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Marine Hydrokinetic Energy

The 30th Annual Emerging Issues Forum focused on innovation and nowhere is innovation more apparent than in the field of energy.

North Carolina’s coast has tremendous energy resources and there are many different ways to harness that energy. President Obama has proposed opening up the Outer Continental Shelf to oil and gas drilling in the 2017-2022 Bureau of Land Management lease program. Seismic testing may begin as early as this year to locate the most promising drilling locations. Governor McCrory, a vocal supporter of the President’s recommendation, has taken a leadership position as co-chair of the Outer Continental Shelf Governors Coalition, a group of coastal state governors that shares information on energy resource evaluation and planning.

North Carolina’s coast also has significant wind resources - more than any other state along the eastern seaboard, as the Department of Energy’s high-resolution wind map reveals. Although three ocean locations off North Carolina’s coast have been selected for future offshore wind projects, a lease sale for these sites will not open until mid-2016. In the meantime, Dominion Virginia Power is currently installing two 6-megawatt direct-drive wind turbines.
26 miles off the coast of Virginia Beach, Virginia.

While offshore oil and gas and offshore wind have been getting a lot of attention, North Carolina has also been busy working in the nascent field of marine hydrokinetic energy. This effort was launched in 2010 by the North Carolina General Assembly and is spearheaded by the University of North Carolina Coastal Studies Institute (UNC-CSI) in Wanchese, NC.

If you have ever felt a wave crash over you, then you understand firsthand the power of the ocean. The kinetic energy of waves, tides, and ocean currents represents an untapped and potentially enormous energy resource. Although North Carolina’s long and shallow coastline offers ready ocean access, there are still questions to be answered about marine hydrokinetic energy before it can be fully developed as a mature resource. These questions include:

- How much renewable energy can be harnessed in the ocean?
- What types of devices should collect the energy?
- Will they hold up to coastal storms and work within a marine environment?
- How expensive is it to build those structures?

UNC-CSI researchers are working with the engineering programs at NC State University, the University of North Carolina at Charlotte, and North Carolina A&T University to answer these questions. Although North Carolina cannot match Europe’s investment and
Research in marine hydrokinetic energy development, UNC-CSI experts have determined that they can improve these devices and systems by testing them in an open ocean environment. They are now supporting tests of wave energy devices and their environmental impact at Jennette’s Pier in Nags Head.

An ocean energy research instrument at Jennette’s Pier

UNC-CSI researchers have also studied the Gulf Stream as a potential energy resource. The Gulf Stream is a warm ocean current that travels from the Gulf of Mexico, flows around Florida and North Carolina, and finally heats waters off the coast of the United Kingdom. It represents an attractive potential site for ocean current technology because of its strong, constant current of four to five miles per hour. North Carolina has a great opportunity to benefit. Placing a large structure in deep water off the coast is a significant engineering challenge. However, if ocean current energy capture proves to be technically and economically viable and there are no constraining environmental impacts, production of related energy technologies could provide new jobs in North Carolina.

Researchers from UNC-CSI’s partner institutions also have been working on finding better technology components and developing storage options for offshore energy systems. One area of UNC-CSI research is magnetic-g geared power takeoff, which increases the speed of a rotor that is turned by a low-speed input, like that from a wave-energy converter, to minimize efficiency losses and maximize electricity output.

Another area of research is using compressed air to store ocean energy. The concept is to attach a large flexible receptacle to the ocean floor, use ocean energy to fill it with compressed air, and then to
release the compressed air to drive a turbine to produce electricity at times of peak demand. The challenges are considerable at commercial scale. The device must be structurally sound, able to withstand the ocean environment for many years, and be well anchored to the ocean floor. However, ocean-compressed air represents a promising renewable that would help balance intermittent renewable energy sources like wind and solar.

North Carolina is blessed with a beautiful coastal environment and the ocean is a good resource for marine hydrokinetic energy. This exciting new technology deserves more discussion here our state.

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