

Benefits and Effects

Technologies that harvest energy from seawater and large rivers are under development around the world. Marine renewable energy (MRE) devices are designed to take advantage of tidal currents, fast flowing rivers, and waves, as well as persistent ocean currents and natural gradients of temperature and salinity in ocean waters. The potential benefits that MRE can bring to nations and stakeholders are driving research studies, development of engineering systems, and experimental deployments of wave energy converters, tidal and riverine turbines, as well as systems to harvest thermal gradients (called ocean thermal energy conversion, or OTEC) and salinity gradients.

These studies, trials, and experiments are the leading edge of the development of an international MRE industry that is helping to mitigate climate change, decarbonize power systems, and stabilize energy supplies around the world. As this development occurs, it is essential that MRE projects do not harm valuable and often fragile marine populations, habitats, and systems in the oceans. The responsible development of the MRE industry is informed by science-based understanding of the potential effects of MRE installations worldwide.

BENEFITS OF MARINE RENEWABLE ENERGY

MRE systems can provide sustainable, predictable, low-carbon energy to coastal areas and large river basins. The energy can be generated locally, providing energy security and stability for electrical grids in remote areas, as well as supplying power to areas that rely heavily on diesel fuel. MRE devices can provide a new source of power at sea for applications that have relied on diesel, such as offshore aquaculture, or on batteries, such as ocean observation platforms and navigation aids. Power generated by MRE devices could supply higher energy-use activities, such as desalination to produce freshwater for remote coastal areas and islands, providing power to isolated resorts for electric boats and dive tank refills, extracting critical minerals from seawater, and generating hydrogen as a portable energy source.



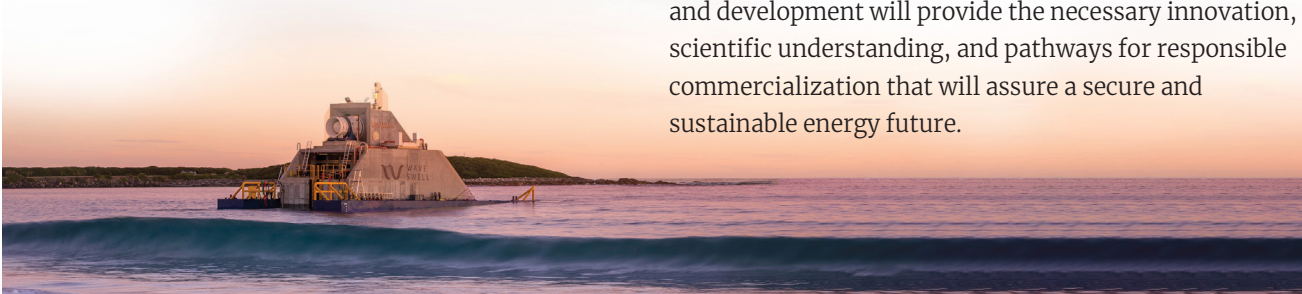
MRE development has the potential to bring employment to areas that are often far from other industries, ranging from jobs with MRE development corporations, supply chain companies, environmental consultancies, and government agencies. Increased economic development may follow MRE development, providing social and economic advantages to communities and regions.

Like all renewable energy forms, MRE development aids in mitigating climate change by lowering greenhouse gas emissions compared to conventional power sources, and reducing the acceleration of ocean acidification, increasing seawater temperatures, and rising sea levels that affect marine animals as well as coastal communities that depend on the ocean.

Wave and tidal devices can act as artificial reefs and refuges for fish and other marine organisms, sometimes providing new types of habitats. If MRE project sites are set aside for specific uses, such as prohibitions against fishing, they may act as marine protected areas, allowing fish, shellfish like crab and lobster, and other sea life to thrive, sometimes spilling over into outside areas and boosting fishing opportunities.

POTENTIAL EFFECTS OF MARINE RENEWABLE ENERGY

In addition to the benefits of MRE development, careful study must be undertaken to understand and minimize harm to marine animals, the habitats that support them, and the oceanographic and ecosystem processes that provide them life. Only by understanding the risks from MRE can we assure that development occurs responsibly to protect valuable marine resources and allow them to continue to support the needs of humans in coastal communities and beyond.



OES-Environmental 2024 State of the Science report and executive summary available at:
<https://tethys.pnnl.gov/publications/state-of-the-science-2024>

The areas where MRE projects are sited are among the most energetic and least-understood areas of the oceans. These areas present challenges to observing and documenting how marine animals might interact with the devices, mooring lines, cables, and other infrastructure, or how these installations might affect seafloor or open water habitats. Based on research studies and monitoring around operating MRE devices, the greatest risk appears to be the potential for marine mammals, fish, and diving seabirds to be injured or killed by colliding with rotating turbine blades. Effects of underwater noise from MRE devices on marine mammals and fish, as well as effects of electromagnetic fields on sensitive species (e.g., sharks, rays) are considered low and becoming fairly well understood for small number of devices. Changes in habitats from MRE devices are not likely to cause injury or harm to marine organisms, and severe effects can be mitigated by identifying and avoiding fragile habitats. The level of potential changes in oceanographic systems from small numbers of MRE devices is also considered low. The risks of underwater noise, electromagnetic fields, changes in habitat, and changes in oceanographic systems for MRE projects with small numbers of devices (one to six) can be considered retired. Entanglement of large marine animals in mooring lines and underwater cables associated with MRE systems is also considered low for small number of devices. Displacement remains an area of uncertainty, with research needed as larger deployments and commercial arrays are realized. As larger commercial MRE projects are developed in arrays, some of these potential risks may need to be revisited.

MOVING FORWARD WITH MARINE RENEWABLE ENERGY

As MRE projects develop around the world, research and development will provide the necessary innovation, scientific understanding, and pathways for responsible commercialization that will assure a secure and sustainable energy future.

Go to <https://tethys.pnnl.gov> for a collection of papers, reports, presentations, and other media about environmental effects of MRE.

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