Video: What is marine energy?

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In a new educational video, NREL Water Power Researcher Aryana Nakhai explains what marine energy can do for the country—in the short and long term. Credit: NREL

So you have heard of solar power and wind energy, but what about their younger cousin, marine energy?

Marine energy—which is clean energy generated from waves, tides, ocean currents, free-flowing rivers, and human-made channels—might

be a few decades behind its cousins. But this newer renewable could soon power the blue economy by energizing marine exploration, disaster relief missions, offshore industries (like seafood farms), and more—all while protecting wildlife and ecosystems.

Eventually, marine energy could contribute to a carbon-free electrical grid, too. But first, researchers, like those in the National Renewable Energy Laboratory's (NREL's) water power group, must continue honing these promising technologies, moving them closer to commercial success.

Now, in a new educational video, NREL Water Power Researcher Aryana Nakhai explains what marine energy can do—in the short and long term. She also details the various types of marine energy resources and technology designs as well as what researchers, like Nakhai and her colleagues, are doing to overcome technical challenges and help these technologies deliver clean energy to offshore industries, coastal and island communities, and, one day, the U.S. electrical grid.

"This is a really exciting time to be a researcher in marine energy," Michael Lawson, senior researcher and manager of NREL's water power technologies group, says in the video. "The industry is at such a nascent stage of development where there are many technologies out there that have the potential to become commercially successful."

What types of marine energy technologies exist?

Today, marine energy technologies are still at early stages of development. Researchers are working to improve a range of promising marine energy device designs, hoping that one—or several—will be cost-effective, productive, and robust enough to achieve commercial success.

Some of these technologies are built to sit on the bottom of a river or the

ocean floor, whereas others could bob on the water's surface or rest, half-submerged, near the top. Researchers are still finding more creative—and more cost-effective—ways to harness marine energy.

Where is marine energy generated?

Theoretically, marine energy could be created anywhere water flows naturally. But not all marine energy resources are equally powerful.

Levi Kilcher, a senior researcher in NREL's water power group, studies where marine energy flows and how much power devices might generate in certain sites, like Alaska's energetic Cook Inlet. To help technology developers select sites or locations best suited to their specific technology designs, Kilcher helped create the Marine Energy Atlas, a living map of marine energy resources available across the United States.

In the video, Kilcher explains that wave energy, in particular, is a massive resource that exists along the entire U.S. coastline but especially along the West Coast. "And some of the things that make these technologies particularly exciting is they're very forecastable and predictable," he says. "We have satellites that are constantly measuring the waves, so we can see the waves propagating across the ocean. We know where they're going to go."

What are some of the benefits of marine energy?

As long as the moon stays put and winds keep blowing, water will never stop flowing. Far more energy surges within U.S. oceans and rivers than the marine energy industry could hope to harness. But if researchers tap all accessible marine energy, that power could provide almost 60% of the country's annual electricity needs. For isolated or island communities—like those in Hawaii, Maine, or along remote Alaskan

coastlines—marine energy could help replace some of their dependence on fossil fuels, potentially reducing energy costs and increasing their energy resilience.

As Kilcher said, marine energy is also highly predictable. And it can complement other renewable energy sources, generating more power at night and during the winter, when others tend to wane. But one of marine energy's greatest benefits is its potential to provide clean energy for remote and rural communities located far from any power grid. Out in the deep ocean, for example, marine energy could recharge batteries for observation technologies that look for signs of dangerous tropical storms.

How could marine energy power the blue economy?

The "blue economy" encompasses both offshore industries, like seafood farms, as well as coastal and island communities, which often rely on expensive shipments of liquid fuels for power. And while grid-scale marine energy devices might need a couple more decades of development before they are ready, smaller devices could soon provide power for specific needs, like water desalination—the process of removing salts and other impurities from water to produce clean drinking water.

Desalination technologies can be especially valuable for island nations that have limited access to clean drinking water or reduced supplies as a result of a natural disaster. To further address these needs, NREL researchers recently designed, built, and tested a novel wave-powered desalination system off the coast of North Carolina.

What challenges remain?

Although water resources are free, designing, building, deploying, operating, and maintaining marine energy devices is not. Today's technologies are still not yet cost-effective enough to achieve commercial success, but NREL's water power researchers are studying how to reduce costs without sacrificing energy production or resilience. For example, an NREL team recently designed a variable geometry wave energy converter, which could be cheaper, produce more energy, and better survive powerful ocean waves. Another highly flexible type of wave energy converter could generate electricity from both slow- and fast-moving ocean waves as well as all six wave movements, including forward surges, upward heaves, and circular eddies.

"Working in the ocean is extremely challenging," Kilcher said. And, before marine energy developers deploy their technologies, researchers want to make sure they will not have unintended impacts on the marine environment. At NREL, experts are guiding the development of these technologies to make sure they are also safe. And the data they collect will be made available to the public, so developers can learn how to reduce their costs and risks, too.

How can you get involved?

Whether you are a student learning about marine energy for the first time or a company hoping to hone your promising technology design, you can join NREL's researchers in the quest to advance the marine energy industry.

As Nakhai explains in the video, NREL performs research and development and economic analysis and also partners with other marine energy experts from industry and academia to help accelerate marine energy development. Together with the laboratory's partners and the up-and-coming generation of researchers, NREL can, as Lawson puts it in the video, help "develop the next generation of technologies that

ultimately will become our commercial energy solutions in the future."

Provided by National Renewable Energy Laboratory

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