Tidal Power in Nova Scotia

Ocean renewable energy technologies are generating interest for their potential to contribute to climate change mitigation efforts. Specifically, tidal power in the Bay of Fundy has become a hot topic. Despite the need to decrease our dependence on fossil fuels, it is essential that new technologies be properly tested and proven safe, in order to maintain the integrity of the Bay of Fundy's ecosystems. The Ecology Action Centre (EAC) has prepared this fact sheet in order to educate the public on tidal power in Nova Scotia.

Why is the development of new renewable energy technologies so important?

Due to climate change, rising energy prices, and declining supplies of fossil fuels, Nova Scotia must consider how to meet future energy needs while minimizing further environmental impacts. Consequently, interest in ocean renewable energy technologies, which use the power of tides, waves, or offshore winds to create renewable energy, has increased. Tidal power, for instance, is a promising technology, especially for application in the Bay of Fundy. Due to its high tides, some of the world's most powerful, the Bay of Fundy is thought to be North America's best location for tidal power generation.

Eighty-eight percent of Nova Scotia's electric power is currently fossil fuel based, so electricity generation accounts for 46 percent of the province's greenhouse gas emissions. In addition, Nova Scotia does not have large hydro resources, and currently has limited grid connections to regions supplying renewable alternatives. Energy efficiency and local renewable energy sources must therefore be at the forefront of the province's energy strategy. In 2007, Nova Scotia's *Environmental Goals and Sustainable Prosperity Act* came into force. The Act committed the province to generate 20 percent of its electricity through renewable energy by 2013, and to cut greenhouse gas emissions to 10 percent below 1990 levels by 2020. Though the bulk of this commitment will be met with commercial wind development, tidal power could also contribute to meeting these targets.

What are different types of tidal technologies, how do they work, and what are their potential environmental effects?

Tidal barrages

Until recently, the most common form of tidal power technology was to build a large dam, called a barrage, across a river or inlet. When the tide goes in and out, the water flows through tunnels in the dam. The ebb and flow of the tides can be used to turn a turbine, which powers a generator.

Because tidal barrages require high tides, only about 20 areas in the world are suitable for this technology, though there are hundreds of locations within these areas. In addition, of all the tidal technologies, barrages are the most expensive to build. There are only about a dozen tidal barrages throughout the world, though less than a handful of these facilities

have been used for commercial power generation. Nova Scotia has one tidal barrage in Annapolis Royal that supplies power to the grid.

Barrages are the most ecologically damaging form of tidal power, as they restrict the entire tidal flow at their location. This means that the tidal range is reduced, which in turn affects wildlife habitat and countless species, including certain bird species that feed on exposed mud flats when the tide goes out. Barrages also affect organisms that live in the water column, such as fish. Despite the presence of fish ladders, many individuals are killed by spinning turbines. Other impacts include coastline erosion and build-up of sediment. Recently, proposals to build a barrage across the Severn Estuary in the UK were met with opposition.

Tidal lagoons

Tidal lagoons are an adaptation of barrage or dam technology. Like a barrage, a tidal lagoon uses a head pond to generate power with conventional hydro-turbines. Unlike a barrage, however, a tidal lagoon is a self-contained head pond that is cut off from the rest of the sea, appearing as an island. When the tide drops, there is a difference in water level inside and outside of the lagoon and water is released back into the sea through turbines, creating power. Once the tide rises, the lagoon is filled, thus generating more power.

Many consider tidal lagoons alternatives to ecologically-damaging tidal barrages. However, because tidal lagoons are fairly new, their effects on both the environment and tidal flows in the Bay of Fundy are largely unknown at this point. This presents a challenge as tidal lagoon technology is not designed to be scalable or removable, and would therefore be difficult to test at a demonstration level. Tidal lagoons have the potential to cause considerable damage to the coastal ecosystems and fishing industry of the Bay of Fundy. The rock and gravel walls could smother vital bottom habitat and nursery areas. Depending on placement, the structure itself could affect the circulation and currents in the Bay, as well as impact fish passage and fisheries, transportation, and recreational access to a large section of the Minas Basin. The area inside the tidal lagoon would be fundamentally altered, and may have changes in salinity and sedimentation patterns. Finally, the rock needed to construct a tidal lagoon would likely be excavated from coastal quarries, which could affect normal shoreline processes and greatly increase the vulnerability of coastal areas to climate change.

Tidal Electric (UK) is currently proposing to build a tidal lagoon in Swansea Bay, Wales.

In-stream turbine devices

Today, engineers are building tidal technology that does not require dams or head ponds. New technologies include offshore floating tidal turbines and turbines that are anchored to the ocean floor. These turbines take advantage of natural tidal flows to turn blades and generate electricity.

Demonstration projects using this new technology are currently underway in Race Rocks, BC, East River, New York City, and in Scotland. Environmental impact assessments of these early demonstrations have not yet adequately characterized the interaction of fish and other organisms with in-stream turbines, so the potential impact on fish, invertebrate, and mammal populations remains largely unknown. Underwater turbines have relatively slow rotation rates – between 10-30 revolutions per minute – but the size and spacing of the blades will determine the potential for mortality of fish and other vertebrates due to direct impact. Additional injuries or mortalities of marine life are possible due to cavitation and pressure changes around the blades of the turbines. Meanwhile, the exclusion zones around individual tidal turbines may have a smaller effect on navigation and shipping than other tidal technologies.

A major benefit of these turbines is that, unlike tidal lagoons, they can be removed or relocated if there are adverse impacts. If, following appropriate and sufficient study of environmental impacts during the demonstration phase, this technology is proven to be effective and not harmful to coastal ecosystems, it can be scaled up with care.

What tidal projects are currently in the works in Nova Scotia?

At the moment, the Bay of Fundy only produces about 20 megawatts of power through the Annapolis Power Generating Station, the first modern tidal generating plant in North America. In 1984, Nova Scotia Power assumed operation of the facility and became the first North American utility to include tidal energy in its power grid. However, this facility uses the older barrage technology that has shown some adverse environmental effects. Barrages are dam-like structures that restrict tidal flows. As a result, tidal barrages are known to cause silting and other types of habitat alteration.

Today, a new tidal technology exists that does not require dams or head ponds. This new technology consists of in-stream tidal turbines that resemble underwater windmills. In January 2008, Minas Basin Pulp and Power was awarded the right to construct a tidal power demonstration and research facility, using this new technology, in the Minas Passage area of the Minas Channel. Three types of in-stream turbine devices will be dropped in tidal waters and tested for up to 4 years, potentially connecting 4 MW of energy to the grid. Nova Scotia Power will provide the necessary system upgrade and connection. Upon completion of construction, Minas Basin will turn the facility over to a not-for-profit corporation, which will own and operate the infrastructure. On June 17, 2009, the Fundy Tidal Energy Demonstration Project was registered for environmental assessment, in accordance with Part IV of the *Environment Act*. If the EA is approved, devices should be in the water by late 2009 or 2010.

Why are demonstration projects necessary?

According to the NS Department of Energy's regulatory policy for ocean renewable energy, commercial projects will only be allowed after a demonstration project has shown that the technology can be successful in an offshore environment and can meet all environmental requirements. The demonstration facility will therefore allow proponents

to test the commercial potential and assess the performance of these devices before a large-scale project is attempted.

The demonstration facility Minas Basin Pulp and Power has proposed to build will test three different in-stream tidal energy devices. The three models chosen were:

- The Clean Current 2.2 MW model
- The Nova Scotia Power/OpenHydro 1 MW model
- The Minas Basin Pulp and Power/Marine Current Turbine 1.0 - 1.2 MW model

Each model's effects on the environment and the effect of the environment on the devices will be observed and monitoring techniques will be established.

Because the Bay of Fundy is so emotionally and economically significant to the coastal communities surrounding it, it is essential that any new technology be carefully tested before it is permanently placed in its waters.

What is an environmental assessment?

An environmental assessment (EA) is a process that is used to assess the environmental effects of a proposed project before it is attempted. EAs also propose measures to mitigate adverse effects (see http://www.ceaa.gc.ca/010/basics_e.htm for more information on the EA process).

The Strategic Environmental Assessment (SEA) is an environmental assessment process that takes place before specific projects are considered. It provides opportunities for stakeholders to participate and influence decisions. For example, the OEER (Offshore Energy Environmental Research) Association was commissioned by the Nova Scotia Department of Energy to carry out a SEA focusing on tidal energy development in the Bay of Fundy. The SEA was led by an OEER Technical Advisory Group and information was gathered through a Stakeholder Roundtable, as well as community forums, workshops, etc. The final report, submitted in April 2008, made 29 recommendations to guide the development of marine renewable energy in the Bay of Fundy. More information on the Fundy Tidal Energy SEA can be found at http://www.offshoreenergyresearch.ca/OEER/StrategicEnvironmentalAssessment/tabid/117/Default.aspx.

While the SEA looked at a range of renewable energy sources in the Bay of Fundy, EAs must also be carried out for specific projects. For their demonstration project, Minas Basin Pulp and Power commissioned AECOM Canada Ltd. to prepare a report addressing the potential impacts associated with the demonstration project only. This EA was therefore carried out with a specific location and specific devices in mind. In June 2009, Minas' EA report was submitted for both federal and provincial environmental approval under the *Canadian Environmental Assessment Act* (*CEAA*) and Nova Scotia *Environment Act* and Environmental Assessment Regulations. The full report can be found at http://www.gov.ns.ca/nse/ea/minas.passage.tidal.demonstration.asp.

How will coastal communities be impacted by new tidal power technologies?

The current in-stream turbine project in the Bay of Fundy is a demonstration project only. It is difficult to predict how and where any large scale commercial project might develop. The demonstration phase of this project is a good time for Nova Scotians to consider what community benefits they want to see from this new technology and what they want to avoid so that any future commercial development can incorporate these expectations.

Potential benefits to coastal communities could include:

- Creation of new jobs
    - Manufacture components in Nova Scotia
    - Monitoring and maintenance
- Increased tourism in the area
- Source of clean, local energy (energy security)

Potential negative impacts include:

- Damage to ecosystems of the Bay of Fundy
    - Changes in currents, loss of habitat, mortality of marine life, etc.
- Socioeconomic impacts on fishers and the fisheries and other marine and coastal resource users
- Loss of access
    - Navigation, fishing, or recreation
- Impacts largely depend on the type of tidal technology used (see above)

How can you be involved?

The public can have an impact on how tidal power technology in the Bay of Fundy will develop. To have your voice heard:

- Comment on EA reports
- Attend public meetings to get the latest information
- Ask questions
- Join the EAC or another environmental organization
- Get involved in coastal management or integrated management planning processes
- Participate in the Bay of Fundy Community Forum

Links:

- Minas Basin Pulp and Power http://www.minas.ns.ca/
- Nova Scotia Power http://www.nspower.ca/
- OEER (Offshore Energy Environmental Research Association) http://www.offshoreenergyresearch.ca/Default.aspx?tabid=54

Prepared by Renée Huntley

Coastal Issues Committee Intern
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