

An Ocean of Energy

Generating electricity from tidal flows and wave action

Harnessing the constant motion of waves, tides, and currents to generate electricity has long been one of the holy grails of energy futurists. Now, thanks to advances in technology and a nationwide push for renewable energy, that dream appears to be closer to reality than ever before — with East Coast residents likely to see the greatest gains in Florida and Maine.

“It’s really a confluence of the fact that these technologies are basically borrowing technology and components from other industries — the offshore oil industry, wind, and submarine. All these things come together in our designs,” says Chris Sauer, president and CEO of Miami-based Ocean Renewable Power Company. “Number two, there is such a tremendous influence on renewable energy that we are actually able to attract investors.”

Driven largely by small start-up companies, there are projects in the water or in the development and permitting stages in Hawaii, Alaska, Oregon, Washington State, California, New York, and Rhode Island, says the Ocean Renewable Energy Coalition, a trade association founded to promote energy technologies from clean, renewable ocean resources.

But efforts differ sharply on the two coasts. With large, regular waves, the West Coast is considered ideal for turbines or other mechanisms that generate electricity from waves, so “wave farms” are among planned projects there. Waves along the Atlantic coast, by contrast, are small and irregular, a result of west-to-east global wind flow. That leaves tides and currents as the



KRIS UNGER FOR VERDANT POWER, INC.

Tidal turbine. The first of 100 turbines planned for New York’s East River is lowered into the water. When completed, the project is expected to generate enough electricity to power 8,000 homes.

main available sources of East Coast ocean energy.

TAPPING TIDES

Late last year, Verdant Power became the nation’s first to tap tides when the company placed a turbine in New York’s East River. The 35-kilowatt turbine affixed to the river bottom on the eastern shore of Roosevelt Island generates power for a grocery store and parking garage. Verdant says the project will eventually have at least 100 turbines and generate 10 megawatts of electricity, enough to power nearly 8,000 homes.

Enthusiasts say the Verdant project is just the start. The really promising spots for tidal and current energy have

yet to be tested, they explain. Oddly, such sites lie at the coast’s two most distant points: South Florida and northern Maine.

The Gulf Stream, the narrow but powerful ocean current that carries water north from the Gulf of Mexico to Newfoundland and on to Europe, flows within sight of Fort Lauderdale and Miami beaches, making that area ripe for current-driven turbines. Meanwhile, Maine’s Bay of Fundy, where tides can vary as much as 40 feet in a single cycle and islands act as funnels to accelerate water flow, suggests a huge energy resource.

“We have the Gulf Stream going past the state 24/7, so that makes it attractive,” says Manhar Dhanak, professor

and chairman of Florida Atlantic University's department of ocean engineering. "If we could harness a fraction of the energy of the ocean, then that could be a significant contribution to Florida's energy needs."

Florida lawmakers last fall gave \$5 million to FAU to create the Center of Excellence in Ocean Energy Technology to explore just that possibility. Dhanak and other FAU researchers hope to have a 1- to 3-meter, and at least 50-kilowatt prototype turbine placed in the Gulf Stream by the end of the year, Dhanak says.

Meanwhile, more than 1,800 miles north in Eastport, Maine, Ocean Renewable Power is working on a small demonstration turbine the company says it will place in the Bay of Fundy's Western Passage by November.

The unique turbine is designed to turn the same direction no matter which way the water flows, maximizing energy efficiency throughout the tidal cycle, Sauer explains. If successful, "We believe we can build a 20-megawatt [plant], and we believe we can build that for \$38 to \$40 million," Sauer claims.

FROM PROTOTYPE TO PRODUCTION

Sauer and Dhanak are the first to admit, however, that growing the prototypes into production facilities won't be easy. Corrosive saltwater remains an issue despite improvements to technology. Underwater cabling is another challenge: the deeper and more distant the site, the harder and more expensive it is to move the power to land efficiently.

Currents move relatively slowly and meander somewhat, meaning any Gulf

Stream production power facility would likely have to be quite large and expensive, with many turbines spaced over a relatively wide area. Tides move more quickly but are intermittent, so they will never provide the steady supply available from nonrenewable sources such as coal and nuclear energy.

Still, Sauer says he thinks ocean power could one day produce 10% to 20% of the East Coast's energy needs. Dhanak estimates the Gulf Stream and other South Florida ocean energy projects could provide 20% of Florida's demand.

"It's not the silver bullet," Sauer says. "It's one of many solutions that, when combined with wind and other resources, will basically wean us from imported oil." — Aaron Hoover

Virtual Tsunamis

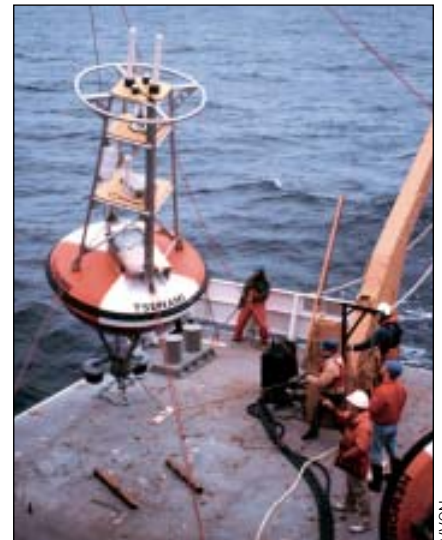
As if hurricanes weren't bad enough

Thousands of people cavort on Daytona Beach on a hot Sunday in August when, out of nowhere, a 15-foot wave floods the beach. The water swamps the sun worshippers and rushes into buildings along Highway A1A.

Emergency managers in Daytona's home of Volusia County sought to prepare for just such an event during a drill earlier this year. Their morning-long exercise was part of a growing effort by local, state, and federal officials to plan for a catastrophe so rare on the East Coast that few hurricane-hardened residents have pondered it: a tsunami.

"The thing about a tsunami is, it's a low probability, high-impact event," says Daniel Noah, a Ruskin, Fla.-based warning coordination meteorologist for the National Weather Service. "We've had them before, and we're going to have them again."

Many tsunamis occur when an earthquake causes rapid movement of the ocean bottom, displacing vast quantities of water. Others well up from underwater landslides or volcanoes. Most tsunamis happen within the seismically and volcanically active "Ring of Fire" surrounding the Pacific. An 8.0-magnitude quake



Seismic sensor. Six tsunami-detecting buoys like this one have been deployed in the Gulf of Mexico. If the warning system works as intended, coastal municipalities may have an hour or more to prepare before the wave washes ashore.

there was the source of the tsunami that left 52 dead in the Solomon Islands in early April 2007.

Although recent tsunamis have struck Asia, they are not unheard of in Europe and the U.S. Perhaps most famously, a massive 1755 earthquake off the coast Lisbon, Portugal, caused a tsunami that killed tens of thousands of the city's 275,000 residents. Modelers believe that earthquake, which occurred in the Azores-Gibraltar fracture zone near Portugal, spurred successive tsunamis that raced across the Atlantic — striking Florida with a series of 7- to 10-foot waves, Noah explains. Florida and other southeastern states are also threatened by undersea earthquakes in the Caribbean's Puerto Rico Trench and by the Cumbre Vieja volcano in the Canary Islands. A fracture zone between Cuba and the Yucatan could cause a Gulf tsunami.

The largest tsunami to strike the East

Coast in recent memory came in 1929, when a likely underwater landslide on the Grand Banks created a 6- to 23-foot tsunami in Newfoundland and reported as far south as South Carolina, according to the U.S. Geological Survey. Overall, there are probably one to two tsunamis every century along the East Coast, Noah estimates. But the hugely devastating Indian Ocean tsunami of December 2004 prompted U.S. officials to expand the warning system already in place for Alaska and Hawaii — the U.S. states most prone to tsunamis — to the Atlantic coast, Noah said.

Today, the National Weather Service's Alaska Tsunami Warning Center monitors the East Coast's seismic hotspots. Because not every quake causes a tsunami, the service has a total of six tsunami-detecting buoys — most installed in 2006 — in the Gulf, Caribbean, and Atlantic. If seismologists

detect an earthquake of at least 6.8 magnitude, the center may issue a tsunami warning, while also seeking to confirm the tsunami via the buoys. That warning goes to the service's Melbourne office and then to other coastal offices, which issue flood warnings to emergency managers and the media.

The weather service believes East Coast communities could face a maximum of a 15-foot wave extending 300 feet inland. On much of the Gulf Coast, where the extensive underwater continental shelf would dissipate the wave's energy, the biggest wave would be about 18 inches, accompanied by strong currents.

If the warning system works as intended, coastal municipalities may gain an hour or more to prepare, which with efficient evacuation procedures could go a long way toward getting everyone off the beach before the tsunami arrives. — A.H.