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Most of us think about Marine Energy Converters (MECs):
Wave, Tidal, Ocean Current, River Current, OTEC, Offshore Wind, etc
Lot’s of technologies... in wave energy alone there are:
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• From a Systems Approach...
  the grid is called a “Boundary System”

• In Conventional Hydro parlance...
  The connection to the grid is the “Balance of Plant”.

Energy Solutions: Marine Renewable Energy
And, from a Project Developers Grid-Centric perspective:

“Balance of Plant”

- Host Facility & Connecting Utility
- Shore-Based Infrastructure
- Sea-Based Infrastructure
- Marine Energy Converters

Functional task areas

<table>
<thead>
<tr>
<th>Host Facility</th>
<th>Boundary System: Mature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design &amp; Planning</td>
<td>Base infrastructure and procedures. Connecting utility infrastructure and procedures. O&amp;M</td>
</tr>
<tr>
<td>Regulatory &amp; Permitting</td>
<td>Resource adaptation, conceptual design/preliminary/detailed design, program planning</td>
</tr>
<tr>
<td>Implementation, Operations &amp; Maintenance</td>
<td>Site evaluation and selection, environmental analysis, outreach, and agency interaction</td>
</tr>
<tr>
<td>Financial &amp; Business Management</td>
<td>Procurement, fabrication, logistics, installation, commissioning, project operations, maintenance, monitoring, adaptive management, and decommissioning</td>
</tr>
<tr>
<td>Marine Energy Converters (MECs)</td>
<td>Financial &amp; Business Models, Planning, Acquisition Program &amp; Project Management, Program &amp; Grant Administration, Contingency/Configuration/Change Control, Cost Controls</td>
</tr>
<tr>
<td></td>
<td>Boundary System: New Product Development</td>
</tr>
<tr>
<td></td>
<td>Technology invention, prototyping, progressive test, planning, and demonstration. O&amp;M</td>
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Maritime means: Related to the sea and inland waters including water-side & upland activities

Maritime Sector Clusters and Activities:

- **Port Operations**
  - Cargo Loading and Unloading
  - Longshoreman
  - Stevedores
  - Passenger Loading and Unloading
  - Distribution of Cargo (Arrival/Departure)
  - Multimodal Distribution
  - Homeland/Maritime Security
  - Marine Logistics (Cargo Distribution)
  - Spill Response

- **Transportation**
  - Cargo (dry and liquid)
  - Passenger (ferry and cruise)
  - Tug/Towboats (ship assist, tow, bunkering)
  - Recreational

- **Maritime-Related Professions**
  - Marine Engineering
  - Naval Architects
  - Admiralty Lawyers and Staff
  - Risk Managers/Insurers/Surveyors
  - Marine Chemists
  - Merchants Exchange Members

- **Shipbuilding and Repair**
  - Ship Repair Operations
  - Tug and Barge Construction
  - New Vessel Construction
  - Recreational Boat Construction and Repair
  - Ship Engineering and Design

- **Offshore Exploration and Support**
  - Scientific and Oceanographic Research
  - Commercial
  - Academia

- **Fishing and Crabbing**
  - Commercial Fishers
  - Commercial Crabbers
  - Sport & Charter
  - Recreational
  - Operations/Engineering/Logistics Support
  - Catch Operations
  - Processing
  - Marine Hardware and Chandlery
  - Distant Waters Operations

- **Maritime Workforce Deployed around the Globe**
  - US Commercial Mariners on ships of many flags
  - US Merchant Marine & Military Sealift Command
  - Tug & Tow Mariners
  - Local Fishers and Crabbers
  - Distant Waters Fishing and Crabbing Fleet
  - Oil & Gas Operations Fleet
  - Research Vessel Fleet and US NOAA
  - US Coast Guard
  - US Navy & Marine Corps
  - Ocean and River Pilots

**Note:** ~9,000 distinct USCG licenses are domiciled in Oregon

Maritime careers span a wide range of opportunities from deep sea to shoreside positions.
Industry, Government and Academia Working Together

- Maritime Economic Sector Initiative
- Oregon Senate Bill 867 – Maritime Industry Task Force
- Maritime Industry Workforce Solutions Group

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**Oregon State Legislature**

**Oregon Legislative Information**

2017 Regular Session

**SB 867 Enrolled**

Follow this Bill: e-Subs

**Overview**

At the request of: (at the request of Oregon Coastal Zone Management Association (OCCZMA))

Chief Sponsors: 
- Senator Kruse, Roblan, Representative Gomberg, Smith DB
- Senator Johnson, Representative McKeown

Regular Sponsors: 

Regular Title: 

Catchline/Summary: 

Creates Task Force on Maritime Sector Workforce Development.

7-18 (S) 
- President signed.

7-18 (H) 
- Speaker signed.

Current Location: 

- Governors Office - Awaiting Signature

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**SENATE MAJORITY OFFICE**

Oregon State Legislature
State Capitol
Salem, OR

**NEWS RELEASE**

July 1, 2017

CONTACT: Rick Osborn (503) 986-1074
Rick.osborn@oregonlegislature.gov

**Maritime industry is vital to coastal Oregon economy**

SB 867 creates task force dedicated to training coastal workforce for good jobs

SALEM — The Oregon Senate voted today to advance legislation designed to help maritime businesses — as well as current and future workers in that industry — by connecting workforce training opportunities with the needs of maritime sector businesses.

Spearheaded by a bipartisan group of legislators that includes Sens. Roblan Roblan (D-Coos Bay), Sen. Jeff Kruse (R-Roseburg), Rep. David Gomberg (D-Dists) and Rep. David Brock Smith (R-Gold Beach), Senate Bill 867 — which passed the Senate floor on a 30-0 vote — creates the Task Force on Maritime Sector Workforce Development.

“The maritime industry is vital to our state’s economy; it has been a cornerstone throughout our state’s history, and it will continue to create good jobs for the coast,” Roblan said. “As a lifelong educator, I have known for years that training opportunities are of little value if they don’t prepare our students with the skills they need to be successful in the workforce.”
# Wave Energy Project Life Cycle = Jobs

<table>
<thead>
<tr>
<th>Plan/Design/Develop</th>
<th>Manufacture/Assemble</th>
<th>Integrate/Install</th>
<th>Commission/Test</th>
<th>Operate/Maintain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designers</td>
<td>Schedulers</td>
<td>Ocean Engineers</td>
<td>Operators</td>
<td>Maintenance Techs</td>
</tr>
<tr>
<td>Technologists</td>
<td>Buyers</td>
<td>Technologists</td>
<td>Engineers</td>
<td>Electricians</td>
</tr>
<tr>
<td>Materials Scientists</td>
<td>Vendors</td>
<td>Boat Operators</td>
<td>Technologists</td>
<td>Machinists</td>
</tr>
<tr>
<td>Oceanographers</td>
<td>Transportation</td>
<td>Marinas</td>
<td>Designers</td>
<td>Welders</td>
</tr>
<tr>
<td>Meteorologists</td>
<td>Welders</td>
<td>Materials Techs</td>
<td>Materials</td>
<td>Boat Operators</td>
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<td>Electricians</td>
<td>Oceanographers</td>
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<td>Painters</td>
<td>Environmental</td>
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<td>Legal</td>
<td>Quality Assurance</td>
<td>Regulatory</td>
<td>Communications</td>
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<td>Legal</td>
<td>Public Relations</td>
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<td>Mooring Engineers</td>
<td>Ocean Engineers</td>
<td>Communications</td>
<td>Finance</td>
<td>Technologists</td>
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<tr>
<td>Cable Engineers</td>
<td>Mooring &amp; Cables</td>
<td>Integration</td>
<td>Administration</td>
<td>Materials</td>
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<td>Integration Testing</td>
<td>Public Relations</td>
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<td>Lodging/Food</td>
<td>Distribution</td>
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More to MHK than “Levelized Cost of Energy (LCOE)”

• Engineers love precise metrics, and LCOE is precise and inaccurate
• MECs need time in the water, generating power to confirm LCOE
• Power for Oregon Coast is generated east of the Coast Range

Cost + Pricing + Value

• Cost: Will be higher than baseload generation (coal, hydro, gas, nuclear)
• Pricing: “Nodal Pricing of Distributed Generation”
  • Location, Location, Location
• Value: What is that next kWhr worth in different situations?
  • Clean, Renewable Energy
  • System Benefits
  • Public Benefits
Tale of Two Test Sites: Infrastructure Planning
### Common to both: Need for Energy Security, Energy Independence and Disaster Resilience

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#### Camp Rilea Armed Forces Training Center
- *Energy Independence/Security/Resilience/Net Zero*
  - **Base:** 500kW average, ~1MW peak, PacifiCorp
  - **Community:** 50 MW at BPA Lewis & Clark Substation

#### Vandenberg Air Force Base
- *Energy Independence/Security/Resilience/Net Zero*
  - **Base:** 10MW min, 20MW ave, 28 MW peak, PG&E
  - **Community:** >100 MW

#### Test Center
- **Deep Water:** >60m
- **Surface or Bottom-Mounted**
- **Near Term Market:** 25MW to 40MW

#### Waves-to-Wires and Near-Shore Pumpers
- Longer-term testing: deep water “graduates”

---

#### California Wave Energy Test Center (CalWave)
- **initiated by PG&E WaveConnect**
- **CalWave I study led by Cal Poly**
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#### Camp Rilea Armed Forces Training Center
- "A site that will cooperate with testing"
- **Shallow and Mid-Depth WECs**
- **Surface/Floating or Bottom-Mounted**
- **Near-term Market:** 1MW

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#### Waves-to-Wires and Near-Shore Pumpers
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Energy Solutions: Marine Renewable Energy

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Oregon Military Department
with National Guard Bureau
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initiated by PG&E WaveConnect
CalWave I study led by Cal Poly

Camp Rilea Armed Forces Training Center
“Great Coastal Gale of 2007!”

Vandenberg Air Force Base
Wildfire! Feb 2017

Requirement: Disaster-Resilient Power
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