Bay's science opens up with energy projects

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At the Atlantic Geoscience Society 36th annual colloquium recently in Greenwich, scientists presented new results on ocean current modeling, bay floor mapping, sediment and marsh dynamics - all in relation to potential impacts of tidal power in the Bay of Fundy.

Research scientist Dr. David Greenberg of the Bedford Institute of Oceanography (BIO) and mathematician Dr. Richard Karsten of Acadia University are refining an ocean model to explore how a tidal farm of hundreds of turbines could affect water levels.

Research in the 1970s indicated solid barrages planned for the Upper Bay of Fundy would increase tidal high water levels in some places and decrease them elsewhere.

Given the strong currents through the deep, narrow channel, it makes a promising location for the generation of electrical power using in-stream turbines. Karsten's simulations suggest up to 6.9 GW of power could be extracted; however, the result might be an increase in tidal amplitude of over 15 per cent along the entire Gulf of Maine.

Greenberg showed images of the Boston airport and the railroad across the Tantramar marshes and commented, "people build too close to the water."

He believes the tides in the Minas Basin could experience a 30 per cent decrease in amplitude if the maximum amount of power is extracted. Such large changes could have harmful environmental impacts, but Karsten said the simulations also indicate up to 2.5 GW of power can be extracted with less than a five to six per cent change.

According to Nova Scotia Energy, 2.5 GW powers over 800,000 homes. The question is whether and to what extent a five or six per cent change in tidal range would change sedimentation and erosion, especially around the shores of Minas Basin.

The fastest currents are located in the Minas Passage, a promising location for the implementation of additional turbines like the trial models deployed last fall. More water flows through Minas Passage twice a day than all the major rivers of the world combined carry to the sea daily.

The tidal amplitude has been changing significantly over the last 10,000 years (or since the end of the last ice age), Greenberg said. John Shaw of the Geological Survey of Canada even suggested the tide range in Minas Basin increased suddenly as a result of a catastrophic break through a natural barrier across the Minas Channel about 5,000 years ago.

In one of the Glooscap legends, the Mi'kmaq god asks his friend, Beaver, to build a dam so he can take a bath. When Beaver subsequently won't remove the dam, Glooscap asks Whale to flip his tale to take out the barrier. This legend eerily mimics the suggested natural breakthrough, although Shaw acknowledged physical evidence hasn't been found.

Greenberg noted, with or without tidal power, the tide ranges in Gulf of Maine and Bay of Fundy are unstable and the sea level could rise.

Gordon Fader of Atlantic Marine Geological Consulting in Halifax (formerly with BIO) outlined his years researching the bottom of the Bay of Fundy.

Using photos, video stations and multibeam bathymetry, which provide a detailed picture of the topography of the seafloor and water depths; he determined the optimal sites for the three trial turbines. This kind of imagery amounts to the underwater equivalent of an aerial photograph.

He detailed how the construction of a subsea transmission cable will allow current and future tidal devices to deliver power directly to the electricity grid. He would like to see new research projects examine the influence of destructive fishing techniques, such as bottom dragging for scallops, on the stability of the sediment in the Bay of Fundy and Minas Basin, as well as on the level of turbulence off Cape Split.

Researchers Michael Li of BIO and Danika van Proosdij of St Mary's University also presented their findings on sediment dynamics.

Nova Scotia Power and its tidal technology partner, OpenHydro, successfully deployed the first commercial scale in-stream tidal turbine in the Bay of Fundy in November. The one-megawatt commercial scale turbine reached the Fundy Ocean Research Centre for Energy (FORCE) deployment site in the Minas Passage and is now operational, rotating with the tides, collecting data and producing energy. Submitted

Figuring out the flow

By Andrew Foote

The Bay of Fundy is famous for its tides, likely the largest in the world.

The Nova Scotia government and developers of new tidal power devices have been determining how best to take advantage of this massive flow of water to generate electricity.

In November, the first of three different companies' test turbines were put in place in the Minas Passage, a narrow area between Parrsboro and Cape Split, about 100 kilometres north of Halifax.

Matthew Lumley, communications advisor with Nova Scotia's energy department, says an Irish company, OpenHydro, as well as B.C.'s Clean Current and Britain's Marine Current Turbines; are all seeking the prestige that comes with the Bay of Fundy name.

"The developers have many different reasons for wanting to be in the Bay - one of which is the brand, and to establish themselves as meeting some kind of 'Bay of Fundy' standard," says Lumley. "If you can make it here, you can make it anywhere because of the tremendous force of the tides."

Lumley says the provincial government participated in a California study in 2005 that studied potential North American tidal power sites: the Minas Passage could be the most "potent."

After nine companies submitted letters of interest, the province called for bids and selected three companies already testing devices around the world.

Lumley says a conservative estimate of how much power could be generated out of a large-scale tidal project in the bay is 300 megawatts of electricity - enough to power 100,000 homes.

The Minas Passage was chosen because of its bottom features, according to Anna Redden, biology professor at Acadia University.

"It's bare, it's bedrock and it's a stable bottom on which to place a gravity base" of 400 tons, which can hold turbines in place, says Redden.

Both the OpenHydro design, which partnered with Nova Scotia Power for this project, and the Clean Current turbine are open-centred, resembling a donut with the rotor around the edge.

"We liked that OpenHydro's design was simple but robust," says Jennifer Parker, an official with Nova Scotia Power. "Its open centre allows marine mammals to pass through, and it doesn't have a lot of moving or mechanical parts which require the use of any lubricants" which could be released into the water.

The Marine Current Turbines design, partnering with local company Minas Basin Pulp and Power, works much like a wind turbine with two "propellers" mounted on a stand.

Environmental considerations are important, as there is concern about the effect the turbines could have on fish.

"The biggest unknowns regarding the environment relate to the behaviour and safe passage of marine fish and mammals, and whether or not they are likely to come into contact with turbines," Redden says.

She adds researchers don't know at what depth fish in the area swim, or whether they are moving along the shoreline or in deeper waters. There is also a question of how fish will detect and avoid the turbines, with the current so fast and the water so turbulent.

"The flow through the centre (of an open centred turbine) is going to be much faster than the flow in front of the blade, because the blade acts as a partial barrier," she says.

She adds individual fish are likely to be funnelled through the centre or over the top; schools of fish may behave differently.

Marine Current Turbine's website says, since its rotors move one rotation about every four seconds, they're too slow to harm fish.

Most people seem to be excited about the project, but don't want to rush, Lumley says.

"It really is brand new technology, and it's one step at a time. We spent a lot of time (doing assessments) and, in general, the feedback was 'thumbs up, we have this incredible potential, let's move away from coal-based energy; but we don't know enough yet - let's go slowly.'"