Marine Renewable Energy for Powering Ocean Observations

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Background

- The "Blue Economy" is a rapidly growing movement based on the economic, social, and ecological sustainability of the ocean and encompasses various maritime activities, including ocean observations. The demand for ocean data to inform scientific, risk reduction, and national security needs relies upon future deployments of observing systems and overcoming constraints, such as power.
- In Spring 2019, the U.S. Department of Energy's Water Power Technologies Office published the "Powering the Blue Economy" Report which explored opportunities for marine renewable energy (MRE) in maritime markets, including ocean observing and autonomous underwater vehicle (AUV) recharge [2].
- In support of this initiative, online surveys and phone/in-person interviews were conducted with a range of ocean observing experts. Interviewees were asked about: system energy needs, end user requirements, and opportunities for co-development with MRE.

Marine Energy Converters

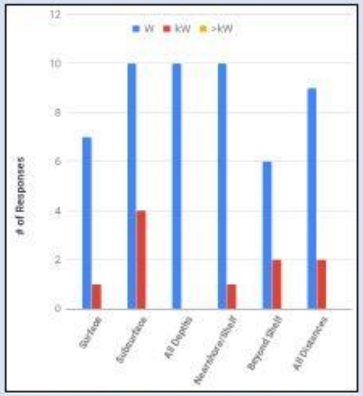


Examples of marine energy devices, including tidal and wave power systems. Pictured examples include (from left to right): SIMEC Atlantis AR1000, CorPower Ocean C3 point absorber, and Ocean Power Technologies PB3.

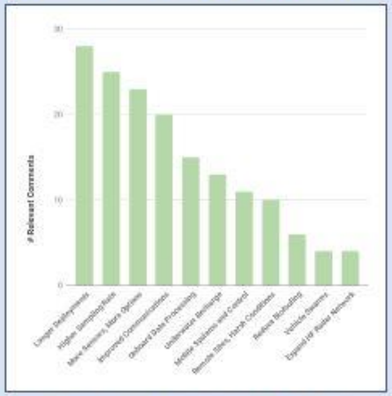
MRE and Ocean Observations: Diversity of Applications

Interviews broadly spanned the regional diversity of ocean observing systems and marine energy resources, as exemplified here by a subset of observing assets and wave resources.

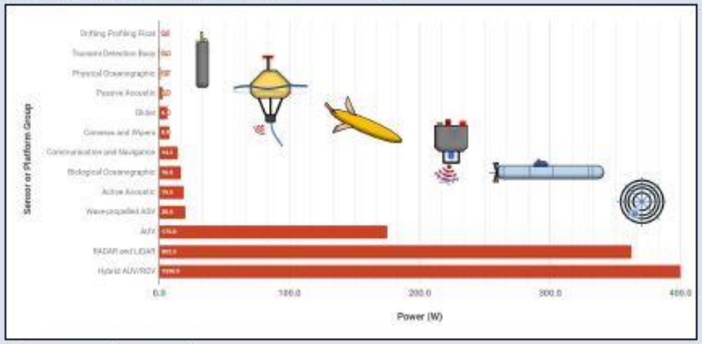
Feedback from Ocean Observation Community: More Power & Extended Missions



Power use range by depth and distance from shore.



Enabling ocean observations with more available power.

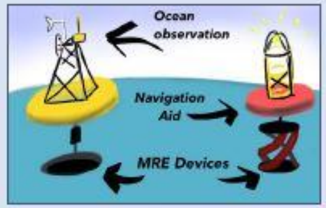


Sensor types and power requirements.

- There were 68 total responses, including 41 SurveyMonkey responses and 27 telephone/in-person interviews.
- Power use ranges reported by respondents were organized by depth and distance from shore. Power used was largely in the watts range, and sometimes kilowatts range, corresponding to power needs of deployed sensors.
- Participants were asked how ocean observations could be enabled with more available power. Power and batteries were most frequently mentioned, followed by data transmission and communications, then survivability.
- Sensors were grouped by category based on common measurement attributes; the power requirements for each category were averaged to show range of power needs across sensor types. About a quarter (26%) of sensors run on less than 1 W, nearly half (48%) run on 1-10 W, 19% require 10-100 W, and the remaining (7%) use >100 W.
- Operators of buoy networks indicated that the ability to provide 10s to 100s of watts to their systems would strongly enable expanding sensor payloads and continuous operation throughout the year, especially in winter months and at high latitudes.
- Operators of AUVs have expressed that larger amounts of power, 100s of watts to kilowatts, would enable a step-change in future resident AUV missions by enabling underwater recharging and operation of larger numbers of vehicles.
- Geographically, investigators from all U.S. regions (i.e., Atlantic, Gulf of Mexico, Pacific, Alaska, and Great Lakes) expressed a desire for greater amounts of power to expand ocean observing missions, as well as requests for greater amounts of power to serve missions in deeper oceanic regions and at high latitudes (e.g., under ice sheets) to support a sustained underwater vehicle presence.

Research to Support Co-Design ★ Call to Action ★

- Common themes and challenges identified through the surveys and interviews will inform the next foundational research and development steps needed to advance the integration of MRE with ocean observing systems. The aim is to enable higher sampling rates, longer deployment times, and greater spatial and temporal data resolution.
- While various MRE technologies have been developed over the years, most are focused on utility-scale opportunities for power generation and are not necessarily suited to the unique (and typically much smaller) power requirements of ocean observing systems, as identified by end users in our surveys [1].
- Interviewees were welcoming of future opportunities to explore integration of marine energy with the ocean observing systems they operate and several volunteered their platforms as testbeds for such integration.
- Future research will explore specific end use cases within ocean observing for marine energy integration and development of engineering design requirements based on identified end user needs.



MRE application to ocean observations
Image courtesy of Molly Grear, Pacific Northwest National Laboratory [2]

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(2) A. LiVecchi, A. Copping, D. Jenne, A. Gorton, R. Preus, G. Gill, R. Robichaud, R. Green, S. Geerlofs, S. Gore, D. Hume, W. McShane, C. Schmaus, H. Spence. 2019. *Powering the Blue Economy; Exploring Opportunities for Marine Renewable Energy in Maritime Markets.* U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Washington, D.C. pp. 207.