SMEA Capstone Description
Environmental, Economic, and Social Benefits and Costs of Tidal Energy Development

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## Background

San Juan County is located in northwest Washington state and includes four large islands: San Juan, Orcas, Lopez and Shaw, as well as hundreds of smaller islands, reefs and rocks. Approximately 20 of the islands are inhabited. San Juan County is the smallest county in Washington by total landmass. The islands are isolated from the mainland of Washington by waters of the Salish Sea.

One cost of this isolation is dependence on power from the mainland delivered by an undersea cable that is vulnerable to disruption. To improve energy security for the archipelago, the utility (Opalco) that serves all of the San Juan Islands, in collaboration with San Juan County government, is exploring the development of tidal energy, in conjunction with the development of other renewable energy sources. The tidal currents around the San Juans are strong and promise adequate renewable energy to power many homes and businesses. However, there is a need to examine the potential effects on the marine environment and biota, the social-ecological benefits of marine ecosystems for island community social services and community values, interactions with tribal fishing and other treaty rights, as well as economic benefits and costs of such a project.

## Tidal Energy Project

Tidal energy harvesting is a small industry worldwide, made up of small companies with differing devices and methods of installation. Commercial development of marine energy is at its inception in Europe and North America. For information on tidal energy planning by OPALCO, see their 2020-2040 Integrated Resource Plan.

The technology proposed for harvesting tidal energy around the San Juan Islands is the U.K.-based Orbital Marine Technology – the O2 (Figure). The O2 has been extensively tested in Europe but has not yet been deployed in North America. The device is:

- 74 meters (m) long, floats semi-submerged, with approximately 1.5 m above the waterline and 2.3 m below the water
- 50 m wide, including the span of the tidal turbine blades underwater
- Total draft of the operational device is 23.2 m
- Anchored to the seafloor with four anchors and mooring lines at a depth of 50–100 m.

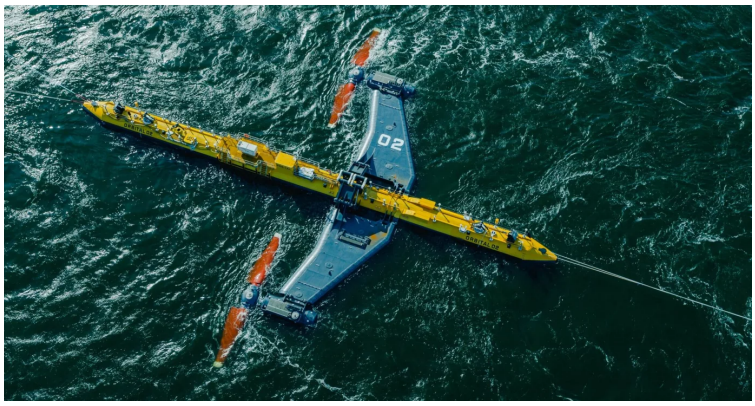


*Figure 1. Orbital Marine Technology O2 floating tidal turbine, deployed at the European Marine Energy Center in Orkney, United Kingdom.*

## Requirements for Deploying and Operating Tidal Projects

Deployment and operation of the Orbital Marine floating tidal turbine must meet federal, state, and local regulatory requirements. These requirements range from NEPA, to consultations on the Endangered Species Act, the Marine Mammal Protection Act, the Migratory Bird Treaty Act, and numerous other federal statutes, as well as Coastal Zone Consistency and applicable state statutes under SEPA.

In addition to specific environmental documentation and requirements, there is a need to understand the values and interests of the local community and tribal members likely to be benefit from and be affected by the project.

## SMEA Capstone Project

The specific research questions for this project will depend on SMEA students' interests and expertise. Students, in collaboration with PNNL researchers, will develop the research question(s) and develop a project management plan during Winter quarter 2023. During the project (Spring 2023-Winter 2024), SMEA students will be encouraged to interact with PNNL researchers examining potential environmental effects of tidal devices and systems that will drive permitting and licensing processes, and to examine the benefits and costs, of developing tidal energy. Working directly with Pacific Northwest National Laboratory staff, students will gain access to information about the proposed tidal project and also have the opportunity to become a part of the process led by Opalco. The tidal project is in the initial stages of scoping and determining potential effects of the project for permitting purposes, as well as searching for financing for full project buildout. The students will have the opportunity to observe the process and to meet with interested parties where needed. Stakeholders and other interested parties include the tribes and underserved communities on the San Juan islands. The capstone project results may help to inform the regulatory and stakeholder processes.

Depending on the selected research question(s), students may observe and/or participate in community meetings, interview community members, and analyze secondary data on potential environmental, social, and economic effects of tidal energy. Some students may need to travel to the San Juan Islands occasionally. PNNL staff and the supervising faculty will work with students to determine deliverables which could include a report, co-authored peer-review paper, database, and/or a variety of communication materials (e.g., flyers, videos, commentary pieces etc.). While the results of the

capstone will be shared with the project proponent and the tidal device developer, the outcomes and deliverables will be determined by the students and mentors.

Communication on the project: PNNL staff members (according to the stage of the project) and the faculty advisor will be available for weekly project management meetings with students. A canvas site will be created to host project-related documents.

Timeline

| Date Range | Tasks |
|---|---|
| January 3rd – March 10th 2023 | • Register for 1 credit of SMEA 600 B (advising) with Nives Dolsak<br>• Read key readings on tidal energy and social acceptability of energy infrastructure, with specific focus on ocean energy<br>• In collaboration with the PNNL collaborators, select the research questions, determine the appropriate data collection and data analysis methods, specify the deliverables, define individual team members' tasks, including additional course work that may be instrumental. Complete the Capstone Project Management Plan.<br>• Observe relevant community events and read local news |
| March 27th- June 2nd 2023 | • Register for 3 credits of SMEA 650 with Nives Dolsak<br>• Write the first draft of the introduction section<br>o Energy demand and supply in the studied area<br>WA state energy strategy<br>• Complete literature review and write the first draft of the literature review section<br>o Benefits and challenges of tidal energy<br>Acceptability of ocean energy technologies<br>Other aspects of literature review to be determined in winter 2023 quarter.<br>• Write the first draft of the methodology section<br>o Research Question<br>Data collection methods<br>Data analysis methods |
| Summer 2023 | Observe relevant community events and read local news |
| September 27th -December 8th 2023 | • Register for 3 credits of SMEA 650 with Nives Dolsak<br>• Data collection and analysis<br>• Write first draft of the findings section |
| January 3rd – March 8th 2024 | • Register for 3 credits of SMEA 650 with Nives Dolsak<br>• Revise the methods section<br>• Revise the findings section<br>Complete the deliverables<br>Present in SMEA and (if applicable, at PNNL/Opalco, and possibly in the community) |


Pacific Northwest National Laboratory (PNNL)

PNNL is one 17 US Department of Energy's (DOE) national laboratories, located across the US. The purpose of the national labs is to address research, technology, and development challenges that face the nation, maintaining a brain trust to pivot to new and important questions as they arise.

PNNL is located here in Washington State, with the main campus in Richland in the Tri-Cities, across the mountains. In addition to the Richland campus (and small campuses in OR and MD), PNNL has the only marine station among the national labs, with a fully outfitted marine laboratory in Sequim Washington, on the Olympic Peninsula. A number of coastal division staff (including Andrea, Katie, and Debbie) belong to the Sequim location but are stationed in Seattle.

PNNL is one of three national labs that address the emerging field of marine energy development for DOE; PNNL leads the environmental and social aspects of marine energy development for wave, tidal, offshore wind, and other ocean energy technologies.