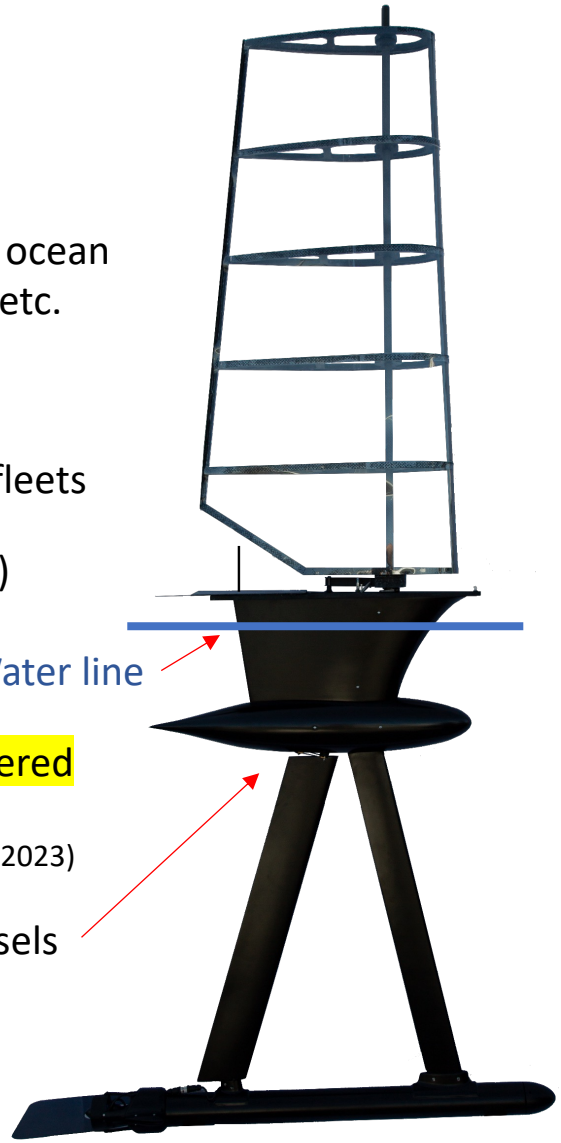
Katie Verlinden, Ph.D.
Applied Ocean Sciences

Getting the best science into the hands of people solving the ocean's hardest problems.

Who We Are

5-year-old Innovative Developer

- **Unique, autonomous platforms & sensors** for ocean observation, cargo delivery, comms gateways, etc.
- **Engineered for durability**, reusable platforms
- **Disruptively economical** to permit swarming/fleets
- **Minimal signature** (acoustic, IR, radar & visual)
- **Highly scalable and variable systems**
- **Long duration**: wind-propelled and solar-powered
- **Submerging**: Factory installed option (beginning 2023)
- **1st Vessel:** Semi-Submersible Observation Vessels
- **Three lines of business**:
  - Monohull observation vessels (HORUS)
  - Multihull cargo vessels (HERMES)
  - Unique sensors



What We Do

Platforms, Sensors and New CONOPS

- **5 U.S. patents issued**. 5 more pending. HORUS (Gen8 = G8) at TRL 7-8. *Adding greater solar capability Lightweight ≈ 34 kg. Easy-to-deploy & retrieve.*
- **Rigid Acoustic Arrays** (with Applied Ocean Sciences [AOS])
- **Heeling Wingsail** (*Patent Pending – Nov. 2021*)
- **Submerging & Righting Capsized Watercraft** (*Patent Pending – Dec. 2021*)
- **Depth Control of Submersible Vessels** (*Patent Pending – June 2022)*
- **Two SBIR Phase I grants** (DOE & NSF) + **Phase II** (DOE) Looking for possible concurrent Phase II awards
- Collaborate with innovative sensor & payload mfgs reducing cost & complexity of unmanned missions
- **Future** 1) larger monohulls 2) cargo multi-hull

Proud to support SDGs

7 AFFORDABLE AND CLEAN ENERGY
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

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SubSeaSail®

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ASGUARD: Advanced SeaGoing & Underwater Research Device

Adding submerging & EMF monitoring capabilities to HORUS

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SSS DOE SBIR Phase I (June 2021-June 2022)

DoE is seeking low-cost, user-friendly environmental monitoring and resource characterization tools for Marine and Hydrokinetic (MHK) ocean energy installation sites.
In June 2020, SSS received a SBIR Phase I grant to conceive ASGUARD.
Phase I ended on June 27, 2022.

- SSS has designed submerging vessel to 30 meters with much effort in unique buoyancy engine (Patent Pending);
- SSS worked with AOS on an acoustic array that will work at the surface and underwater to 30 meters;
- Identified magnetometers that can be integrated in Phase II;
- Required review of solar and electrical capability to support sensors & submerge to 30 meters; and
- Before the end of Phase I, SSS demonstrated a prototype submerging capability in a NOAA 2-million-liter tank.

HORUS with extended rigid X2(4) acoustic array

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Submerging Capability being Developed

(Pictures from Phase I DOE – June 2022)

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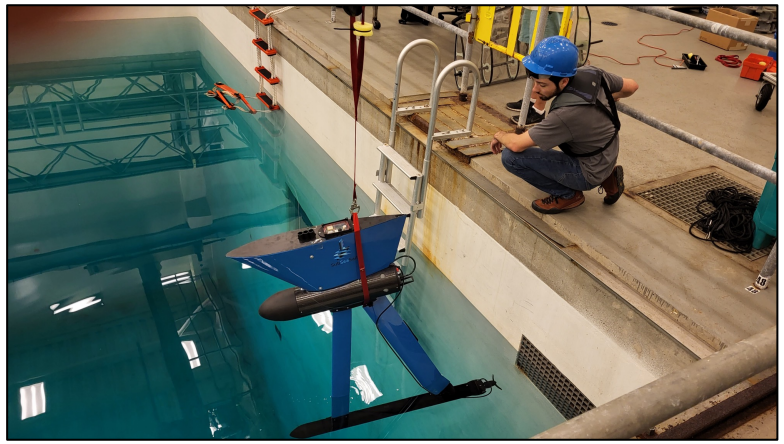
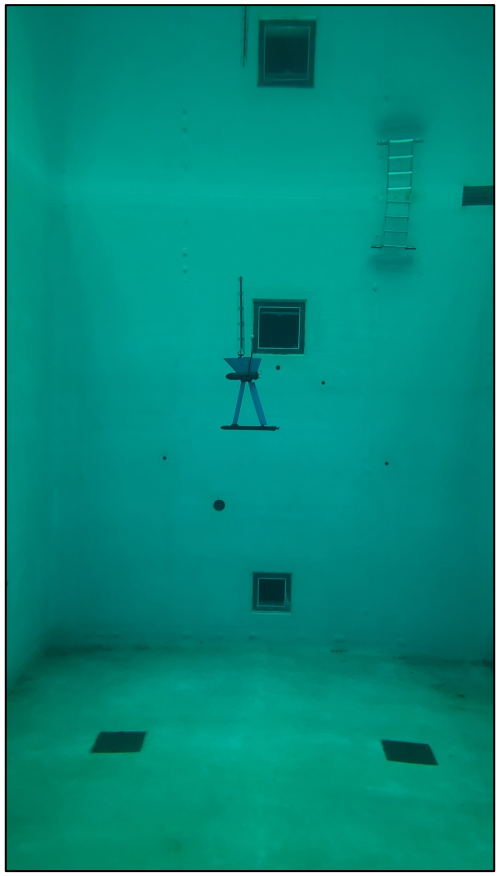


Deploying

Submerging



Holding Position

Submerging capability will allow vessels to hide from bad actors/weather and listen/monitor underwater

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SSS DOE SBIR Phase II (Aug 2022-Aug 2024)

*The purpose of an Initial Phase II award is to perform the research and development (R&D) required to meet DOE objectives…In many cases, Phase II results in a prototype, product, or working process that can be demonstrated to a potential investor or customer…**Award confirmed July 22, 2022.***

First 12 months:

- SSS will develop submerging MHK monitoring vessel with sensors capable of functioning to 30 meters
- SSS will add e-field sensor to sensor suite
  NOTE: *ASGUARD will have other uses (e.g., Homeland Security and DOD)*.
- Investigate other sensors that could be useful for environmental monitoring of offshore energy installations

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Second 12 months (as soon as completed):

- Deploy the 30-m submerging vessel for in-ocean testing and baseline measurements over extended period at PacWave with Oregon State University (& possibly others)
- Develop a stronger vessel with sensors to be able to submerge and function down to 100 meters

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Sensors

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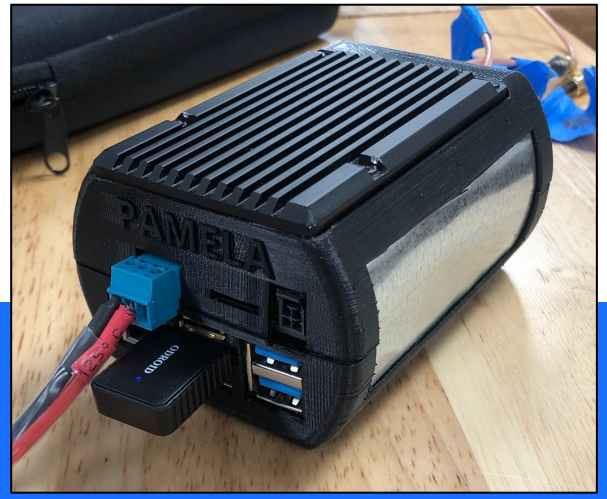
Third party sensors successfully deployed:

- CTD (Conductivity, Temperature, and Depth) sensor - with US Army Corps of Engineers (USACE)
- Leaking explosive detection – with USACE
- Turbidity sensor – with USACE
- UUV carried (to simulate future deployment) – ANTX Gulfport 2019
- Video (GoPro cameras) – with USACE

SSS Sensors (to take advantage of unique HORUS vessel attributes) (*acoustic equipment developed with partner Applied Ocean Sciences*)

- Multiple rigid acoustic arrays: kickstand array, 4 hydrophone L-array, reconfigurable array, 1 hydrophone towed array
- PAMELA™ (Passive Analog/acoustic Monitoring Electronic Logging and Acquisition) 5” on-board processing unit for acoustics & other sensors designed to be low-SWaP (Size, Weight, and Power) (below left)
  - Weather observation station + 360° light mounted on mast (below center)
    (Combined with IMU in computer box, this is like a moveable weather buoy)



Weather Station Specifications (Preliminary):

Wind Speed Range	0.1-60 knots
Wind Sped Accuracy	5%
Wind Direction	+/- 180 degrees, relative to mounting
Wind Direction Accuracy	+/-4 degrees
Temperature Accuracy	+/-1 degree C
Barometric Pressure	+/- 0.5 mbar
Weight	150 gm
Power	12V, 25 mA
Waterproof	30m
Output	RS232, max 10Hz
Connector	8 Pin MCIL, mates with SubSeaSail MastLight

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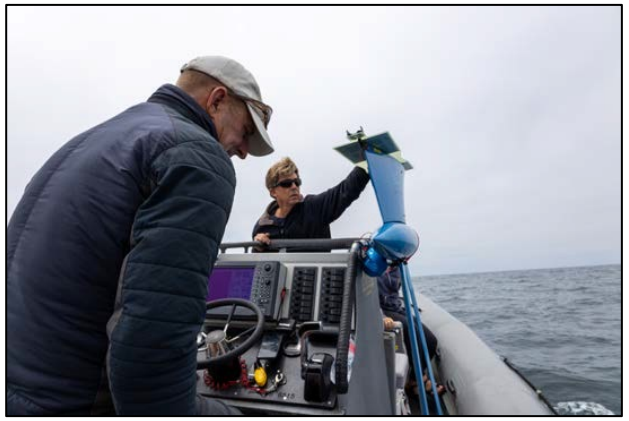
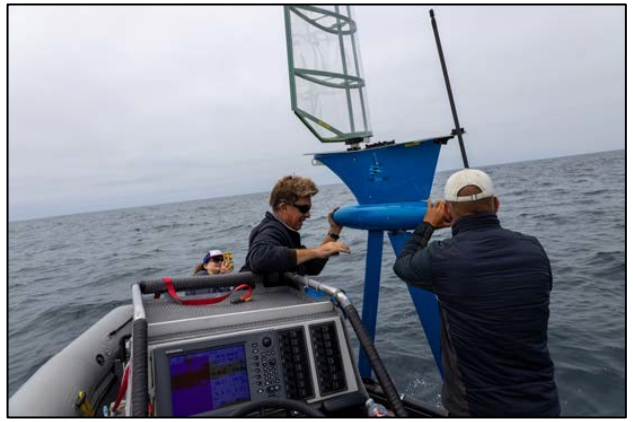
Easy-to-Deploy





Easy-to-Recover

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SubSeaSail Can Help MHK Development!

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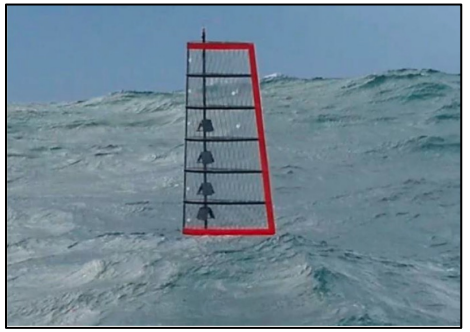
1. Sound created (especially during poor weather)



2. Marine life impacts

Pamela Martinez-Loustalot, UABCS

3. Electromagnetic fields

https://www.bbc.com/news/uk-scotland-south-scotland-58869465

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3. Electromagnetic fields

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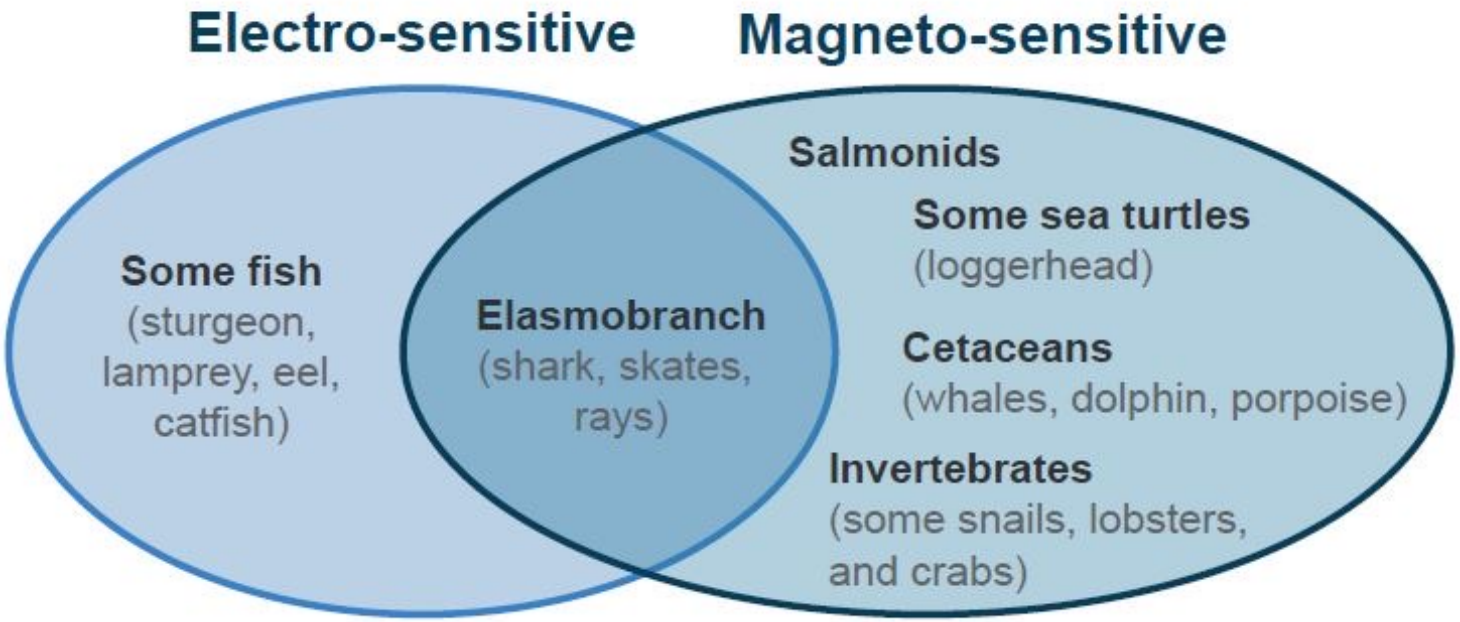

Marine life that can detect electric and/or magnetic fields, use these senses for different life functions, including:

- Navigation and orientation
- Interactions with predators and prey
- Avoidance and attraction

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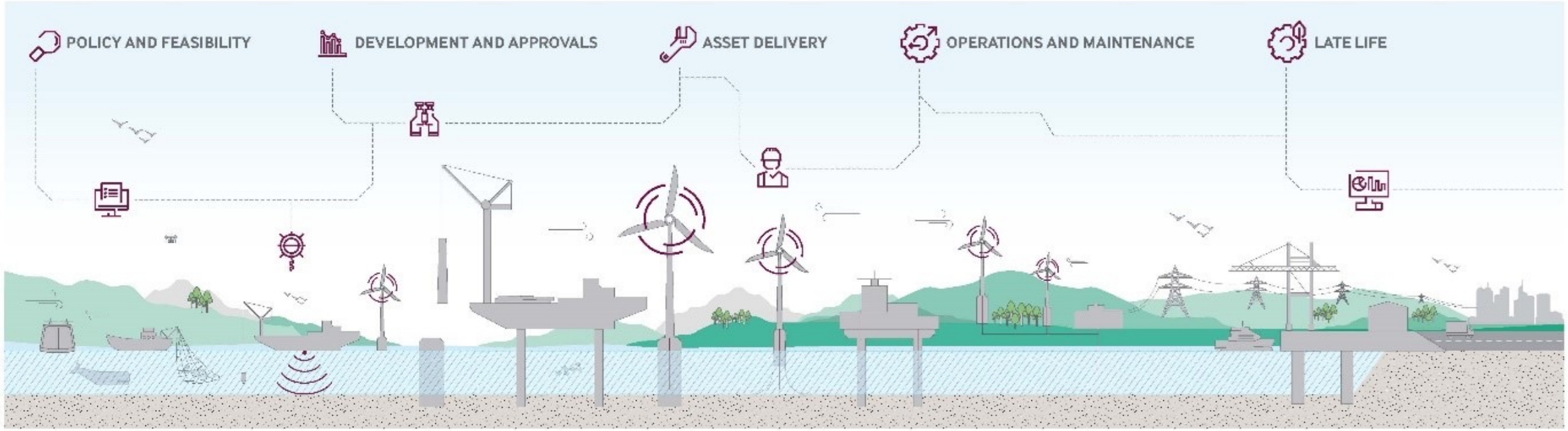

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RPS

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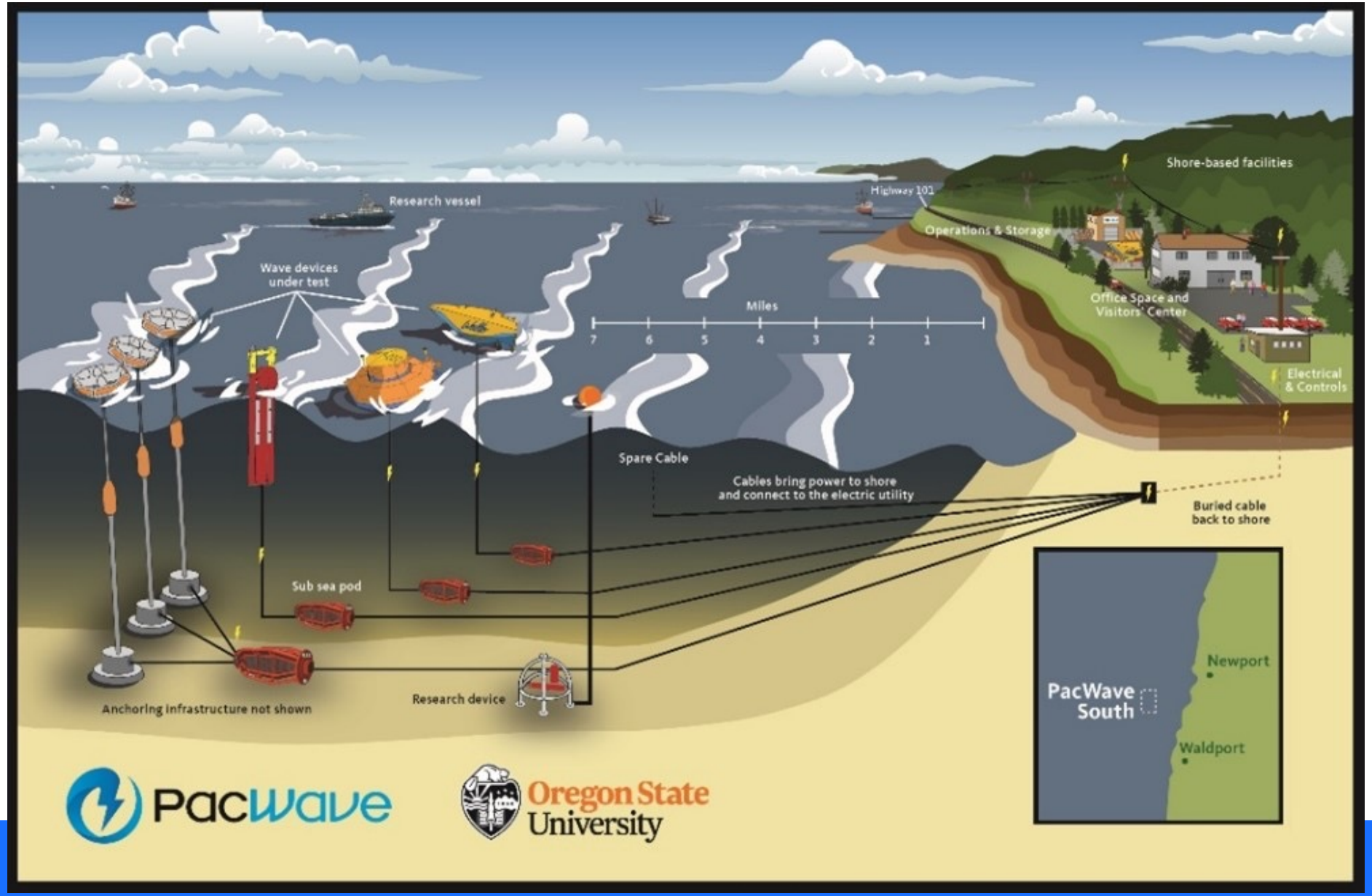

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For More Information

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