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## Energy From the Restless Sea

By [HEATHER TIMMONS](#)

NEWCASTLE, England — There is more riding the waves here than surfers, thanks to a growing number of scientists, engineers and investors.

A group of entrepreneurs is harnessing the perpetual motion of the ocean and turning it into a commodity in high demand: energy. Right now, machines of various shapes and sizes are being tested off shores from the North Sea to the Pacific — one may even be coming to the East River in New York State this fall — to see how they capture waves and tides and create marine energy.

The industry is still in its infancy, but it is gaining attention, much because of the persistence of marine energy inventors, like Dean R. Corren, who have doggedly lugged their wave and tidal prototypes around the world, even during the years when money and interest dried up. Mr. Corren, trim and cerebral, is a scientist who has long advocated green energy and pushed through numerous conservation measures when he was chairman of the public energy utility for the city of Burlington, Vt.

Another believer in the technology is Max Carcas, head of business development for Ocean Power Delivery of Edinburgh. “In the long run, this could become one of the most competitive sources of energy,” said Mr. Carcas.

His company manufactures the Pelamis, a snakelike wave energy machine the size of a passenger train, which generates energy by absorbing waves as they undulate on the ocean surface.

With high oil prices, dwindling fuel supplies and a growing pressure to reduce [global warming](#), governments and utilities have high hopes for tidal energy. The challenge now is turning an accumulation of research into a viable commercial enterprise, which for many years has proved elusive.

No one contends that generating energy from the oceans is a preposterous idea. After all, the “fuel” is free and sustainable, and the process does not generate pollution or emissions.

Moreover, it is not just oceans that could be tapped; the regular flow of tides in bodies of water linked to oceans, like the East River, hold promise too. In fact, it seemed like such a sensible idea that inventors started making the first wave of such generators centuries ago. Many operated like dams, trapping water and then releasing it after the tides fell. But they

were outmoded with the rise of steam engines and other more efficient fuel sources.

Ocean energy had a brief revival when oil prices rose in the 1970's, and prototypes were tested in Europe and China. But financing dried up when oil prices were low in the 1990's, and advances in wind turbines and other renewable energy elbows out tidal projects.

These days, wave power designs vary from machines that look like corks bobbing in the ocean to devices that resemble snakes pointing into waves. There are shoreline machines that cling, like limpets, to rocks.

Tidal power machines, in contrast, often come in the form of turbines, which look like underwater windmills, and generate energy by spinning as tides move in and out; some inventors also are testing concrete-and-steel machines that lie on the seabed and pipe pressurized water back to the shore.

Even big commercial power companies are joining the action. [General Electric](#); Norsk Hydro, a Norwegian company; and the Germany power giant Eon have recently pledged money for new projects or investments in tiny marine energy companies.

"It is an untapped renewable energy source," said Mark Huang, senior vice president for technology finance in General Electric's media and communications business, which is financing marine projects. "There is no where to go but up," Mr. Huang said. He added that solar or wind energy should be viewed "as a case study" for the direction marine energy could take.

Right now, wave power generators are being tested near the shores of New Jersey, Hawaii, Scotland, England and Western Australia. A long-awaited East River tidal turbine project is to start this fall, and Representative William D. Delahunt, Democrat of Massachusetts, has proposed that the United States follow in Britain's footsteps to build an ocean energy research center, the country's first, off the Massachusetts coast.

A handful of commercial projects are also in the works, including the world's first "wave farm," as the fields of machines are known, being installed off the north coast of Portugal. A field of tidal turbines is also being built off the shore of Tromsø, Norway.

Britain could generate up to 20 percent of the electricity it needs from waves and tides, according to an estimate by a government-financed group here called the Carbon Trust. That is about 12,000 megawatts a day at current usage, or three times what Britain's largest power plant produces now. In fact, England and Scotland have become experimental laboratories for ocean energy development. As reserves shrink and the offshore oil business in the North Sea winds down, governments are trying to capture the accumulated knowledge and transform oil industry jobs into other ways of generating energy.

One research center here in Newcastle is putting marine devices to the test in a wave pool,

and another is deploying them in the roiling ocean off the Orkneys, the low islands off northernmost Scotland. The Scottish government has pledged to generate 18 percent of its energy from renewable resources by 2010.

If marine energy replaces the burning of some fossil fuels like coal, it can help reduce overall carbon dioxide emissions and possibly increase the diversity and security of energy supply, said John Spurgeon, a marine energy specialist in the British Department of Trade and Industry. Since 1999, the government has committed more than \$47 million to research and development, \$93 million to commercialize that research and additional money to bring the energy into the electrical grid, Mr. Spurgeon said.

No energy source is perfect, though, and marine energy developers are running into some hurdles. While such generators do not emit smoky pollutants or leave behind radioactive waste, the machines are not small or delicate, and can be an eyesore. To draw energy from the ocean, they often need to be rooted on sea floors relatively close to shore, or mounted on rocks on the shore — places that have not traditionally been used for energy generation.

And despite their green-friendly intentions, inventors are finding some of the stiffest resistance is coming from environmental groups.

Take the case of Verdant Power, Mr. Corren's company, which has been trying for years to erect a small field of tidal turbines in the East River — a project that may finally get started this fall. Mr. Corren, the company's technology director, first developed the turbines as part of a [New York University](#) project in the 1980's and planned to attach them to the Roosevelt Island Bridge.

After the school pulled the plug on the project, the design team spent years trying to find a new home. One executive even brought a prototype to Pakistan, but the data it collected was lost when the computers and instruments went missing.

Verdant embarked on a new East River turbine project in 2003, but it has taken two and a half years to get regulatory approval for the project from environmental agencies and the United States Army Corp of Engineers. The issue was not blocking the river to boat traffic, or how it would hook up to the electrical grid or even how it might mar the view, because it is mostly underwater. It was the fish population of the East River.

“We had eight fish biologists against it, and no one on the other side advocating for clean air” or other environmental issues, said Ronald F. Smith, the chief executive of Verdant Power. “You can see that the regulatory process is extremely biased towards doing nothing,” Mr. Smith said, adding that regulators were worried about complaints that could arise from any new projects.

To get approval, the company is installing \$1.5 million in underwater sonar to watch for fish around the turbines “24 hours a day, 7 days a week,” and the data will be shown online, Mr.

Smith said. Verdant Power executives warn against looking forward to a live “East River cam” that broadcasts the murky mysteries beneath the water. Sonar transmissions look more like fuzzy black and white television, they say, and besides they have seen “very, very few fish” on their visits to the river.

Ultimately, Verdant estimates it can generate 10 megawatts of electricity from the East River’s tidal flows — enough to power several thousand homes, though its test turbines will be used primarily to power a Gristedes grocery store on Roosevelt Island.

To date, studies on the effect of wave and tide machines on marine life have been sporadic and sometimes bizarre. For example, in one British trial, frozen fish were shot like projectiles onto a piece of metal that was supposed to estimate the effects of the turning blades of marine turbines.

Proper testing will involve putting some of these devices where they are not wanted, a problem reminiscent of the wind industry’s battle to construct new turbines. Some leading environmental advocates say that the issue is part of a larger wrenching change being thrust on the green movement.

“It’s a major psychological and cultural challenge for the environmental and conservation movement,” said Stephen Tindale, executive director of [Greenpeace](#) UK. “What we need to combat climate change is a complete transformation of our energy system, and that requires a lot of new stuff to be built and installed, some of it in places that are relatively untouched.”

But the potential of marine energy is too strong to ignore. For example, a recent report identified San Francisco Bay as being the largest tidal power resource in the continental United States. “There are tremendous resources for generating power along the northern coast of California,” said Uday Mathur, a renewable energy consultant to government agencies and private enterprises.

The biggest hurdle is creating a landscape for development “where these technologies can thrive,” he said, which includes a combination of government involvement, community support and of course the availability of financing.

“The situation is very similar to wind 15 years ago,” said John W. Griffiths, a former British gas executive and founder of JWG Consulting, which advises on renewable energy projects. He added: “We think that this is an industry waiting to happen.”

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