

PNNL Addresses Barriers to Renewable Ocean Energy Development



Pacific Northwest National Laboratory— Marine Sciences Laboratory

Pacific Northwest National Laboratory's (PNNL) Marine Sciences Laboratory (MSL) is located in Sequim on Washington State's Olympic Peninsula. MSL is the Department of Energy's only marine research laboratory. This unique facility and the capabilities of its researchers to deliver science and technology that is critical to the nation's energy, environmental and security future.

Enabling Sustainable Development of Ocean Energy

MSL researchers are producing tools and conducting studies that will help the nation realize significant sustainable renewable energy from the nearshore and ocean environments. Our research programs are directed towards:

- Risk based assessment and mitigation of environmental effects of offshore wind and marine and hydrokinetic (MHK) energy
- Optimizing siting of coastal energy installations, including offshore wind
- Optimizing technologies to meet environmental and power production goals
- Optimizing production of biofuels by marine algae

U.S. Department of Energy Directives to PNNL for Ocean Energy Research

The Department of Energy's Office of Energy Efficiency and Renewable Energy has directed PNNL to support the responsible development of offshore wind and marine and hydrokinetic energy through several multi-year tasks focused on assessing environmental effects.

Tasks for MHK include:

- **Classifying and evaluating environmental effects**
 - Organize and compile data into a "smart", searchable database called a knowledge management system
 - Use risk assessment tools to determine the most important risks through development of a MHK Environmental Risk Evaluation System (ERES)
- **Modeling effects of energy removal from water bodies**
- **Laboratory and field studies to determine effects on animals**
 - Electromagnetic fields
 - Acoustic output
 - Physical interaction (strike, entrainment, impingement, attraction, avoidance)
- **Siting constraints and opportunities**
 - Stakeholder engagement and spatial planning



Ocean Power Technology's Power Buoy (left), installed off the Oregon Coast at Reedsport and Verdant Power tidal turbines (right), slated for installation in Puget Sound, WA.

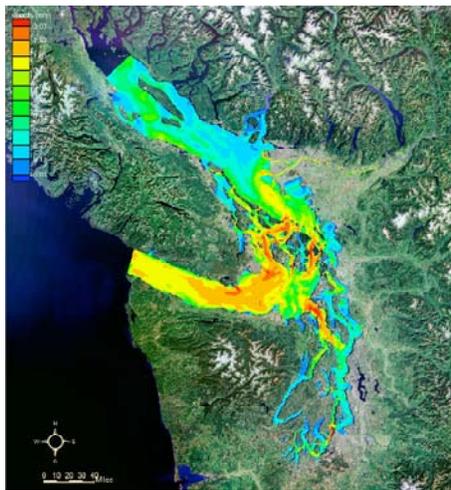


MHK Project Outcomes

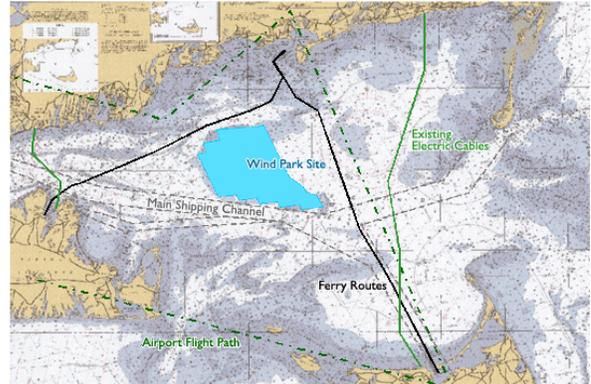
The Environmental Risk Evaluation System (ERES) will evaluate risk of a MHK project through features of:

- o Technology components
- o Water bodies
- o Site characteristics
- o Receptors (aquatic animals, aquatic system response, etc.)

ERES uses cases of compile risk-relevant attributes. Multiple cases are used to “span the analytical space” and accumulate predictive power. Risk will be assigned to attributes of cases using expert opinion initially and experimental, monitoring, and modeling data as they become available.



Plot from PNNL Puget Sound Hydrodynamic Model showing maximum tidal velocities in Puget Sound. Warmer colors show higher velocities. This tool can be used for tidal energy site planning



Cape Wind is the first offshore wind project to be granted federal approval to proceed with construction in Nantucket Sound, MA.

Tasks for offshore wind include:

- **Classifying and evaluating environmental effects**
 - o Offshore wind Environmental Risk Evaluation System (ERES)
 - o Offshore wind Knowledge Management System, linked to that of MHK
- **Environmental monitoring technology assessment and development**
- **Environmental monitoring plan review and protocol development**
 - o In support of floating offshore wind platform demonstration project
 - o Acoustic modeling of offshore wind turbine noise

About Pacific Northwest National Laboratory

The Pacific Northwest National Laboratory, located in southeastern Washington State, is a U.S. Department of Energy Office of Science laboratory that solves complex problems in energy, national security and the environment, and advances scientific frontiers in the chemical, biological, materials, environmental and computational sciences. PNNL currently has approximately 4,900 staff members and a business volume of more than \$1.1 billion. The Laboratory has been managed by Ohio-based Battelle since 1965.

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