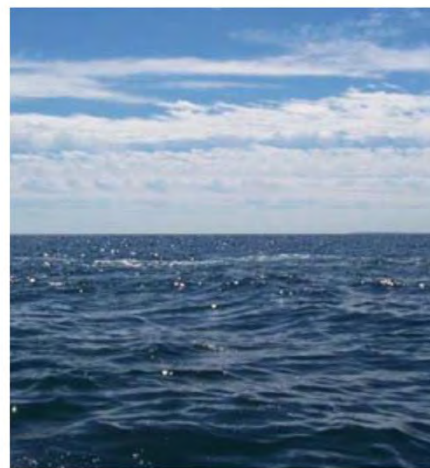


OCEAN POWER GENERATION

*A Comparison of In-Stream, Tidal, and
Wave Energy Conversion in Nova Scotia*

INTRODUCTION

- Vincent Boyd
- Timothy Ferguson
- Shane Kavanagh
- Patrick Korhonen

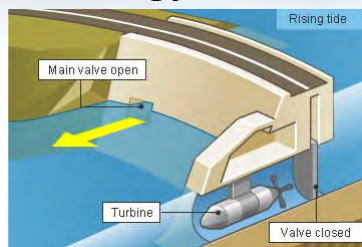


MOTIVATION

- Renewable Energy in Nova Scotia:
 - Bay of Fundy
- Energy harnessed through either:
 - Flow of Water (Kinetic Energy)
 - Height of Tides (Potential Energy)
- Three Technological Options:
 - Tidal Energy
 - Wave Energy
 - In-stream Energy

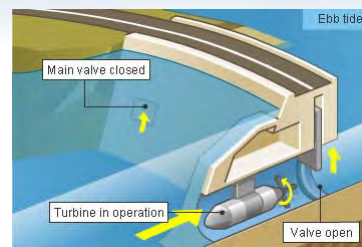
TECHNICAL INFORMATION

Tidal Energy Conversion



During Rising Tide

- Turbine valve closes & Sluices opens
- Seawater enters inlet via Sluices
- Inlet fills with seawater
- Tidal lagoons may “store energy”



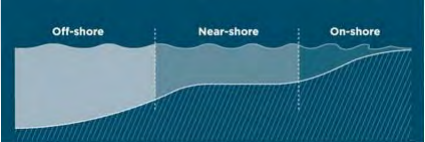
During Ebb Tide

- Sluices closes & Turbine valve opens
- Inlet drains through turbine pipe
- Turbine rotates generator to produce electricity

*Images adapted from <http://futuristictechnology.page.tl>

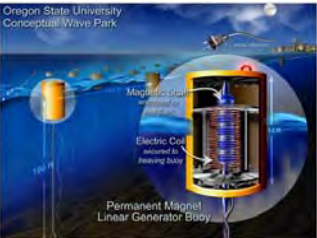
TECHNICAL INFORMATION

Wave Energy Conversion

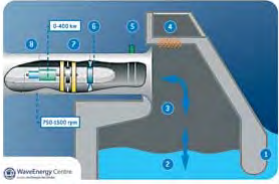


** Adapted from <http://aw-energy.com>*

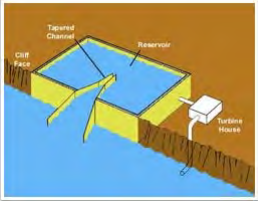
Float or buoy system Oscillating water column Tapered channel (tapchan)



**Adapted from <http://www.treehugger.com>*



** Adapted from <http://www.pico-owc.net>*




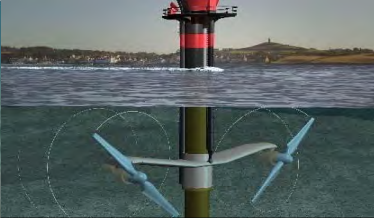
**Adapted from <http://taperedchannelwaveenergy.weebly.com>*

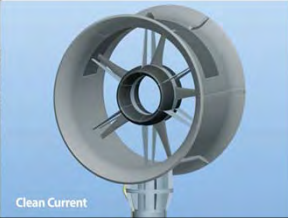
TECHNICAL INFORMATION

In-Stream Energy Conversion

Open Hydro Technology Marine Current Turbine Technology Clean Current Turbine Tech







Clean Current

ECONOMIC FEASIBILITY

Tidal Energy Conversion

- 1800,000 MW of tidal energy can be developed globally (US \$1.0 trillion)
- 240 MW plant at La Rance in Brittany
- 18 MW plant at Annapolis Royal
- 10 plus years to construct
 - cost/KW dictated by discount rate
- Tidal frequency do not match demand
 - Energy storage required
- Plant load factors average ~ 27%



*Images adapted from <http://www.nspower.ca>

ECONOMIC FEASIBILITY

Wave Energy Conversion

- Projected 7.5 cents per kilowatt-hour vs. 3 and 5 for alternative fuels.
- Potential of 2,000 terawatt-hour corresponding to an investment of \$665 billion.
- Suitable sites become one of the largest issues.



*Adapted from <http://www.offshorewind.biz>

ECONOMIC FEASIBILITY

In-Stream Energy Conversion

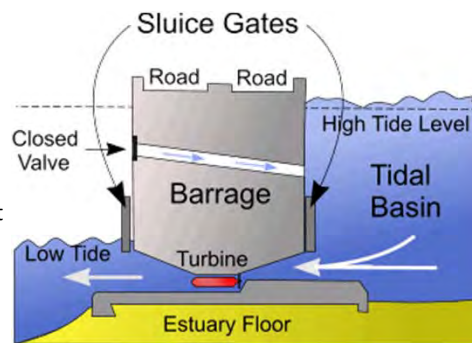
Adapted from: http://www.umaine.edu/mecheng/peterson/classes/design/2007_8/project_webs/tidal_test/pdf/Tidal%20Turbine%20Cost%20Estimation%20Research%202.pdf

	Capacity Factor (%)	Capital Cost (\$/kw)	Real COE (cents/kwh)	CO2 (lbs/Mwh)
Tidal in-stream (minas passage) 4.5 kW/m*m	46	2000	4-6.5	0
Wind (.7 kW/m*m) avg	30-42	1150	4.7-6.5	0
Solar Thermal (southwest US)	33	3300	18	0
600 MW coal plant	80	1275	4.2	1760

ENVIROMENTAL IMPACT

Tidal Energy Conversion

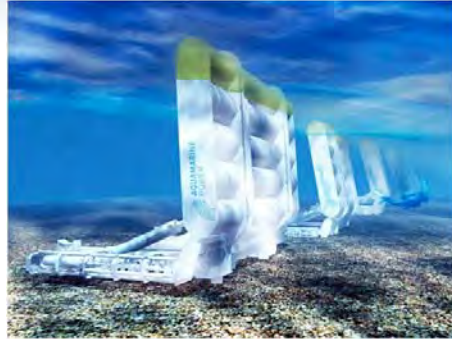
- Few large studies have been completed
- Potential Environmental Impact;
 - Inhibit movement of organisms
 - Inhibit movement of silt
 - Change the level of local tide
 - Change the direction of local current
 - Increase salinity in inlet
 - Emit noise/ Vibrations into water
 - Emit electromagnetic fields in water



ENVIROMENTAL IMPACT

Wave Energy Conversion

- Few large studies have been completed
- Potential Environmental Impact;
 - Noise emitted increases with roughness
 - Decrease in incident wave energy
 - Localized shear stress and turbulence
 - Inhibiting the stream flow



*Adapted from <http://inhabitat.com>

ENVIROMENTAL IMPACT

In-Stream Energy Conversion

- Little to no noise
- No silt disruption
- Some designs have no lubrication (OHTT)
- Slow moving blades
- No/little surface profile
- Reduction of tidal flow velocity

SUSTAINABILITY

Tidal Energy Conversion

- Tidal based energy is a dependable and predictable power supply which cannot be exhausted.
- A plant can be built to operate in excess of 100 years of reliable power.
- The Bay of Fundy has a mean tidal range of 10 m and it is estimated to have the potential of producing 30,000 MW.



* Adapted from <http://www.oceanenergycouncil.com>

SUSTAINABILITY

Wave Energy Conversion

- Waves get their energy from the wind which comes from solar energy
- Available 365 days a year.



SUSTAINABILITY

In-Stream Energy Conversion

- Ships/fleet required for maintenance
- Tide makes underwater maintenance difficult
- MCTT eliminates many of these difficulties

CONCLUSION

- Primary concern for Nova Scotia:
 - Maximum generation of energy
 - Preservation of oceanic ecosystems
 - Economically feasible
- Recommended Solution:
 - In-stream Technology
- Why?
 - ☺ Provide an immense quantity of clean, renewable energy
 - ☺ Significantly reduces the impact on the environment
 - ☺ Financially easier to develop and grow after set-up
 - ☹ Large initial investment

QUESTIONS?

