

Northwest National Marine Renewable Energy Center: Vision, Progress & Goals

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Outline

- Overview of Northwest National Marine Renewable Energy Center
- NNMREC Open Ocean Test Facility, Newport Oregon
- NNMREC Plans for Grid Connect Test Facility



US DOE National Marine Renewable Energy Centers



Northwest National Marine Renewable Energy Center (NNMREC)

- University of Washington (tidal)
- Oregon State University (wave)

Hawaii National Marine Renewable Energy Center (HINMREC)

- University of Hawaii
- Wave, OTEC

Southeast National Marine Renewable Energy Center (SNMREC)

- Florida Atlantic University
- Ocean Current
- OTEC



The Northwest National Marine Renewable Energy Center (NNMREC)

- A partnership between Oregon State University & the University of Washington funded by the U.S. Department of Energy
- Develop a full range of capabilities to support wave and tidal energy development
- Center activities are structured to:
 - Facilitate commercialization of marine energy technology,
 - Inform regulatory and policy decisions,
 - Close key gaps in scientific understanding,
 - Educate the first generation of marine renewable energy engineers and scientists.



OSU's Leading Efforts in Wave Energy Research

Technical

Testing/Demonstration
Forecasting
Survivability/Reliability
Advanced Materials
Device/Array
Optimization

Environmental

Sediment Transport
Electromagnetic Fields
Benthic Ecosystems
Acoustics
Site Characterization

Social

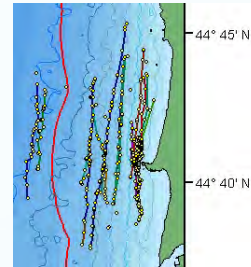
Fisheries/Crabbing
Outreach/Engagement
Existing Ocean Users
Local/State Economies



Environmental Studies at HMSC

• NNMREC Environmental “Seed Projects”

- Seabird colony gap analysis and at-sea distributional information
- Sound propagation model development and calibration
- Population dynamics of mysid shrimp in relation to natural and artificial structures in habitats targeted for wave energy development



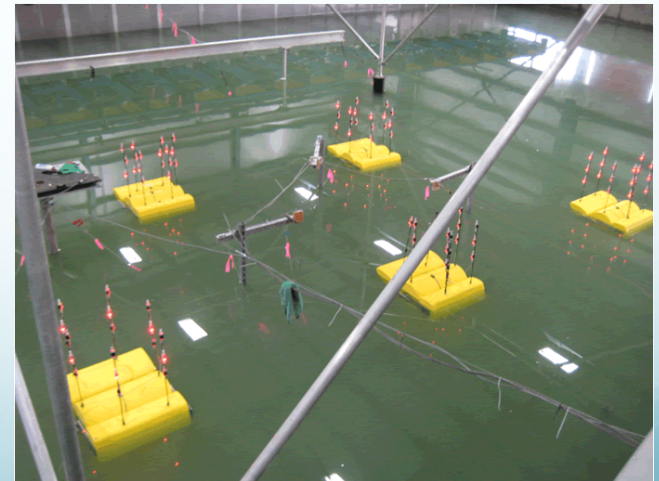
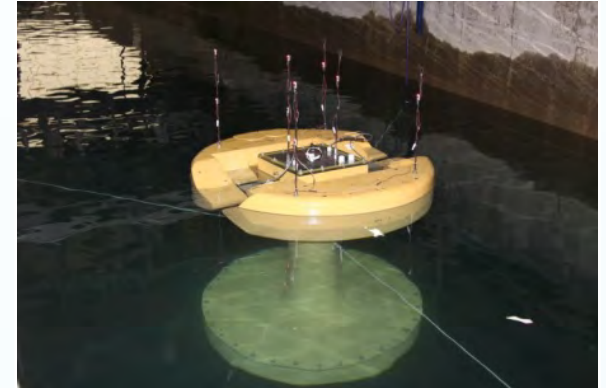
• OWET Collaborations

- Benthic community baseline characterization
- Gray whale distribution and movement patterns



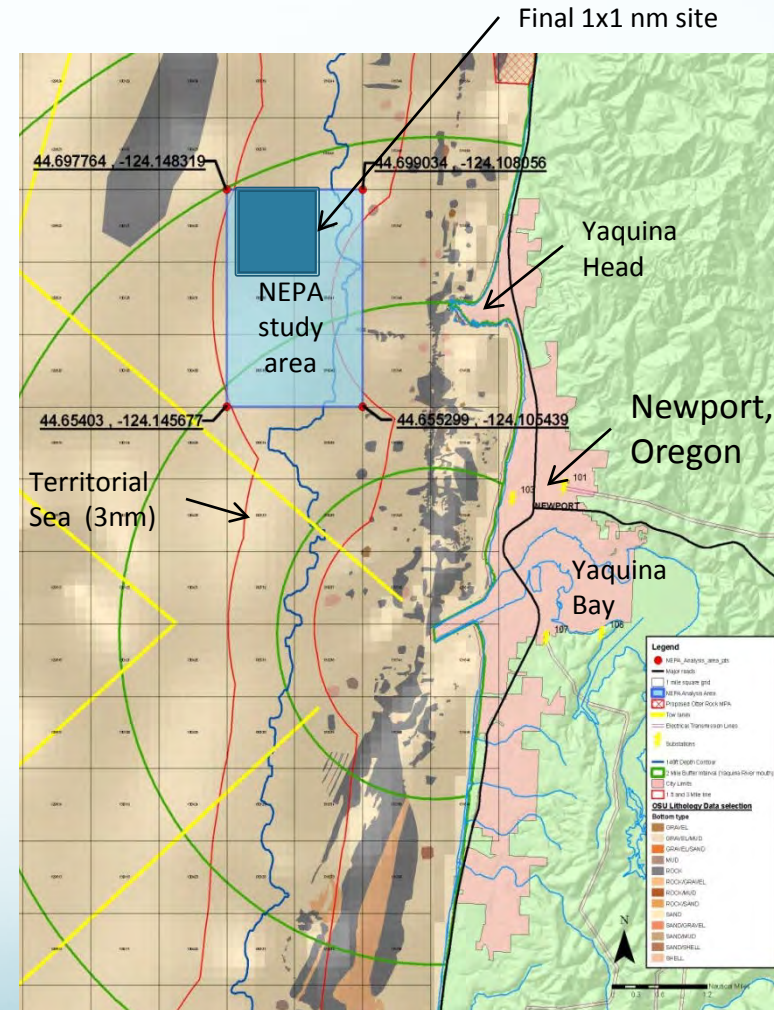
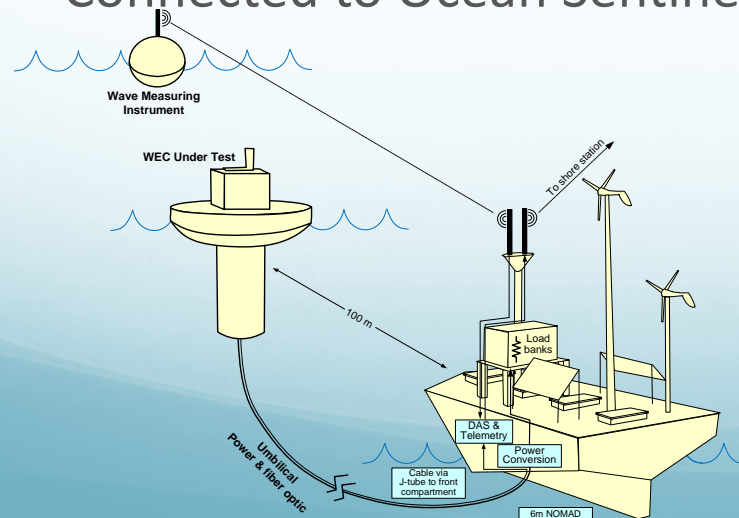
Developer Scaled Testing Support

In 2011 NNMREC tested five different small scale technologies in our facilities

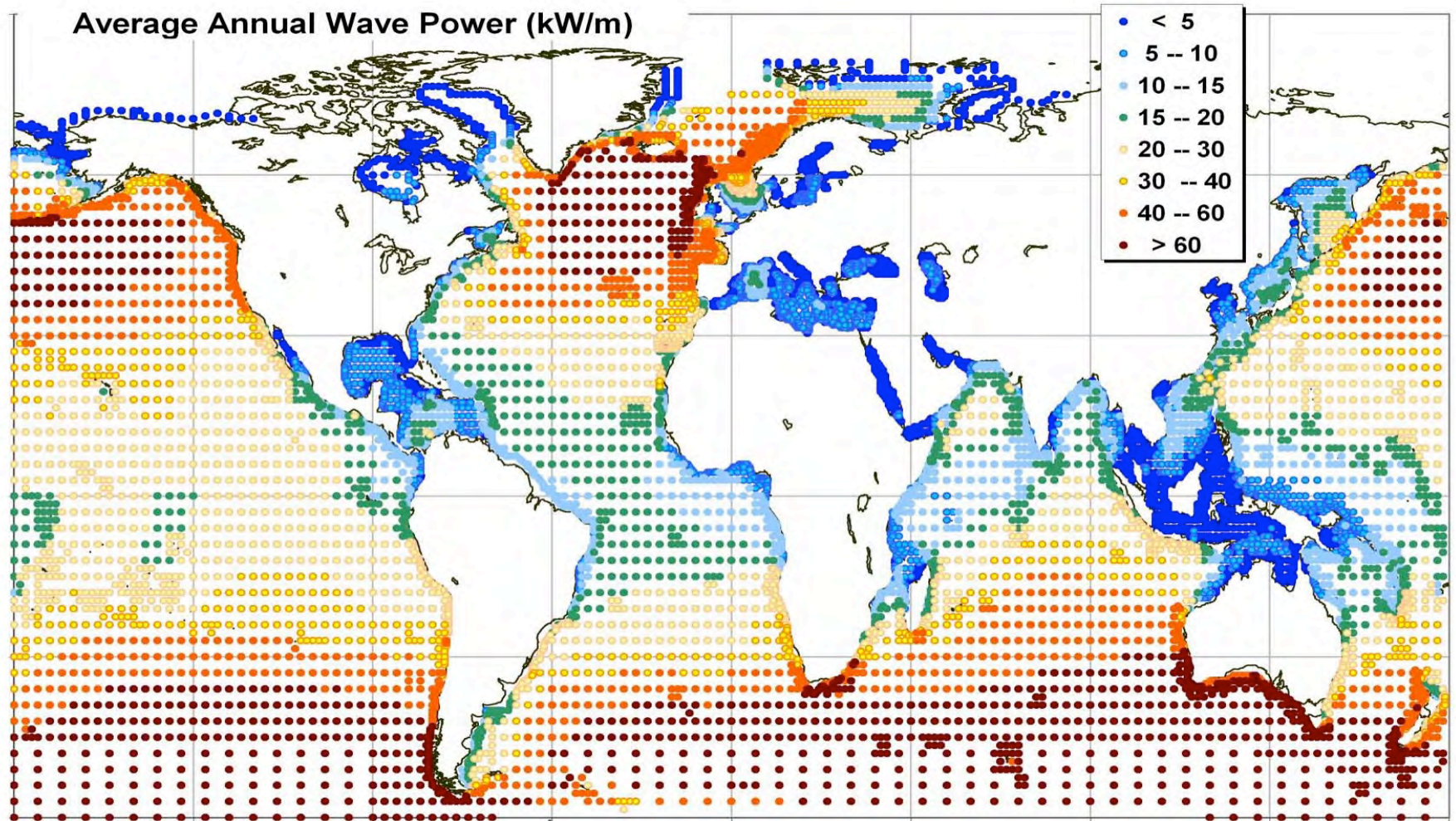


Newport Open Ocean Test Facility

- Permitted Open-Ocean Test Site
- Available Year round
- 2 devices can test concurrently
- Testing Scenarios:
 - Self-contained testing
 - Connected to ship
 - Connected to Ocean Sentinel



Wave Resource Worldwide



Grid-Connected Site: The Oregon Advantage

- **Resource required for TRL 9; summer mild for TRL 5-7**
- **Environmental testing results can be leveraged along the US West Coast**
- **Proximity to manufacturers**
- **Strong state support**
- **Oregon Wave Energy Trust**
- **Site accessibility**
- **NNMREC's "one stop shopping" for testing**
- **Oregon State University research leadership**



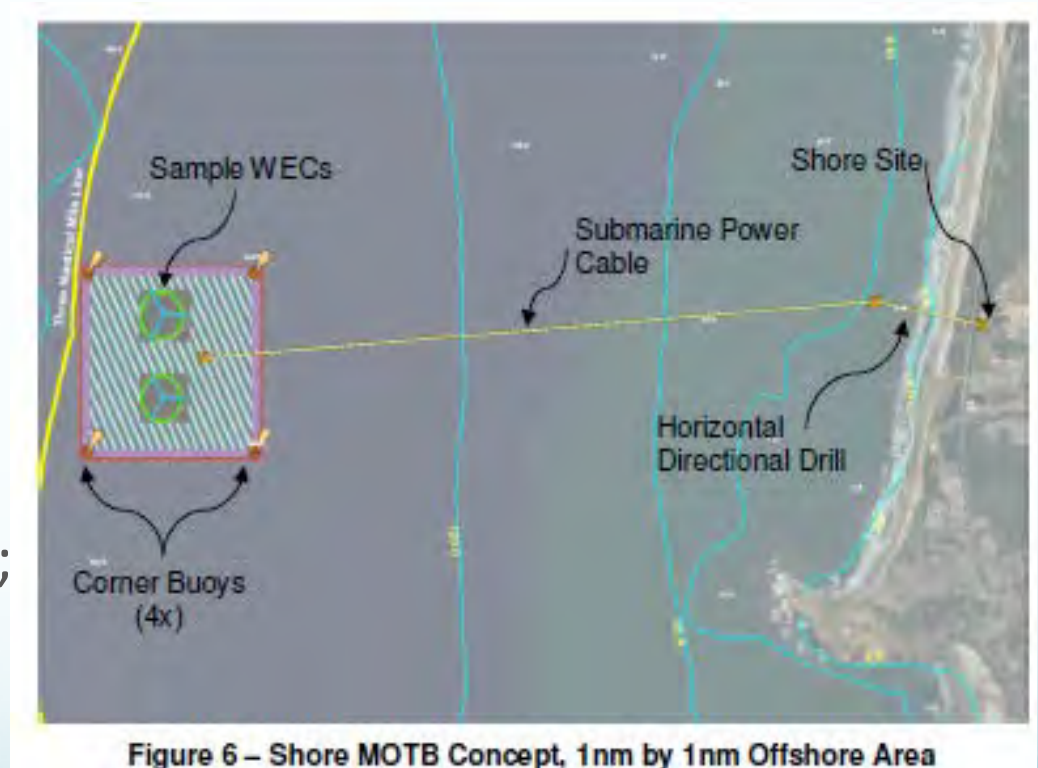
Grid-Connected Site: Feasibility Study

- **Four sites considered: Clatsop County, Newport, Reedsport, Coos Bay**
- **Desired Site Characteristics**
 - 60m in depth, 80 – 100m optimal
 - Sandy or soft bottom preferred
 - Proximity to deep water port (min 30 – 35m depth)
 - Suitable on-shore location for monitoring
 - Proximity to Interconnection: Maximum desired cable length: 3 – 5 miles
 - Proximity to O&M facilities: 1 hr transit each way
 - Minimal negative effects on environment and prior use



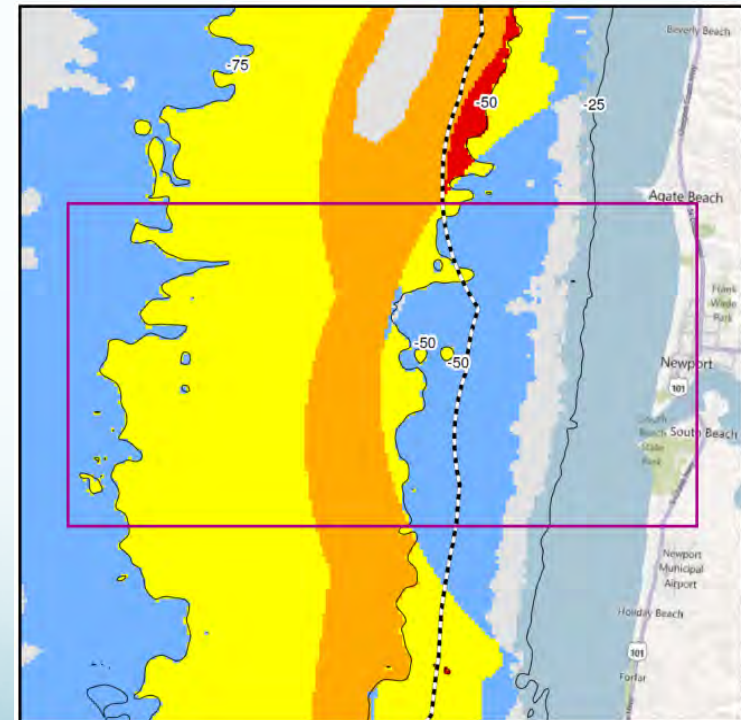
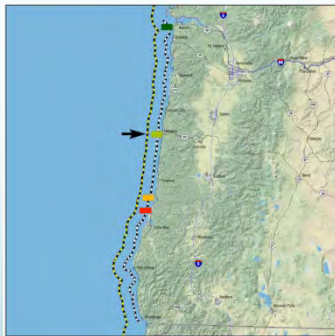
Test Facility Structure

- Bury cable from shore to test site
- Develop shore-side data acquisition system, grid emulator and load bank
- Shore-side infrastructure; connect to grid



Newport, OR

- Proximity to current test site; City leaders have vision of marine science & engineering hub
- Strong relationship with fishing community
- Shallowest port of those considered
- Good proximity to OSU's ship operations, HMSC and Corvallis
- Good proximity to NSF's OOI effort
- Slowly increasing water depth



Our Process

- **Goal: Eligibility for USDOE funding this year (2012)**
- **Meet with smaller groups of community leaders to identify issues of concern and interest in each area**
- **Prepare preliminary development plans for sites**
- **Meet with larger community group to vet local options**
- **Select site**
- **Prepare Development Plan**
- **Apply for funding**



Thank you



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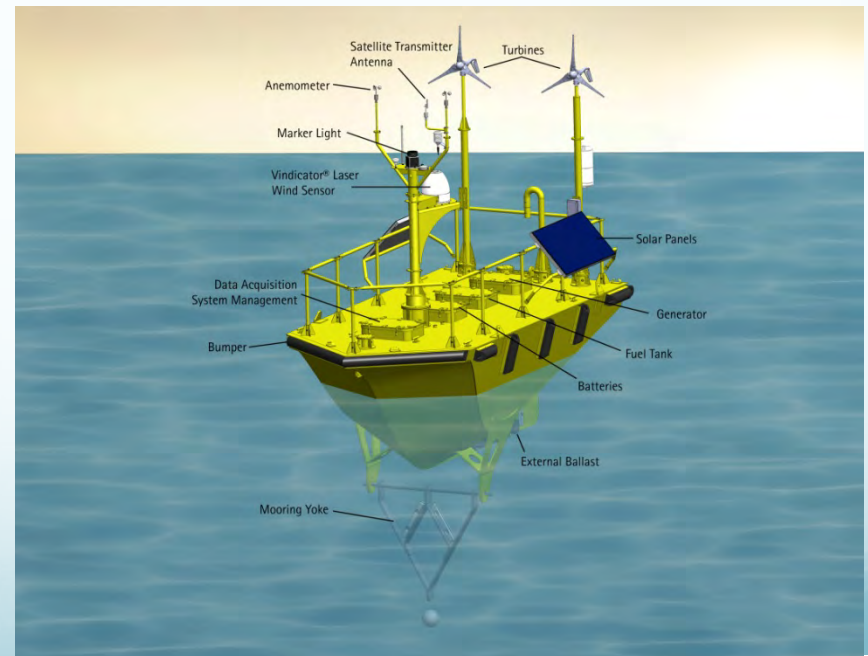


BACKUP SLIDES



Ocean Sentinel MOTB

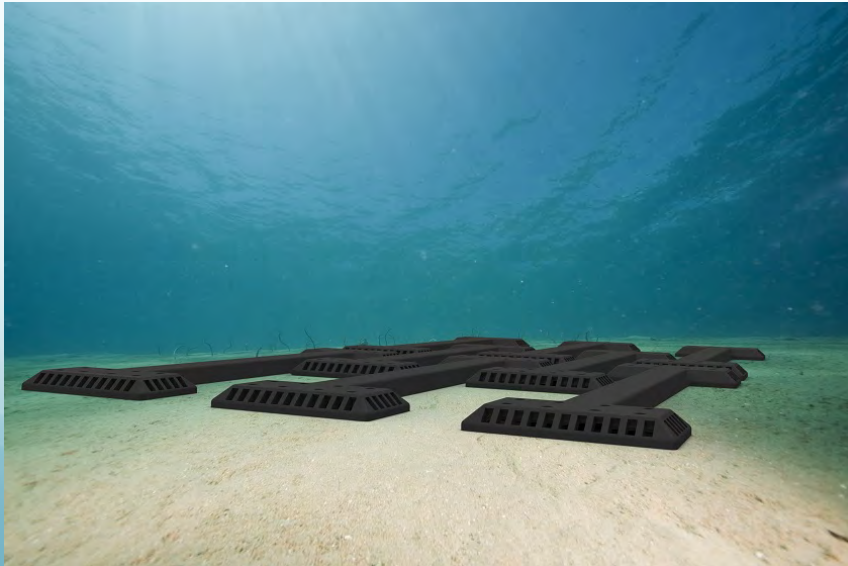
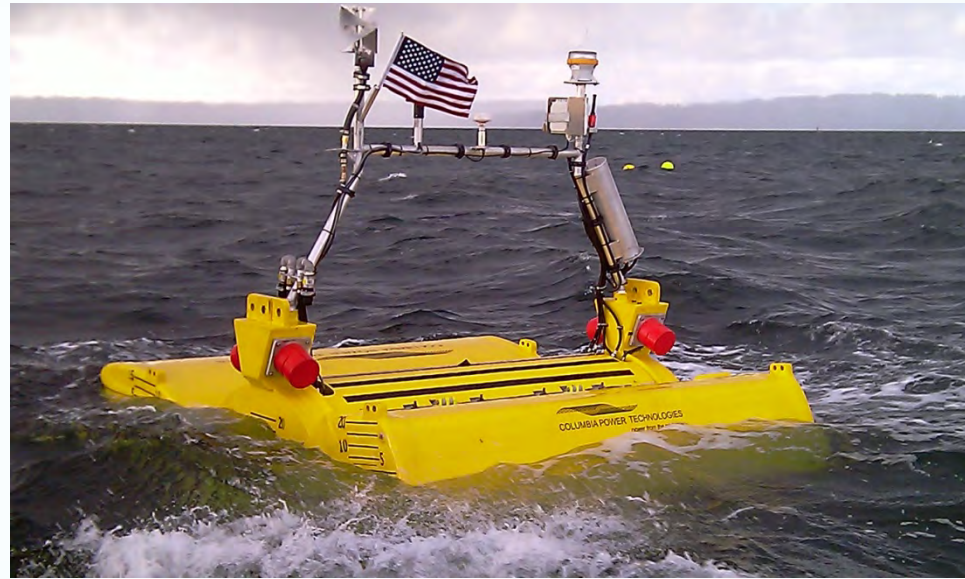
- Based on 6m NOMAD design, working with AXYS Technologies
- Initial average power rating 100kw average
- Load bank: power processing & dissipation
- Data transmission via umbilical & wireless telemetry



Wave Energy Devices

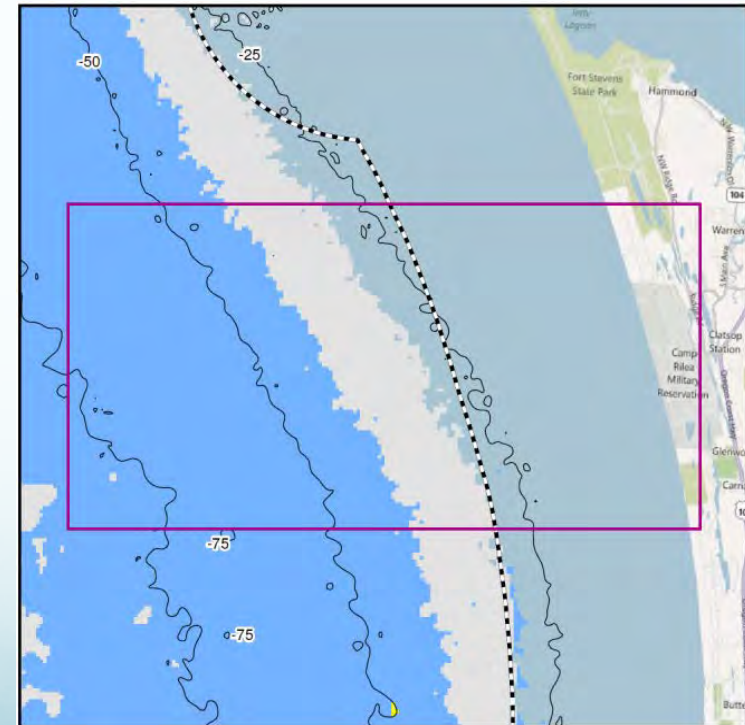
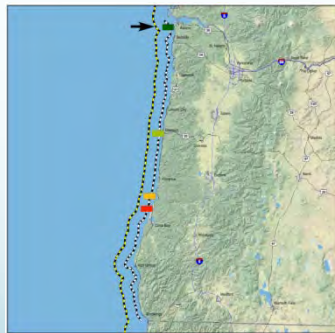


Wave Energy Devices



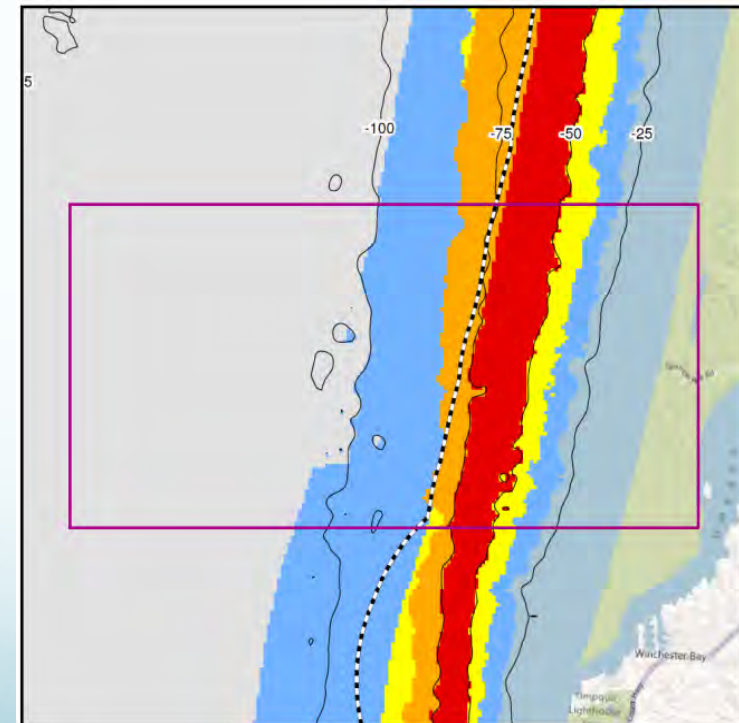
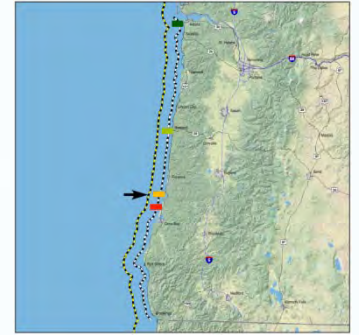
Clatsop County, OR

- Camp Rilea, Oregon's only DoD facility located here (National Guard)
- Shortest distance to Portland and Columbia River
- Potentially less impact on commercial fishing
- Longest transmission distance: 8.9NM to 75m depth
- Slowly increasing water depth



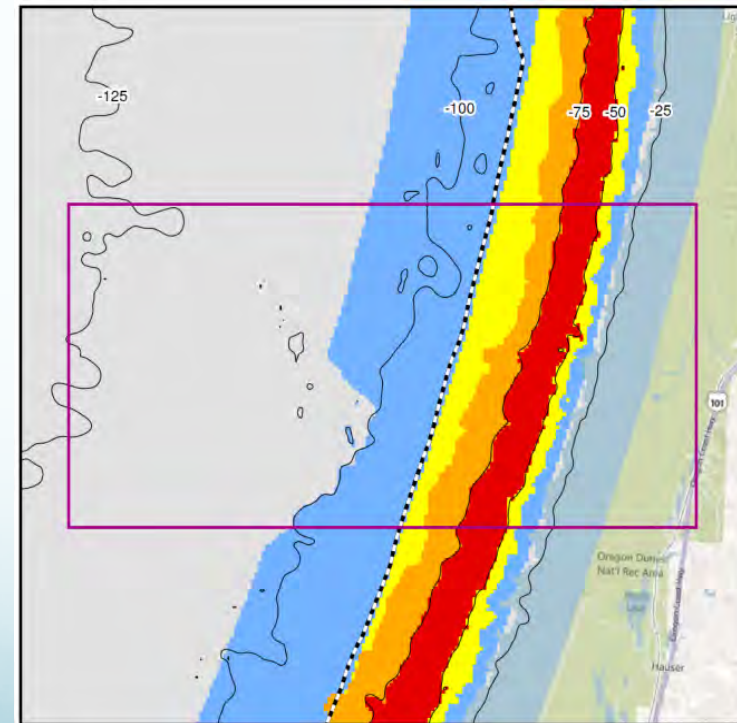
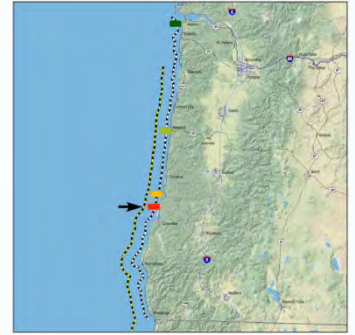
Reedsport, OR

- Proximity to OPT project—possibility for shared infrastructure (cable and on-shore assets)
- City leaders appear to be receptive to dual use
- Moderate proximity to very good deep water, all weather port (Coos Bay)
- Good proximity to maintenance location (Winchester Bay)
- Rapidly increasing water depth



Coos Bay, OR

- Proximity to possible Principle Power off-shore wind project—possibility for shared infrastructure (cable and on-shore assets)
- Very close proximity to very good deep water, all weather port
- Shortest transmission route
- Longest driving distance from PDX
- Rapidly increasing water depth
- Best site for deployment and maintenance



NOAA Buoys for Wave Data



Average Power at Buoys

Station I.D.	Latitude (deg.)	Longitude (deg.)	Depth (m)	Distance (km)	Avg. Power (kW/m)
46002	42.57	-130.46	3500	480	51
46050	44.641	-124.5	123	35	35
46059	37.983	-129.997	4600	560	45
46013	38.242	-123.301	116	25	29
46001	56.3	-148.021	4200	300	44
46083	58.243	-137.993	136	45	33
51001	23.445	-162.279	3430	260	30
51201	21.673	-158.116	200	6	17
51202	21.415	-157.678	100	6	16

North
Oahu
East
Oahu



Average Power at Buoys

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46013	38.242	-123.301	116	25	29	Bay CA ↙
46001	56.3	-148.021	4200	300	44	Yakutat
46083	58.243	-137.993	136	45	33	AK ↙
51001	23.445	-162.279	3430	260	30	North
51201	21.673	-158.116	200	6	17	Oahu ↙
51202	21.415	-157.678	100	6	16	East Oahu ↙



Seasonal Average Power

