Maine Tidal Power Initiative (MTPI): The mission of MTPI is sustainable tidal energy development through data-driven science that transforms traditional technology and finance-driven energy practices to those combined with decisions of policy-makers, citizens, and developers, which are critical to ensuring economically feasible, environmentally responsible, and socially acceptable technologies in the complex multi-use ocean environment. Our vision is to foster ocean energy development that is guided by principles that ensure sustainable and broad benefits to all citizens. These principles are rooted in a solid understanding of the natural environment, state-of-the-art and well-suited technology, economic returns, and social acceptance supported by cross-disciplinary integration, stakeholder engagement, and integrated coastal systems research. Tightly coupled to this vision is our goal to educate and train the next generation thinkers, researchers and skilled workforce who can integrate knowledge across disciplines and adapt to global markets with a full appreciation of diverse cultures and ideals worldwide.

Research Themes

Sustainable tidal energy development requires linkages and feedback between social, engineering, and bio-physical systems. Figure 1 illustrates the established research themes of the multi-disciplinary team currently working to link knowledge-to-action between these integrated systems.

Engineering Tidal Systems

Near coastal regions with high tidal energy potential are dynamic environments. Tidal devices operate within an engineered system involving supporting substructure, the water column and seafloor sediment. MTPI's Engineering Systems Team is focused on research related to geotechnical, structural dynamics, and fluid dynamics components of tidal systems. Understanding the effects of energy extraction on sediment transport and scour near and downstream from the device is critical to maintain adequate substructure support and identify potential impacts to ground fisheries, coastal features. Effective and low cost foundation and anchoring systems are critical for fixed seabed and floating tidal infrastructure in a variety of geologic settings. The MTPI Seafloor Engineering Unit is researching solutions for efficient and robust foundation options for both fixed bottom and floating tidal energy devices that consider both the complex lateral loading from currents, and scour and sediment transport around the foundations that have the potential to reduce foundation capacity. Additionally, research involving numerical simulations coupled with turbine models are required to predict near field flow using the tide inlet boundary conditions output by the large scale numerical tide predictions being investigated by the MTPI Resource Assessment Team. With the incorporation of a sediment transport model, potential scouring around deployment sites and near- and far- field sediment transport can then be investigated.

Expanding regions of application of tidal and wave energy devices in the oceans implies moving into deeper coastal areas requiring moored floating systems. The motion of floating systems innately reduces a system's energy capture efficiency, and our research aim to study mooring and floating configurations that optimize the stability of the platform vs. energy capture efficiency. Our research will also examine design modifications that can 'tune' the system in such a way to contribute to an increase in energy capture efficiency, for example by exciting the floating system in resonance.

Educational opportunities

Meeting the global need for sustainable energy requires a specially trained workforce that can employ a systems approach to understand, predict, and react to changes in linked natural, built, and social systems that transcend disciplinary perspectives. MTPI researchers and students conduct cooperative hypothesis-driven disciplinary and cross-disciplinary research at the energy-environment-society nexus with special attention to incorporating the human dimensions of renewable energy development research in collaboration with diverse partners (e.g., government, industry, stakeholder groups).

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