FACT SHEET

Ocean energy

Ocean energy explained

There are four sources of ocean energy: waves, tides, osmotic and thermal energy – all of which can be converted into electrical energy.

How it works

Waves: Wave energy can be harnessed and converted into electrical energy at onshore or offshore sites through a number of technological mechanisms. Onshore or coastal sites extract power from breaking waves. Deep-water sites have three to eight times as much wave power as coastal sites and are more efficient in electrical energy conversion; however, the transmission and maintenance costs increase the further the installation is offshore.[1]

Tides: The daily variation in tides can be converted into electrical energy in coastal areas. There must be a difference of at least 5 metres between the high tides and low tides to harness energy from them. The significantly higher density of seawater allows ocean currents to carry much more energy than air, making tidal technology more productive than wind power plants, even when ocean currents are slower than wind speeds. Turbines, which resemble wind turbines, can be placed offshore once water depths are 20–30 metres. Other options to harness tidal energy are more environmentally invasive, such as dams and tidal fences, both of which can interfere with sea life and silt flows.[2]

Osmotic: When salt water from the ocean meets freshwater, there is a pressure differential created because salt from the seawater wants to move into the freshwater. As it does so, energy is released. Capturing and converting this energy is the goal of osmotic ocean energy production.

Thermal: Some 70 per cent of the Earth is covered by oceans, making them the world's largest solar collector. Ocean thermal energy conversion (OTEC) relies on temperature differences between sun-warmed water near the ocean's surface and colder waters in the deep ocean to produce steam to power a turbine and then condense it back into liquid. A difference of 20 degrees is needed, making OTEC power production most viable in tropical coastal zones.[3]

Opportunities in Asia and the Pacific

- Sites for all types of ocean power are limited geographically.
- Sites for all types of ocean power are limited geographically. Areas for tidal power are limited in the Asia-Pacific region, with the greatest potential north of Australia, around New Zealand and off the coast of northern China to the Republic of Korea and southern Japan. Wave power potential is highest around Japan, Indonesia's Sumatra and Java islands and off the southern coast of Australia, extending east to New Zealand.[4]

[1] California Energy Commission website "Ocean Energy" (17 February, 2011). Available from www.energy.ca.gov/oceanenergy/index.html (accessed 30 November 2011).

[2] United States of America, Department of Energy website *"Ocean Tidal Power"* in Energy Savers. Available from www.energysavers.gov/renewable_energy/ocean/index.cfm/mytopic=50008 (accessed 30 November 2011).

[3] United States of America, Department of Energy website "Ocean Thermal Energy Conversion" in Energy Savers. Available from www.energysavers.gov/renewable_energy/ocean/index.cfm/mytopic=50010 (accessed 30 November 2011).

[4] Per Christer Lund, *Energy from Wind and Ocean: A North East Asia Study* (Tokyo, Innovation Norway, 2010). Available from http://neec.no/uploads/windocean.pdf (accessed 30 November 2011).

- Wave energy has a potential to replace carbon-intensive power systems based on diesel, especially in remote coastal areas or small islands.[5]

Trends in development

Early stage development: There is little existing ocean energy development worldwide and in the Asia-Pacific region. Wave power is in a demonstration phase, and mostly small scale. A few large-scale tidal barrage developments have been in place for decades, given their similarities to hydroelectric technology for damming rivers, but there has not been widespread development. Thermal and osmotic energy conversion systems are still being researched.[6]

Republic of Korea leading tidal development: Between 2007 and 2009, four plans for large-scale tidal power plants were announced in the Republic of Korea, each escalating in size – up to the 1,320 MW Incheon Bay project.[7] The Sihwa Lake Tidal Power Station went online in August 2011, becoming the world's largest tidal power plant, with a capacity of 254 MW. To drive development, the Republic of Korea has set a specific feed-in tariff for tidal power. Public and private funding for further R&D has increased significantly, amounting to 13 billion euros in 2010.[8]

Strengths with ocean energy

- **Relatively steady supply:** Compared with solar and wind energy, the ocean energy is a more reliable source of energy, with support from technology advancements.
- **Vast potential:** Although the development of ocean energy technologies is still in a nascent stage, a theoretical potential for ocean energy (7,400 EJ per year) is huge enough to accommodate the energy needs of current and future generations.[9]
- **Job creation potential:** Researchers for a European Ocean Energy Association report estimated that 10–20 jobs per MW of ocean energy could be created in coastal regions with good ocean energy resources.[10]

Challenges to using ocean energy[11]

- High capital costs prove to be a major hurdle to development. In addition to the development of under water transmission, most coastal regions lack high-voltage transmission lines and would need significant transmission upgrades to move power to the load centres.
- Low-profile installations may present a hazard to shipping navigation and fishing, creating conflict with other economic uses of the water. Ocean front views may be disturbed by onshore or near-shore installations (such as tidal dams), leading to reduced tourism or real estate values along the coast.

[5] Hans Christian Soerensen and Alla Weinstein, "Ocean energy: Position paper for IPCC", Keynote paper presented at the IPCC Scoping Conference on Renewable Energy, Lübeck, Germany, 20-25 January 2008. Available from www.eu-oea.com/euoea/files/ccLibraryFiles/Filename/000000000400/Ocean_Energy_IPCC_final.pdf (accessed 30 November 2011).

[6] European Commission Research and Innovation website "Technical Background". Available from http://ec.europa.eu/research/energy/eu/research/ocean/background/index_en.htm (accessed 30 November 2011).

[7] Per Christer Lund, *Energy from Wind and Ocean: A North East Asia Study* (Tokyo, Innovation Norway, 2010). Available from http://neec.no/uploads/windocean.pdf (accessed 30 November 2011).

[8] International Energy Agency, Ocean Energy Systems, *Annual Report 2010: Implementing Agreement on Ocean Energy Systems* (Lisbon, 2010). Available from www.iea-oceans.org/_fich/6/2010_Annual_Report.pdf (accessed 30 November 2011).

[9] Intergovernmental Panel on Climate Change, *Special Report on Renewable Energy Sources and Climate Change Mitigation* (Geneva, 2011)

[10] Hans Christian Soerensen and Alla Weinstein, "Ocean energy: Position paper for IPCC", Keynote paper presented at the IPCC Scoping Conference on Renewable Energy, Lübeck, Germany, 20-25 January 2008. Available from www.eu-oea.com/euoea/files/ccLibraryFiles/Filename/000000000400/Ocean_Energy_IPCC_final.pdf (accessed 30 November 2011).

[11] ibid.

- Installations, particularly those near the coastline, can create environmental hazards for sea life, especially those that migrate to and from the shore. With proper sitting, impacts can be minimal. Installations can also impede the flow of sediments, causing unnatural silt build-ups, which affect ocean life.
- For conversion systems that rely on the use of hydraulic fluids, there is a threat of spills or leaks if the equipment is faulty and cannot withstand ocean waves or storms.

Implementing strategies

Fund R&D: Most ocean energy technologies are either approaching or currently in a demonstration phase. Promoting further R&D by offering public funds or creating an enticing environment for private funds is important for future development.

Increase awareness: Cultivating public awareness and the awareness of policymakers to the various sources of ocean energy is important because the ocean has been overlooked in much of the literature and current policies on renewable energy.[12] To increase awareness, the quality and access to data on ocean energy resources must also be improved.[13]

Rely on feed-in tariffs: For countries with good ocean energy resources, setting a specific feed-in tariff for the various kinds of available ocean energy can promote targeted development.[14]

[12] ibid.

[13] David Leary and Miguel Esteban, "Climate change and renewable energy from the ocean and tides: Calming the sea of regulatory uncertainty", *International Journal of Marine and Coastal Law* (2009), 24. Available from http://agc-wopac.agc.gov.my/e-docs/Journal/0000014590.pdf (accessed 30 November 2011).

[14] ibid.