EcoLogo[CM] Program Criteria Review

Certification Discussion Document

CCD-003: Electricity-Renewable Low-Impact
(F) TIDAL & WAVE-POWERED ELECTRICITY

Table of Contents

1 Instructions

EcoLogo[CM] is inviting stakeholders to participate in the review of CCD-003: Electricity-Renewable Low-Impact. This standard is being revised to assure that the current requirements continue to define environmental leadership for renewable low-impact electricity.

Currently, both the scope and the criteria statements found in CCD-003 determine what the EcoLogo[CM] Program considers to be environmental leadership amongst all types of electricity production in North America. During this review, the EcoLogo[CM] Program will re-examine both the scope and the criteria statements. As such, leadership will continue to be defined by first determining what types of electricity can be considered as "renewable low-impact" (i.e. scope), and second what requirements should be established to assure that facilities which produce these types of electricity are following best environmental practices according to the market (i.e. criteria statements).

Stakeholder contributions play a pivotal role in the EcoLogo[CM] standards development process.

To begin your participation and register for the review process:

- Send a request to forums@ecologo.org and specify your name (first and last name), indicating your affiliation, and your wish to participate in the CCD-003: Electricity-Renewable Low-Impact.

While the EcoLogo[CM] Standard Development Forum is the main tool for compiling comments, the EcoLogo[CM] program will also accept comments by e-mail and fax. These comments may also be posted to the online forum and will be viewable by all registered forum participants involved in the discussion.

This stakeholder consultation period will be open for 52 days beginning Nov 18, 2008. Comments must be received by January 9, 2009.

Your time and input in helping us to establish the most stringent environmental standards are very much appreciated. We will send you a reminder as our closing date for comments approaches.

Sincerely,

EcoLogo[CM] Program Management
Attn: CCD-003 - Electricity-Renewable Low-Impact
TerraChoice Environmental Marketing Inc.
E-mail:jbaribeau@terrachoice.com
Toll free: 1-800-478-0399 ext:241
Telephone: 613-247-1900 ext:241
Fax: 613-247-2228

2 Introduction

Tidal and wave-powered electricity is not currently included in EcoLogo^{CM} certification criteria document (CCD) for Renewable Low-Impact Electricity and therefore, no tidal and wave power electricity have yet been third-party certified by the EcoLogo^{CM} Program. However, based on a preliminary review of life cycle information, it seems that tidal and wave-powered electricity products, if properly built, could offer considerable environmental benefits and meet strict requirements for *inter alia* a reduction in noxious air emissions as well as for tidal and wave ecosystem and wildlife impacts.

The purpose of this section of the Certification Discussion Document is to provide you with broad market information for tidal ad wave-powered electricity in Canada and the U.S., and to initiate a discussion to help identify which criteria the EcoLogo^{CM} Program should consider revising to ensure that tidal and wave-powered electricity generating facilities continue to represent environmental leadership as "renewable low-impact electricity" generating facilities.

The EcoLogo^{CM} Program is designed to support a continuing effort to improve and/or maintain environmental quality by reducing energy and materials consumption and by minimizing significant life cycle environmental impacts. Life cycle review is an ongoing process and as such, EcoLogo^{CM} CCDs are regularly updated. Products are also re-audited regularly to ensure certified products continue to offer significant environmental benefits.

3 Description

The two main types of electricity under discussion in this CDD include tidal and wave power. Tidal energy comes from the gravitational forces of the moon on the Earth (Bedard, 2007). Tidal currents, the horizontal movement of the water caused by coastal tides, can also be used to create power from the two high and two low tides that occur during a period of time slightly greater than 24 hours (DOE, 2005; MIT, n.d). Wave power, alternatively, is derived mostly from the large amount of kinetic energy found in waves created by surface winds (Bedard, 2007; MIT, n.d.). According to Cassedy (2000), it is the hydraulic pressure or mechanical pressure of waves that can drive turbines. The up and down motion of surface waves, the breaking of waves, and the underground current of waves can all be used to create energy.

According to EMEC (n.d.b.), the most common tidal technologies used in Canada and the U.S. include:

> *A) Horizontal Axis Turbine: This device extracts energy from moving water in much the same way as wind turbines extract energy from moving air. Devices can be housed within ducts to create secondary flow effects by concentrating the flow and producing a pressure difference.*
>
> *B) Vertical Axis Turbine: This device extracts energy from moving water in a similar fashion to that above, however the turbine is mounted on a vertical axis.*
>
> *C) Tidal Barrages (Impoundment schemes with sluices): Tidal power plants operate "in bays or estuaries where the size and shape of the basin make a natural resonance with the tidal fluctuations, thus amplifying the motion of the water(Cassedy, 2000, p.195)".*

E) Other Designs: This covers those devices with a unique and very different design to the more well-established types of technology or includes those for which information on the device's characteristics could not be determined.

According to EMEC (n.d.c.), the main wave power technologies used in Canada and the U.S are:

A) Attenuator: An attenuator is a floating device which works perpendicular to the wave direction and effectively rides the waves. Movements along its length can be selectively constrained to produce energy.

B) Point absorber: A point absorber is a floating structure which absorbs energy in all directions through its movements at/near the water surface.

D) Oscillating water column: An oscillating water column is a partially submerged, hollow structure. It is open to the sea below the water line, enclosing a column of air on top of a column of water. Waves cause the water column to rise and fall, which in turn compresses and decompresses the air column. This trapped air is allowed to flow to and from the atmosphere via a turbine, which usually has the ability to rotate regardless of the direction of the airflow. The rotation of the turbine is used to generate electricity.

F) Submerged pressure differential: These devices are typically located nearshore and attached to the seabed. The motion of the waves causes the sea level to rise and fall above the device, inducing a pressure differential in the device. The alternating pressure can then pump fluid through a system to generate electricity.

4 Market Overview

According to the Pembina Institute (n.d.), tidal power accounts for a total capacity of less than 250 MW worldwide yet has a potential to exceed 450 terawatt hours, most of it in Asia and North America. In contrast, according to Renewable Energy Policy Network for the 21st Century (2007), wave power technologies, although being employed in limited quantities on a commercial basis, still show a commercial promise. Renewable energy supporters think that wave power has a promising future. In fact, some suggest that 0.1% of the renewable energy within the world's tidal and waves could supply more than 5 times the global demand for energy (BBC News, 2000). According to the Pembina Institute (n.d.), 10% of the world's electricity supply could be generated through wave power at current energy consumption levels.

4.1 Canadian Market

According to Hrabluk (2008), "the NRC estimates there is about 42,000 megawatts of tidal power in Canadian waters". Just over 30,000 megawatts are located in Nunavut along the Hudson Strait that connects Hudson Bay with the North Atlantic. The Bay of Fundy, with the highest tides in the world, is undergoing another tidal development project and is expected, when fully developed, to generate 300 megawatts of electricity, enough energy to power close to 100,000 homes (Ehrlich, 2008).

Main Canadian Tidal Power Companies and Projects

Company	Technology	Device Type
Blue Energy	Blue Energy Ocean Turbine (Davis Hydro Turbine)	B - iii
Clean Current Power Systems	Clean Current Tidal Turbine	A - i
New Energy Crop.	EnCurrent Vertical Axis Hydro Turbine	B

(European Marine Energy Center Ltd (EMEC), n.d.)

An example of a wave power project in Canada is the one by Finavera Renewables in Ucluelet, British Columbia. The Finavera Power project is currently not running yet has been granted a permit to research the possibility of building a wave energy project of 5MW off the coast of BC (Finavera, n.d.).

Main Canadian Wave Power Companies and Projects

Company	Technology	Device Type
College of the North Atlantic	Wave Powered Pump	A
Sieber Energy Inc	SieWave	A
Waveberg Development	Waveberg	A
SyncWave	SyncWave	B
Wavemill Energy	Wavemill	D

(EMEC, n.d.a)

4.2 American Market

Main American Tidal Power Companies and Projects

Company	Technology	Device Type
GCK Technology	Gorlov Turbine	B - iii
Kinetic Energy Systems	Hydrokinetic Generator, KESC Bowsprit Generator, KESC Tidal Generator	A - i
Ocean Renewable Power Company	OCGen	A - iii
UEK Corporation	Underwater Electric Kite	A - i
Verdant Power	Various	A - ii
Tidal Electric	Tidal Lagoons	E

(EMEC, n.d.)

The Reedsport OPT Wave Park by Tidal and Wve Power Technologies in Douglas County, Oregon is an example of a project underway in the U.S. It is a pilot project that is planned to generate 2 MW of electricity by utilizing tidal and wave PowerBuoy systems (*Renewable Energy World*, 2007; PNGC Power, 2007).

Main American Wave Power Companies and Projects

Company	Technology	Device Type
Aqua Energy / Finevara Renewables	Aqua Buoy	A
Float Inc.	Pneumatically Stabilized Platform	A
Floating Wave Powered Generator	Patent Pending Number US60/662/582	A
GEdwardCook	Floating Wave Generator	A
Independent Natural Resources	SEADOG	A
Ocean Power Technologies	Power Buoy	A
SeaVolt Technologies	Wave Rider	A
WindWavesAndSun	WaveBlanket	A
Able Technologies L.L.C.	Electric Generating Wave Pipe	B
Delbuoy	Wave Powered Desalination	B
Ocean Motion International	OMI Combined Energy System	B
Ocean Wave Energy Company	OWEC	B
Atmocean	Atmocean	B
GEdwardCook	Syphon Wave Generator	F

(EMEC, n.d.a)

5 Other Eco-label Standards

Green-E (2008) will consider adopting tidal and wave-based resources and will review these technologies as they mature.

6 Life Cycle Research Findings

6.1 Life Cycle Definition

Our initial research indicates the life cycle stages of tidal and wave-powered electricity sources from which most significant environmental stressors and impacts occur in the use stage. At this point, the EcoLogo^{CM} Program leaves the scope and boundaries of the life cycle analysis open for discussion since as stakeholders, you might know of other stressors and impacts not currently addressed in this CDD.

6.2 Summary of Major Environmental Impact Categories and Related Stressors

Below you will find some of the major environmental stressors associated to tidal and wave-powered electricity.

Stage of the life cycle	Environmental Stressors (numbers in the table refer to specific sections in the document) according to various Life Cycle Stages and Impact Categories					
	Energy	Resources	Emissions to			Other
	Renewable/ Nonrenewable	Renewable/ Nonrenewable	Water	Air	Soil	
Resource Extraction				6.3.1.7, 6.3.1.8, 6.3.1.9		
Production				6.3.1.7, 6.3.1.8, 6.3.1.9		
Distribution				6.3.1.7, 6.3.1.8, 6.3.1.9		
Use	6.3.1.1, 6.3.2.1	6.3.2.1	6.3.1.2, 6.3.1.3, 6.3.1.5, 6.3.2.2, 6.3.3	6.3.1.7, 6.3.1.8, 6.3.1.9	6.3.3	6.3.1.2, 6.3.1.3. 6.3.1.4, 6.3.1.6, 6.3.3
Disposal				6.3.1.7, 6.3.1.8, 6.3.1.9		

6.3 Discussion Points on Major Environmental Impact Categories and Related Stressors

This section draws attention to the major environmental impact categories and stressors the EcoLogo[CM] Program intends to address in its revision of CCD-003. Each section below contains questions pertaining to the environmental impact categories and stressors under investigation.

6.3.1 Broad Environmental Impact Categories and Related Stressors for Tidal and Wave-Powered Electricity

6.3.1.1 Renewability

According to the Centre for Energy (n.d.), tidal and wave power energy is renewable due to the endless natural motion of waves and tides. Tides occur twice a day due to the gravitational pull of the moon. Waves are produced by the wind on the tidal and wave surface.

6.3.1.2 General Impacts on Marine Animals

It is still fairly unknown to what degree tidal and wave power technologies might impact marine animals. However, some believe that certain technologies would pose less risk of damage to marine life. For example, according to Environmental Data Services Ltd (2002), certain wave power turbines turn too slowly to negatively affect sea creatures. Tidal and wave Energy Council (2008a), echoes this for tidal power by stating that certain turbine technologies like tidal fences can allow water and marine life to flow through them freely and safely. The Ocean Energy Council (2008a) further states that some of the current knowledge of the impact of tidal power systems on transient and migratory marine animals comes from our experience with offshore wind technologies. According to Michel et al. (2007), these animals have returned to offshore wind park project areas post-construction following a short disturbance.

Despite many unknowns of the risk of tidal and wave power technologies on marine animals, some recommendations have been raised in the literature to mitigate or prevent risks when deploying wave power technologies. The following is a list of recommendations:

- *Site works during sensitive time periods for animals should be avoided.*
- *Noise levels during construction, operation and dismantling should be minimized.*
- *Before-After-Impact-Studies should be conducted.*
- *Generic studies on noise reception of sea mammals should be conducted.*
- *Sensitive areas should be avoided.*
- *Tidal and wave energy devices should be properly marked since potential collisions may at worst lead to oil spills.*

The use of pollutant chemicals should be avoided when wave energy devices are protected against the marine environment since anti-fouling agents (such as tri-butyl) might also be toxic to marine life (Wavenet, 2003).

- *Long term monitoring programs for marine mammals should be established to identify and assess possible mitigative measures for effects of development on mammals (Offshore Energy Environmental Research Association(OEER, 2008).*

- *Since vibrations and electromagnetic fields might cause damages to mammal populations, the impacts of these should therefore be monitored (OEER , 2008; Wavenet,2003).*

1.Q) Do you think that the EcoLogo[CM] Program should adopt some or all of the recommendations listed in above? If so, which ones and why? If not, why not?

2.Q) Do you know of other technologies or solutions that can mitigate the potential impacts of tidal and wave power on marine animals (not including fish and birds)?

6.3.1.3 Specific Impacts on Fish

According to Wavenet (2003), no studies on the impact on fish have yet been performed in relation to wave power. Therefore, they state that site-specific and species-specific monitoring studies are necessary. Some of the impacts anticipated on fish and fish larvae according to them could be due to a change in sedimentation/turbidity, accidents, noise, infra-sound vibrations, electromagnetic fields and the potential effects of unnatural reefs if present. OEER (2008) also state that these factors could affect fish stocks when tidal turbine technologies are used.

3.Q) Do you think that the EcoLogo[CM] Program should adopt the recommendation of Wavenet pertaining to fish impacts mentioned above? If so, why? If not, why not?

4.Q) Do you know of other technologies or solutions that can mitigate the potential impacts of tidal and wave power on fish?

6.3.1.4 Specific Impacts on Birds

Wavenet (2003) mentions that, since wave energy converters generally do not elevate much above sea level, actual impacts on birds are expected to be rather low. However, they still advise to avoid placing large wave energy projects in the vicinity of significant bird areas. They mention that some of the drivers that may affect birds due to wave development include:

- *potential physical changes to habitat*
- *timing of construction period*
- *oil spills due to accidental collisions*
- *noise*
- *changes in feeding conditions.*

OEER (2008) has recommended that long term monitoring programs for marine birds should be established; that surveys to support project-specific environmental assessment prior to deployment should be conducted, and that possible mitigative measures for effects of certain tidal turbines development on birds, including the secondary effects associated with changes in prey availability, should be assessed and implemented.

5.Q) Should we include the recommendations in CCD-003 above to mitigate and prevent potential impacts on birds in our criteria? If so, why? If not, why not?

6.3.1.5 Impacts on Seabed

Wavenet (2003) thinks that changes to the wave regime along the shoreline could change the composition of the shoreline by affecting sediment structure and dynamics. Similarly, OEER (2008) stipulates that changes in seabed structure may occur due to installation of energy devices and their overall operation. Moreover, new foundations, cables and hard substrates may impact the seabed ecology. OEER (2008) recommends that commercial application of marine renewable energy developments should go ahead only when a proponent can demonstrate that there will be no significant adverse effects on the fundamental hydrodynamic processes of a tidal regime (energy flow, erosion, sediment transportation and deposition) or on biological processes and resources.

6.Q) Should the EcoLogo[CM] Program only certify tidal and wave power projects that can demonstrate that they have not cause significant adverse effects on the fundamental hydrodynamic processes of a tidal or wave regime (energy flow, erosion, sediment transportation and deposition) or on biological processes and resources? If so, why and how? If not, why not?

6.3.1.6 Aesthetic Impacts

OEER (2008) mentions that, in scenic areas, visual impacts due to construction activities of tidal installations may arise. Similarly, Wavenet (2003) states that certain near shore wave power devices may cause an intrusion to the seascape which may result in some unpopularity. OEER (2008), however, mentions that in some cases, locals may see tidal power technologies in their landscape as a source of pride.

6.3.1.7 Greenhouse Gas Emissions

According to Wavenet (2003) and OEER (2008), tidal and wave power generating facilities emit little greenhouse gases like CO_2 and methane. For instance, according to Wavenet (2003), the total CO_2 emissions is in the order of 15 g/kWh emissions when the whole life cycle is considered for nearshore wave power.

7.Q) Do you think that greenhouse gases from tidal and wave power generating facilities should be addressed in CCD-003? If so, how and why? If not, why not?

8.Q) Do you know what the total CO_2 equivalents/kWh would be for the whole life cycle of tidal generating facilities?

9.Q) Recent studies suggest that hydroelectric dams can produce significant amounts of carbon dioxide and methane through the decay of submerged plant material. In some cases, these emissions rival that of power plants running on fossil fuel (Live Science, 2008). Is this the case also for tidal barrages as well? If so, how?

6.3.1.8 Reduction in NOx and SOx Emissions

According to Wavenet (2003), life cycle NOx and SOx concentrations for wave power production are negligible compared to other energy sources like coal plants with with low NOx burners and flue gas desulphurisation. Nearshore wave life cycle emissions of SO_2 are of 0.05 g/kWh. Low emissions of these two gases are actually one of the advantages of using wave power.

10.Q) Do you know what the total NOx and SOx emissions/kWh would be for the whole life cycle of tidal generating facilities?

11.Q) What are the NOx emissions/KWh for the whole life cycle of wave power generating facilities?

12.Q) Do you think that the EcoLogo^{CM} Program should establish guidelines on NOx and SOx emissions thresholds for tidal and wave-powered electricity or do you think that these types of energy sources already represent leadership within the renewable low-impact electricity sector?

6.3.1.9 Reducing in CO and Particulate Air Emissions

According to Wavenet (2003), some of the benefits of using wave power production include a reduction in CO and particulate emissions compared to other energy sources.

13.Q) Do you know what the total CO and Particulate Matter emissions/kWh for the whole life cycle of both tidal and wave power?

14.Q) Do you think that the EcoLogo^{CM} Program should establish CO and PM emissions threshold levels for tidal and wave-powered electricity or do you think that these types of energy sources already represent sufficient leadership within the renewable low-impact electricity sector?

6.3.2 Specific Environmental Impact Categories and Related Stressors for Wave-Powered Electricity

6.3.2.1 Efficiency

According to the Wave Energy Council (2008b), wave energy contains roughly 1000 times the kinetic energy of wind, allowing much smaller devices to produce the same amount of power in a fraction of the space. Moreover, they state that wave power production is more consistent than wind or solar resulting in higher overall capacity factors. Furthermore, because wave energy varies as the square of wave height, a much higher power production from waves averaged over time results.

6.3.2.2 Improving Water Availability

According to Thorpe (2007d), within 5 to 10 years' time, wave energy could start to make a significant contribution to the provision of potable water. Some companies are hoping to use wave technology to create potable water through reverse osmosis, which may help address some water shortages.

6.3.3 Specific Environmental Impact Categories and Related Stressors for Tidal Barrages

There are only about 40 sites on the Earth with the tidal range between high and low tides of at least five meters required to make electricity from tidal plants (DoE, 2005). According to the Conference Board of Canada (2003), the consequences of artificially changing the tides in a coastal area from a tidal power station are poorly understood. According to Energy Systems Research Unit of the University of Strathclyde (n.d), the environmental impacts and associated stressors associated with tidal barrages are site-specific. Some of the impacts and stressors may include:

- *Tidal barrages reduce the time mud flats are exposed and covered and therefore affect bird and other wildlife and fisheries (Pembina Institute (n.d.).*
- *Fish might be beheaded when going downstream through turbines. Based on knowledge from hydro power facilities, 85% or more of fish should survive when going downstream through turbines (Baker, 1991).*
- *An increase of the sea level (Daborn, 1977)*
- *A reduction in currents (Daborn, 1977)*
- *A lower salinity (Daborn, 1977)*
- *Changes in sediment type and distribution (Daborn, 1977)*
- *An increase in ice formation and ice staying longer into the spring (Daborn, 1977)*
- *A greater surface runoff and erosion of valuable soil (Daborn, 1977)*
- *Existing benthic communities that depend on intertidal organisms might be destroyed due to a reduced intertidal zone (Daborn, 1977)*

15.Q) Do you think that CCD-003 should allow for the inclusion of tidal barrages? If so, how and why? If not, why not?

6.4 General Considerations

16.Q) Do you think that all of the potential significant environmental impact categories and related stressors for tidal and wave-powered electricity have been properly addressed in this CDD? If not, which impact and/or stressor do you think is missing and why? How do you propose the EcoLogo^{CM} Program should address these?

7 Performance Testing

17.Q) Do you know of performance tests the EcoLogo^{CM} Program should be aware of for tidal and wave-powered electricity?

8 Reference

Renewable Energy World. (2007). *Agreement to Develop Wave Power Park in Oregon*. Retrieved March 24, 2008, from http:// www.renewableenergyworld.com/rea/news/story?id=47546

Bedard, R. (2007). *Power and Energy from the Tidal and wave Energy Waves and Tides: A Primer*. Retrieved March 23, 2008 from http://www.tidal and waverenewable.com/wp-content/uploads/2008/03/power-and-energy-from-the-tidal and wave-waves-and-tides.pdf

BBC News. (2000). *How it works:* Wave power station. Retrieved March 23, 2008, from http://news.bbc.co.uk/1/hi/sci/tech/1032148.stm

Cassedy, E. (2000). *Prospects for Sustainable Energy A Critical Assessment*. Cambridge: Cambridge University Press

Centre for Energy. (n.d.). *Tidal and Wave Energy*. Retrieved June 19, 2008, from http://www.centreforenergy.com/outsideNav.asp?href=http://www.essentialtalk.com/public/sales/seeds/tidal/index.html&template=0

Conference Board of Canada. (2003). *Renewable Energy in Canada*. Retrieved March 24, 2008, from http://www.conferenceboard.ca/pdfs/Renewable_Energy_Canada.pdf

Energy Systems Research Unit of the University of Strathclyde. (n.d.). *Tidal Power*. Retrieved August 25, 2008, from http://www.esru.strath.ac.uk/EandE/Web_sites/01-02/RE_info/Tidal%20Power.htm#envirob1

Environmental Data Services Ltd. (2002). Wave and tidal stream developers dip a toe in the water. *Alternative Energy Sources, 32*. Retrieved March 24, 2008, from http://www.r-p-a.org.uk/content/images/articles/Tidal/tidal_article.pdf

European Marine Energy Center Ltd. (n.d. a). *Wave Energy Developers*. Retrieved May 6, 2008, from http://www.emec.org.uk/wave_energy_developers.asp

European Marine Energy Center Ltd. (n.d. b). *Tidal Energy Devices*. Retrieved June 20, 2008, from http://www.emec.org.uk/tidal_devices.asp

European Marine Energy Center Ltd. (n.d. c). *Wave Energy Devices*. Retrieved June 20, 2008, from http://www.emec.org.uk/wave_energy_devices.asp

European Thematic Network on Wave Energy. (2003). *Results from the work of the EuropeanThematic Network on Wave Energy*. Retrieved May 5, 2008, from http://www.wave-energy.net/Library/WaveNet%20Full%20Report(11.1).pdf

Finavera. (n. d.). *Wave Energy: Ucluelet, Canada*. Retrieved March 22, 2008, from http://www.finavera.com/en/wave/ucluelet

Green-E. *National Standard Version 1.5*. Retrieved July 28, 2008, from http://www.green-e.org/docs/energy/Appendix%20D_Green-e%20Energy%20National%20Standard.pdf

Hrabluk, L. 2008. *Going Green: Tide runs high for harnessing tidal and wave power*. Retrieved June 20, 2008, from http://www.canada.com/victoriatimescolonist/news/story.html?id=872f353a-6174-424d-a6ab-048c4433f97b&k=91835&p=2

Live Science. (2008). *Power of the Future: 10 Ways to Run the 21st Century*. Retrieved June 20, 2008, from http://www.livescience.com/environment/top10_power_21stcentury-1.html

MIT (n.d.). *Tidal and wave Currents*. Retrieved March 24, 2008, from http://web.mit.edu/ejl/www/uwenergy/

N.A. 2007. *New sources of electrical energy found in Canada's boundless coasts*. Retrieved June 20, 2008, from http://www.crimewatchcanada.com/environment/tidalenergy.htm

Ocean Energy Council. (2008a). *What is the impact tidal and wave current energy has on the environment?* Retrieved May 2, 2008, from http://www.oceanenergycouncil.com/index.php/Tidal and wave-Currents/What-is-the-impact-tidal and wave-current-energy-has-on-the-environment.html

Ocean Energy Council. (2008b). *Wave Energy*. Retrieved May 2, 2008, from http://www.oceanenergycouncil.com/index.php/Wave-Energy/Wave-Energy.html#6

Offshore Energy Environmental Research Association (OEER). (2008). *Fundy Tidal EnergyStrategic Environmental Assessment Final Report*. Retrieved June 18, 2008, from http://www.offshoreenergyresearch.ca/OEER/SEAHome/tabid/117/Default.aspx

Pembina Institute. (n. d.). *Energy Source:Tidal Power*. Retrieved March 19, 2008, from http://re.pembina.org/sources/tidal

Renewable Energy Policy Network for the 21st Century. (2007). *Renewables 2007 Global Status Report*. Retrieved March 11, 2008, from http://www.ren21.org/pdf/RE2007_Global_Status_Report.pdf

St-Germain. (2005). *A Case Study of Wave Power Integration into the Ucluelet Area Electrical Grid*. Retrieved May 5, 2008, from http://www.iesvic.uvic.ca/publications/library/Dissertation-StGermain.pdf

Thorpe, T. (2007a). *Harnessing the Energy of Tides*. Retrieved March 19, 2008, from http://www.worldenergy.org/publications/survey_of_energy_resources_2007/tidal_energy/755.asp

Thorpe, T. (2007b). *The Prospects for Wave Energy*. Retrieved March 19, 2008, from http://www.worldenergy.org/publications/survey_of_energy_resources_2007/wave_energy/763.asp

Thorpe, T. (2007c). *Wave Energy Technologies*. Retrieved March 19, 2008, from http://www.worldenergy.org/publications/survey_of_energy_resources_2007/wave_energy/761.asp

Thorpe, T. (2007d). *Wave Energy Technologies*. Retrieved March 19, 2008, from http://www.worldenergy.org/publications/survey_of_energy_resources_2007/wave_energy/762.asp

U. S. Department of Energy (DoE). (2005). *Tidal and wave Tidal Power*. Retrieved March 24, 2008, from http://www.eere.energy.gov/consumer/renewable_energy/tidal and wave/index.cfm/mytopic=50008

U. S. Department of Energy (DoE). (2005). *Tidal and wave Wave Power*. Retrieved March 24, 2008, from http://www.eere.energy.gov/consumer/renewable_energy/tidal and wave/index.cfm/mytopic=50009

Wavenet. (2003). Results from the work of European Thematic Network on Wave Energy. Retrieved June 18, 2008, from www.wave-energy.net/Library/WaveNet%20Section%20A%20-%20Exec%20Sum%20&%20Introduction(11.1).pdf