

Marine Renewable Energy Research and Development at Virginia Tech's Advanced Research Institute (VT-ARI)

The past ten years have seen substantial progress in harnessing marine renewable energy resources, particularly offshore winds, waves, and tidal currents. VT-ARI researchers are studying the feasibility of these technologies in a variety of North American collaborative projects, as well as investigating their potential contribution to Virginia's energy needs.

Offshore wind energy is the most commercially mature of the marine renewable energy technologies, with Denmark, Germany and the United Kingdom being particularly active in its deployment. Nearly thirty offshore wind projects are under development in the UK, and these could supply more than 8% of that nation's annual electricity demand in the coming decade.



The 60-megawatt North Hoyle project off the coast of Wales is typical of today's offshore wind farms. Installed in May 2003, it consists of thirty Vestas 2-MW turbines, each having a rotor diameter of 80 meters. This project occupies an area of six square kilometers.

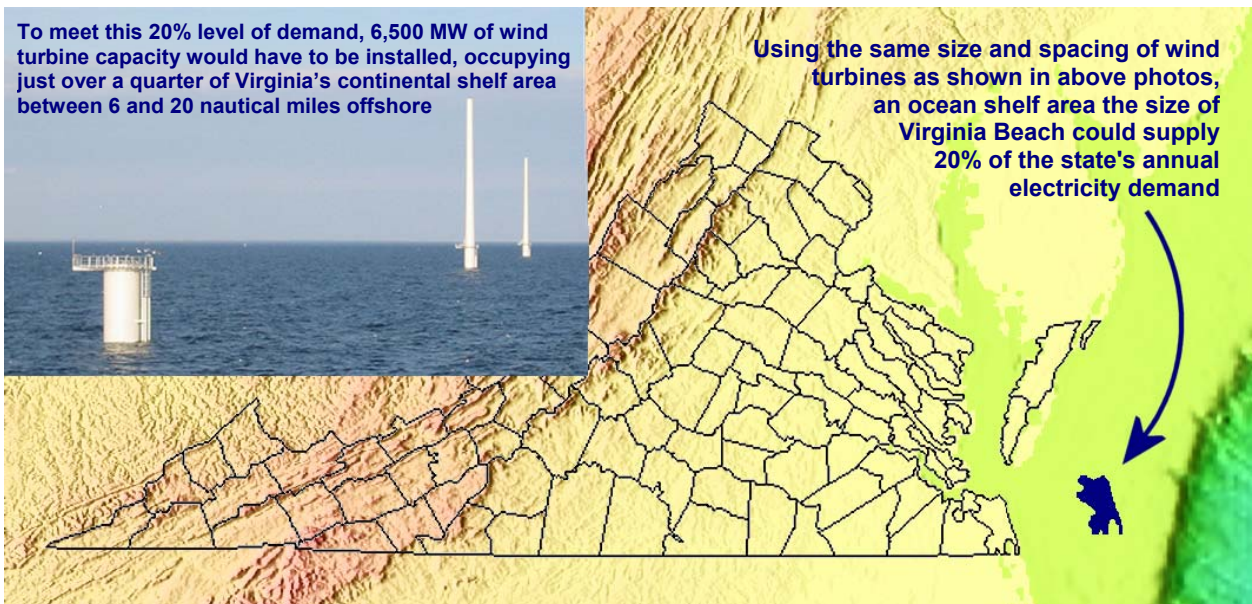
Local fabrication and installation contracts account for about \$500-600 per kilowatt of an offshore wind farm's capital cost. Marine service contracts amount to about one cent per kilowatt-hour. These represent large new business opportunities for the Hampton Roads region. Offshore aquaculture might also be incorporated into such projects, improving the business case and providing added sustainable economic development potential for Virginia's coastal communities.



To meet this 20% level of demand, 6,500 MW of wind turbine capacity would have to be installed, occupying just over a quarter of Virginia's continental shelf area between 6 and 20 nautical miles offshore



Using the same size and spacing of wind turbines as shown in above photos, an ocean shelf area the size of Virginia Beach could supply 20% of the state's annual electricity demand



The Virginia Coastal Energy Research Consortium

The Virginia Coastal Energy Research Consortium was established by the Virginia General Assembly in 2006. The Virginia Tech Advanced Research Institute was named as one of five founding members, along with Old Dominion University, the Virginia Institute of Marine Science, Norfolk State University, and James Madison University. The Consortium serves as an interdisciplinary research, study, and information resource for the state on coastal energy resources, including offshore winds, waves, marine biomass, and methane hydrates.

In addition to quantifying the potential energy and economic benefits of offshore wind energy development in Virginia, VT-ARI researchers also are identifying opportunities for the state's innovative manufacturers to develop lower-cost fabrication materials and methods for marine renewable energy structures. The development of an offshore test bed for large wind turbines and integration of intermittent wind and wave power with other generation sources in the state are other key areas of VT-ARI research for the Virginia Coastal Energy Research Consortium.

Tidal current energy can be harnessed by underwater turbines driven by the ebb and flow of the tides. This innovation in tidal power avoids the environmental impacts of damming a bay or estuary. VT-ARI is collaborating with the Electric Power Research Institute (EPRI), utilities, and the appropriate state or provincial government agencies to plan and develop demonstration projects for tidal current turbines in the Puget Sound region and the Bay of Fundy. VT-ARI also is doing tidal and river current modeling studies for Verdant Power.



This 35-kilowatt underwater turbine was developed by Verdant Power and assembled in Charlottesville, Virginia. Six of these turbines have been operating in a 200 kW demonstration project in New York's East River (pictured at left) since May 2007. The 5 m diameter rotor has three blades and is on the downstream end of the turbine nacelle, which yaws 180° when the tide turns.

Wave energy is less mature than offshore wind or tidal current energy, but an EPRI feasibility study, in which VT-ARI also participated, found that for many sites in the United States, wave power is likely to realize economies of mass production more quickly than wind power. VT-ARI is now doing a wave energy forecasting feasibility study for Bonneville Power Administration.



The Pelamis wave energy device resembles a floating sea snake, absorbing energy from relative angular motion at the joints between its sections as waves travel along its length. The photo at left shows one of three units being assembled by the UK company, Ocean Power Delivery, Ltd., for a pilot plant off the coast of Portugal, which eventually will grow into a 28 MW project.