ENVIRONMENT

They tapped the mighty Gulf Stream for power in a test. Does ocean energy have a future?

BY SARAH LOFTUS
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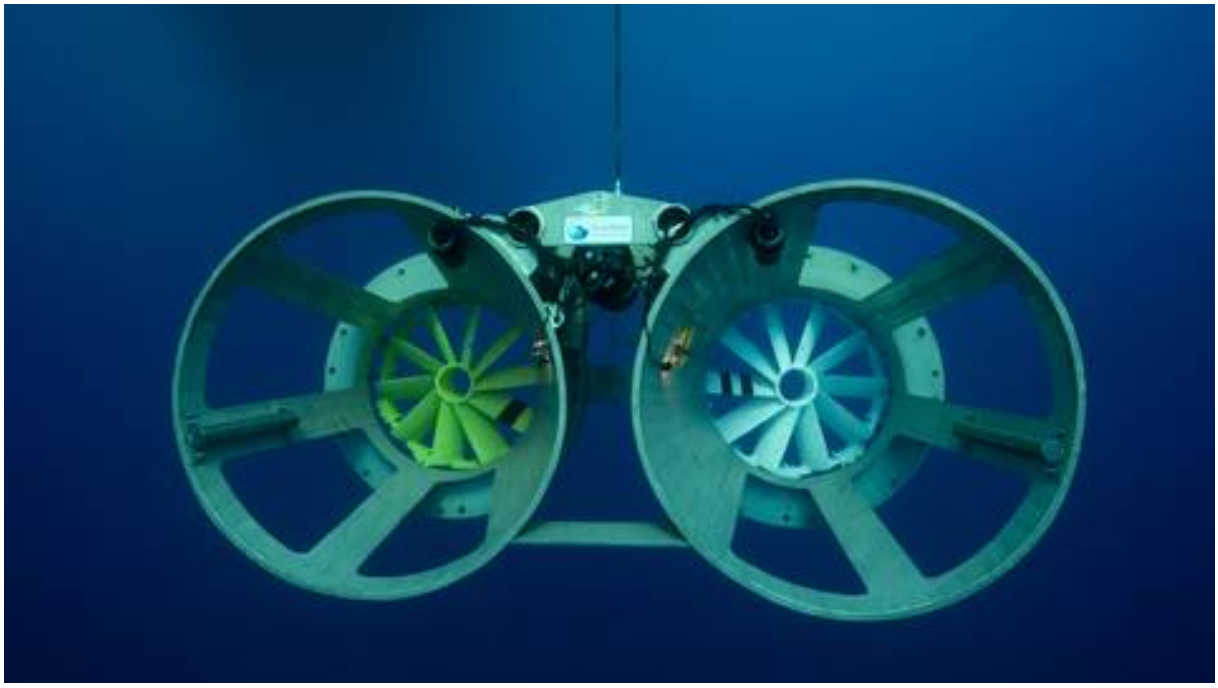

The turbine prototype that generated power for 24 hours was suspended from the research vessel.
CONTRIBUTED TO THE MIAMI HERALD

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The appeal of ocean currents like the Gulf Stream is their relentlessness. This balmy jet of seawater speeding northward up Florida's coast could spin underwater turbines all day, generating reliable and renewable energy.

That's why researchers and entrepreneurs have been brainstorming how to produce electricity from the Gulf Stream for decades. But it has long been more of a vision than a reality, grounded

by the staggering cost of designing, building and installing a system large and dependable enough to plug into the grid — not to mention an obstacle course of other regulatory and technical hurdles.

Nevertheless, a South Florida company and university research team are quite literally taking the plunge.

Leaders of OceanBased Perpetual Energy and researchers from the Southeast National Marine Renewable Energy Center, or SNMREC, traveled 20 miles off the coast of Florida in late May with three turbine prototypes onboard. They suspended one prototype underwater to generate power for an unprecedented 24 hours in the Gulf Stream.

"When it came to 24 hours and 1 minute, I couldn't help it, I said 'We've done it!'" said Nasser Alshemaimry, founder and CEO of OceanBased, which funded the demonstration. "We have found the holy grail of perpetual energy."

That would be the Gulf Stream, a warm ocean current that flows up the east coast of Florida. While its speed and location fluctuate, the current can reach speeds over 5 miles per hour at the surface.

“It’s like a river. It’s a 18 or 20 mile-wide river in the middle of the ocean,” said Alshemaimry.

Researchers at SNMREC have been measuring the Gulf Stream for about 10 years to find the best location for underwater turbines. The current is bowl-shaped under the ocean surface, said Gabriel Alsenas, director of SNMREC. The middle of the current is the deepest and the edges are shallower. The most dependable source of power is in the center, 10 to 30 miles offshore, he said.

Flowing seawater is already used to generate power, but mostly from incoming ocean waves and the gradual rise and fall of ocean tides. Unlike ocean waves and tides, and the wind and sun, ocean currents theoretically could generate renewable energy constantly.

Researchers have studied the power potential of other ocean currents too, including the Kuroshio Current around Japan and Taiwan and the Agulhas Current around South Africa. But turbine arrays don’t exist inside ocean currents yet.

Nasser Alshemaimry, CEO of OceanBased Perpetual Energy, onboard a research vessel in the Gulf Stream during the turbine demonstration. *CONTRIBUTED TO THE MIAMI HERALD*

FROM PILOT TO INVENTOR

Alshemaimry's early interest in renewable energy developed after seeing air pollution each time he descended back to land as an airline pilot in the 1970s. He later led real estate and construction projects as an entrepreneur, incorporating solar panels in a Saudi Arabia housing project in 1976.

It wasn't until 2008 that Alshemaimry turned to the ocean for energy. He invented equipment to power a desalination plant from ocean waves. He also partnered with a Swedish company to develop wave energy projects around the world.

Alshemaimry grew frustrated though as he confronted the fact that wave energy only worked for a fraction of the day, when there were waves. He didn't think it could substantially contribute to replacing fossil fuels, so in 2017 he gave up.

A year later, Alshemaimry was invited to an energy conference in Scotland, where he talked about his desire for a continuous renewable energy source. A U.S. Department of Energy representative approached him afterwards and told him about the Gulf Stream, and about the work that SNMREC was doing at Florida Atlantic University.

Alshemaimry had already been living in Florida for over 40 years at that point. He'd even been given the key to the City of Miami in 1980 for creating over 1000 jobs in the county. The Gulf Stream was at his doorstep.

After talking with Alsenas at SNMREC, Alshemaimry was committed to Gulf Stream energy. His company OceanBased and SNMREC have been working together for over a year to develop a plan.

A PROTOTYPE TURBINE

OceanBased wants to tackle the whole package of large-scale renewable offshore energy. Their major priority is to attract investors and customers, creating demand for ocean energy. The 24-hour demonstration was a first step to show their capabilities.

SNMREC and another partner company built the turbine prototype used for the demonstration. The turbine looks like two connected discs with rotors on the inside. The generators that make electricity are encased in rings around the discs. Alsenas said the turbine reminded him of WALL-E's eyes, referring to the popular Disney robot left to clean up an earth trashed by humans.

OceanBased's next steps are to partner with investors, a turbine manufacturer, and a management company to handle the major financial, technical and regulatory challenges of the project.

The company's ultimate plan involves turbines with propellers measuring anywhere from 30 to 100 feet across, floating roughly 60 to 80 feet below the ocean surface. They'd be tethered to heavy boxes filled with seawater on the ocean floor. Alshemaimry noted that cables, tethers and anchors are not new inventions and have been in the ocean for decades.

Laying down cables to bring power back to shore might be too expensive to do initially, said Alsenas. One alternative could be an offshore barge to test the power while they're still in the research and development phase.

UNCHARTED REGULATORY WATERS

Installing turbine arrays in the Gulf Stream hasn't been done before. Regulations specific to ocean current energy don't exist in the U.S. yet, said Andrea Copping, an expert on the environmental effects of marine energy technologies.

Projects would need a lease from the Bureau of Ocean Energy Management, would need to comply with laws protecting marine mammals and endangered species, and would need additional permits from the Army Corps of Engineers, the Coast Guard and other agencies. Regulations developed for offshore wind energy can be a starting point, though, said Alsenas.

Underwater propellers that only make about a dozen rotations per minute may seem relatively harmless, but potential impacts need consideration. Companies looking to place underwater turbines offshore need to test effects on the surrounding environment, which will take time and money.

"There's a tough road for these developers to get through," said Copping, who is based at the Pacific Northwest National Laboratory and recently published an international report on the environmental impacts of marine renewable energy.

The environmental risks of most concern, she said, are animal collision and disturbance of the sea floor.

Animal collision is one of the more difficult impacts to measure. Researchers don't know what the likelihood is that animals like whales and sea turtles will collide with turbines or mooring lines. They also aren't sure how seriously a collision would affect different marine animals.

"We're slowly getting a handle on things like effects of noise, and electromagnetic fields, and changes in habitat, but collision risk is still the very toughest one," said Copping.

SNMREC researchers flew slowly over the ocean each month in 2009 and 2010 to document

when and where they saw marine animals. They're also developing underwater sensors to detect animals around a turbine.

On the bottom of the ocean, anchors and cables would need to avoid critical habitats and marine life like deepwater coral.

Noise from the turbines and electromagnetic fields from the cables likely wouldn't disrupt animals sensitive to sound or the Earth's magnetic field, but these impacts still need to be tested.

A bigger question might be what are the relative environmental risks of offshore renewable energy versus carbon emissions from fossil fuels for the same amount of power. Researchers are beginning to compare these risks, said Copping. Legislation like the Endangered Species Act doesn't regulate carbon emissions linked to climate change.

MONEY FLOW IMPORTANT, TOO

While installing a turbine array in the Gulf Stream might be another ten years away, OceanBased is starting small with a special permit to build a 5-megawatt array for research and development.

Even if the project turns out to be technologically and environmentally feasible, OceanBased will need funding and customers. Their top priority is finding people willing to invest in ocean current energy.

The company's goal is to have a 5000-megawatt array in the future, enough to power over 3.5 million homes. Alshemaimry estimates the project would involve thousands of turbines, costing $18 billion and creating thousands of jobs.

The company needs to negotiate contracts with its first customers who'd be willing to pay what's likely to be a higher price than electricity from fossil fuels. Examples could be a coastal hydrogen fuel cell plant or a business that wants to advertise its use of completely renewable energy, said Alsenas. Eventually OceanBased might supply power to the grid.

"The problem is they're really expensive at this point, we're not far enough down the curve to really lower the cost," said Copping about large-scale marine energy technologies in general. Other options could include powering ocean observation technologies or offshore agriculture, said Copping.

Alshemaimry is optimistic.

"It will be the birthplace of ocean current energy," he said about Florida. "I'm very happy, I'm proud that I'm doing this because this is my state."

Sarah Loftus is a Mass Media Fellow with the American Association for the Advancement of Science, sponsored by the Heising-Simons Foundation.