

## Marine & Hydrokinetic Technologies

The U.S. Department of Energy's Water Power Program supports the development of advanced water power devices that capture energy from waves, tides, ocean currents, rivers, streams, and ocean thermal gradients. The program works to promote the development and deployment of these new technologies, known as marine and hydrokinetic technologies, to assess the potential extractable energy from rivers, estuaries, and coastal waters, and to help industry harness this renewable, emissions-free resource to generate environmentally sustainable and cost-effective electricity.

The program's research and development efforts fall under two categories: Technology Development and Market Acceleration.

### Technology Development

The Water Power Program works with industry partners, universities, and the Department of Energy's national laboratories to reduce the technical barriers to marine and hydrokinetic device development, to improve device reliability and performance, and to understand and evaluate various technology types.

### Technology Development, Testing & Deployment

Water Power Program projects support the marine and hydrokinetic technology industry in its design and development of devices and components, as well as the deployment and testing of those devices in the laboratory or in open-water settings. The program supports the development and testing of a wide variety of marine and hydrokinetic systems and components, from earliest-stage proof-of-concept studies through full-scale demonstration projects. Projects are typically funded through competitive awards, which are designed to help devices progress toward commercial readiness along well-defined technology readiness levels. The testing of these devices and components in a variety of settings allows the program to determine baseline costs and performance attributes for different water resources and technology types.

The program has established three university-led National Marine Renewable Energy Centers to facilitate in-water testing of marine and hydrokinetic devices and components. These centers, one jointly run by Oregon State University and the University of Washington, one by the University of Hawaii, and one operated by the Center for Ocean Energy Technology at Florida Atlantic University, are planned with open-water test berths as well as laboratory facilities that will allow researchers to investigate devices in real-world conditions. The test centers are active in a number of research areas, including enhancing acoustic monitoring and acoustic deterrence capabilities, environmental impact studies and permitting, modeling of energy conversion devices, grid modeling, and corrosion research.



Marine and hydrokinetic devices include (clockwise, from top) Ocean Renewable Power Company's Turbine Generator Unit, NREL/Pix 17210; Columbia Power Technology's SeaRay, photo courtesy of Columbia Power Technology; Verdant Power's Free Flow System, NREL/Pix 17209; Free Flow Power Corporation's Smarturbine, photo courtesy of Free Flow Power Corporation; the Wavebob point absorber, photo courtesy of Wavebob; OpenHydro's Open-Centre Turbine, photo courtesy of OpenHydro.

### Research Tools & Models

The Water Power Program develops tools and models that support the design, development, and optimization of marine and hydrokinetic devices. The program conducts projects with industry, universities and national laboratories, including computational modeling of device performance, improvement of mooring design, and research on device array spacing. These projects will help maximize efficient electricity generation at marine and hydrokinetic power plants while mitigating potential environmental effects.

### Technology Characterization & Evaluation

The Water Power Program evaluates and assesses information on the cost and performance of marine and hydrokinetic device designs. Activities include:

- Evaluation of empirical performance data to compare technologies across types and device designs
- Supporting the development of a standard taxonomy and metrics to describe and compare device performance
- Collection, analysis, and dissemination of information on U.S. and international technologies and projects.

The program is developing marine and hydrokinetic reference models that will be used to project energy conversion electricity costs for various marine and hydrokinetic devices and evaluate opportunities for device cost reduction. Reference models will be a valuable tool in identifying targeted research and development needs for those areas that will ultimately result in lower energy costs.

## Incentives for Renewable Energy

Federal and state governments encourage the growth of renewable energy technologies by offering financial incentives for their development and deployment. Federal incentives that may be applied to marine and hydrokinetic technologies include:

- **Renewable Energy Production Incentive (REPI)**
- **Renewable Electricity Production Tax Credit (PTC)**
- **U.S. Department of Treasury - Renewable Energy Grants**
- **Clean Renewable Energy Bonds (CREBs)**
- **Qualified Energy Conservation Bonds (QECBs)**
- **U.S. Department of Energy - Loan Guarantee Program**
- **USDA - Rural Energy for America Program (REAP) Grants**
- **USDA - Rural Energy for America Program (REAP) Loan Guarantees**

For more information on federal and state renewable energy incentives, see [www.dsireusa.org](http://www.dsireusa.org).

## Funding from the U.S. Department of Energy

The Water Power Program funds research and development projects with industry and in partnership with federal, state, industry, national laboratory, and other stakeholder groups. The program uses competitive solicitations, known as Funding Opportunity Announcements, to award funding for research and development projects. Funding Opportunity Announcements are posted on [windandhydro.energy.gov/financial.html](http://windandhydro.energy.gov/financial.html).

Additional marine and hydrokinetic funding opportunities for small businesses (located in the U.S. with up to 500 employees) can be found through the Department of Energy's Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Program, which offers grants to small businesses to stimulate technological innovation. Small businesses that are funded under these programs retain the rights to any technology developed and are encouraged to commercialize the technology. For additional information on SBIR/STTR opportunities, see [www.science.doe.gov/sbir](http://www.science.doe.gov/sbir).

## Market Acceleration

To accelerate market development and the growth of marine and hydrokinetic technologies, the Water Power Program supports projects to reduce the time and costs associated with siting water power projects, to better quantify the potential magnitude, costs, and benefits of water power generation, and to identify and address other barriers to deployment.

## Environmental Impacts & Siting

The Water Power Program funds studies that examine the potential effects of marine and hydrokinetic technologies on specific marine species and their ecosystems. The program is also developing tools to evaluate overall environmental risk, methods for monitoring the effects of these technologies on marine organisms, and a comprehensive database of marine and hydrokinetic environmental research and data.

## Resource Assessments

There is a vast amount of energy contained in waves, tides, ocean currents, undammed rivers and streams, and ocean thermal gradients. However, the total recoverable energy has not been well quantified or mapped in U.S. waters. The program is filling this need by assessing each of these major energy resources using available in situ measurements, remote sensing data, and advanced models. Publicly available, user friendly energy density maps will be produced using the results of these assessments.

## Economic Analyses & Market Development

The Water Power Program conducts economic analyses to quantify the benefits of the widespread deployment of effective and cost-competitive marine and hydrokinetic systems. Activities include assessing industry research and development needs, identifying policy mechanisms and market designs that will support accelerated deployment, and providing information and training to potential members of the marine and hydrokinetic industry and other stakeholders.

## Program-Supported Marine and Hydrokinetic Projects

The Water Power Program supports dozens of marine and hydrokinetic projects such as the development of tidal and ocean current devices and utility-scale buoys, studies on habitat and marine life, and assessments of energy production potential. For a complete list of Water Power Program projects, see the U.S. Department of Energy's Wind and Water Power website at [eere.energy.gov](http://eere.energy.gov).

## Information Resources

- Wind and Water Power Program — [windandwater.energy.gov](http://windandwater.energy.gov)
- Marine & Hydrokinetic Technology Database — [windandhydro.energy.gov/hydrokinetic](http://windandhydro.energy.gov/hydrokinetic)
- Hydrodynamic Testing Facilities Database — [windandhydro.energy.gov/hydrodynamic](http://windandhydro.energy.gov/hydrodynamic)