Sustainable Development Law & Policy

Volume 7
Issue 3 *Spring 2007: Sustainable Energy*

Article 7

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Scott Johnson

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"New-Wave" Interest in an Old Alternative Resource

*by Scott Johnson**

Due to increasing concerns regarding energy policy, security, and climate change, various alternative energy resources recently enjoyed increased media and investment attention in both domestic and international spheres.[1] Among these is "ocean energy," which encompasses energy derived from waves, tides, currents, and salinity and thermal gradients.[2] Like other resources, wave energy is imperfect, and its development raises numerous challenges.[3] However, wave energy may have great potential, particularly in light of the increasing environmental and economic costs of fossil and nuclear energy, to provide clean, abundant, and sustainable energy in suitable regions around the globe, or at least, to contribute to the production of clean energy carriers (e.g., hydrogen) for use in other applications.

Wave energy is, in essence, concentrated solar energy.[4] Solar radiation creates temperature and air pressure differentials on land and over water, which result in wind.[5] These winds blow over ocean surfaces, causing ripples, then chop, then developed seas, and eventually, swells, which can travel thousands of miles in deep water until dissipating their energy when they break on shore.[6] Wave energy technologies extract the kinetic energy from surface waves, or from subsurface pressure fluctuations,[7] and convert that energy into electricity, or make it available directly for other purposes.[8] Compared to traditional generation resources, e.g., fossil fuel combustion and nuclear generation, wave energy, with appropriate site selection and careful design, is generally environmentally benign, does not directly generate emissions or waste, is generally low-profile (far offshore or close to or below the ocean's surface), generally is more predictable than solar and wind generation, and carries zero continuing fuel cost.[9] Research into wave energy extraction technologies began in earnest following the oil crises of the early 1970s.[10] However, available financing diminished with depressed oil prices in the 1980s and 1990s.[11] Wave energy technology garnered relatively little research or investment attention since that time, and therefore, still is considered an emerging technology.[12]

Wave energy has limitations, many of which are economic or technical.[13] Extraction technology remains expensive, and is not cost-competitive with traditional generation.[14] For example, extraction potential for deep ocean wave energy can be many times greater than extraction potential at adjacent coastal sites, but long-distance undersea transmission is prohibitively expensive.[15] Technical considerations, such as the oscillating, low-frequency nature of wave energy, which would require it to be converted to standard frequency before addition to the U.S. national grid, and which present a potential reliability problem, also must be addressed.[16] Proving actual energy conversion potential and demonstrating marine survivability of wave energy extraction technologies also are among the challenges to be overcome if wave energy is to become a viable, large-scale alternative resource.[17] Despite these economic and technical obstacles, however, the costs of wave energy extraction are decreasing.[18]

Relatively few large-scale wave energy extraction projects currently are operational. However, in recent years, several commercial projects have been installed, or are planned to be installed, off of the coasts of Portugal and Scotland, among other nations.[19] In February 2007, citing "increasing interest in new hydroelectric technologies," including wave energy,[20] and recognizing the "significant potential," for such technologies to increase U.S. hydropower production,[21] the U.S. Federal Energy Regulatory Commission ("FERC") issued an interim statement of policy for review of preliminary permit applications for wave, current, and river instream new technology projects.[22] The interim policy provides for, among other things, "strict scrutiny" of new preliminary permit applications.[23] However, while FERC's proposed regulations might delay wave and other energy projects in the short term, increased regulatory certainty could, in fact, foster future development.

Widespread implementation of wave energy extraction technologies could serve several sustainable development goals, including enabling developing coastal and island nations to increase electrification and standards of living, while minimizing carbon emissions and other pollution.[24] If able to be included in commercial generation portfolios in developed nations, wave energy extraction technology might also reduce fossil fuel consumption and promote the concomitant benefits of such reductions. Where technological limitations or reliability requirements prevent interconnection with local electric transmission infrastructure, wave energy extraction technologies could be used in independent, off-grid operations for standalone desalinization operations[25] or hydrogen production.[26] Realization of the promise of wave energy, which some commentators describe as "too important to overlook,"[27] will require continued focused research, development, investment, and regulatory support. Current global environmental, economic, and energy security concerns provide a strong mandate for such efforts.

Endnotes: Wave Energy *on page 72*

** Scott Johnson is a JD candidate, May 2010, at American University Washington College of Law.*

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[1] *E.g.,* Heather Timmons, *Energy from the Restless Sea; a Renewable Source, and Clean, But Not Without its Critics*, N. Y. TIMES, Aug. 3, 2006, at C1; *see also PG&E Wades Into Ocean Energy*, PLATTS ELECTRIC POWER DAILY, Mar. 1, 2007, at 10.

[2] Electric Power Research Institute, Ocean Energy, http://www.epri.com/oceanenergy/default.asp (last visited Mar. 2, 2007) [hereinafter EPRI, Ocean Energy].

[3] Timmons, *supra* note 1.

[4] Electric Power Research Institute, *Overview: EPRI Ocean Energy Program*, Sept. 14, 2006, at 8, *available at* http://www.epri.com/oceanenergy/attachments/ocean/briefing/Duke_Sep_14.pdf (last visited Mar. 6, 2007) [hereinafter EPRI, *Overview*]; Electric Power Research Institute, *Final Summary Report, Project Definition Study, Offshore Wave Power Feasibility Demonstration Project* (Sept. 22, 2005), *available at* http://www.epri.com/oceanenergy/attachments/wave/reports/009_Final_Report_RB_Rev_2_092205.pdf (last visited Mar. 6, 2007) [hereinafter EPRI, *Final Report*].

[5] EPRI, *Overview*, *supra* note 4, at 8.

[6] *See* EPRI, Ocean Energy, *supra* note 2; EPRI, Overview, *supra* note 4, at 8.

[7] U.S. Department of Energy, Ocean Wave Power, http://www.eere.energy.gov/consumer/renewable_energy/ocean/index.cfm/mytopic=50009 (last visited Mar. 6, 2007) [hereinafter Ocean Wave Power].

[8] *See*, *e.g., Australian to Utilize Ocean Waves to Power Desalinization*, GREENWIRE, Nov. 7, 2005 [hereinafter GREENWIRE].

[9] EPRI, *Final Report*, *supra* note 4, at 7; World Energy Council, 2004 Survey Of World Energy Resources 407 (2004), *available at* http://www.worldenergy.org/wec-geis/global/downloads/ser04/SER_Wave_04.pdf (last visited Mar. 6, 2007); EPRI, *Overview*, *supra* note 4, at 16; Ocean Wave Power, *supra* note 7.

[10] *See*, *e.g.,* World Energy Council, *supra* note 9, at 401; U.N. Atlas of the Oceans, Wave Energy, *available at* http://www.oceansatlas.org/servlet/CDSServlet?status=ND0zMDYyJjY9ZW4mMzM9KiYzNz1rb3M~ (last visited Mar. 6, 2007).

[11] Timmons, *supra* note 1.

[12] Intnl. Energy Agency, Renewables in Global Energy Supply 9-27 (2007), *available at* http://www.iea.org/textbase/papers/2006/renewable_factsheet.pdf (last visited Mar. 6, 2007); EPRI, Final Report, *supra* note 4, at 7.

[13] New and Renewable Energy Centre, Wave and Tidal Energy, http://www.narec.co.uk/technologies-wave-tidal.php (last visited Mar. 6, 2007).

[14] Ocean Wave Power, *supra* note 7.

[15] California Energy Commission, Ocean Energy, http://www.energy.ca.gov/development/oceanenergy/ (last visited Mar. 6, 2007).

[16] California Energy Commission, *id.*

[17] Intnl. Energy Agency, *supra* note 12, at 27; California Energy Commission, *supra* note 15.

[18] Ocean Wave Power, *supra* note 7.

[19] *See*, *e.g.*, BBC News, *Orkney to Get "Biggest" Wave Farm* (Feb. 21, 2007), *available at* http://news.bbc.co.uk/1/hi/scotland/6377423.stm (last visited Mar. 2, 2007); Luqman Cloete, South Eyes Wave Power, NAMIBIAN, Feb. 20, 2007, available at http://allafrica.com/stories/200702200988.html (last visited Mar. 6, 2007).

[20] *Preliminary Permits for Wave, Current, and Instream New Technology Hydropower Projects*, 118 F.E.R.C. ¶ 61,112 at para. 2 (2006) [hereinafter FERC NOI].

[21] FERC NOI, *id.* at P. 3.

[22] FERC NOI, *id.* at P. 1; *see also Reedsport OPT Wave Park, LLC*, 118 F.E.R.C. ¶ 61,118 at PP 1, 11 (2006) (noting that FERC is applying its new "strict scrutiny" policy for the first time with respect to a 50-megawatt wave project off of the Oregon coast); Press Release, FERC, Commission Seeks Comments on Permitting Process for Wave, Current and Instream New Technologies (Feb. 15, 2007), *available at* http://www.ferc.gov/press-room/press-releases/2007/2007-1/02-15-07-H-1.pdf (last visited Mar. 6, 2007).

[23] FERC NOI, *supra* note 20, at P 16.

[24] EPRI, *Final Report*, *supra* note 4, at 7.

[25] Greenwire, *supra* note 8.

[26] EnergyPulse.net, *Tidal Mega-Power and Hydrogen Production in Northeastern Canada* (Feb. 13, 2007), *available at* http://www.energypulse.net/centers/article/article_print.cfm?a_id=1421 (last visited Mar. 6, 2007).

[27] EPRI, *Final Report*, *supra* note 4, at 9.