

Marine Renewable Energy in Canada

Aotearoa Wave and Tidal Energy Association
4th Annual Conference
April 19 -20th, 2010

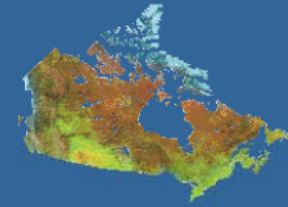
Melanie Nadeau, P.Eng.
Renewable & Integrated Energy Systems, CanmetENERGY



Natural Resources
Canada

Ressources naturelles
Canada

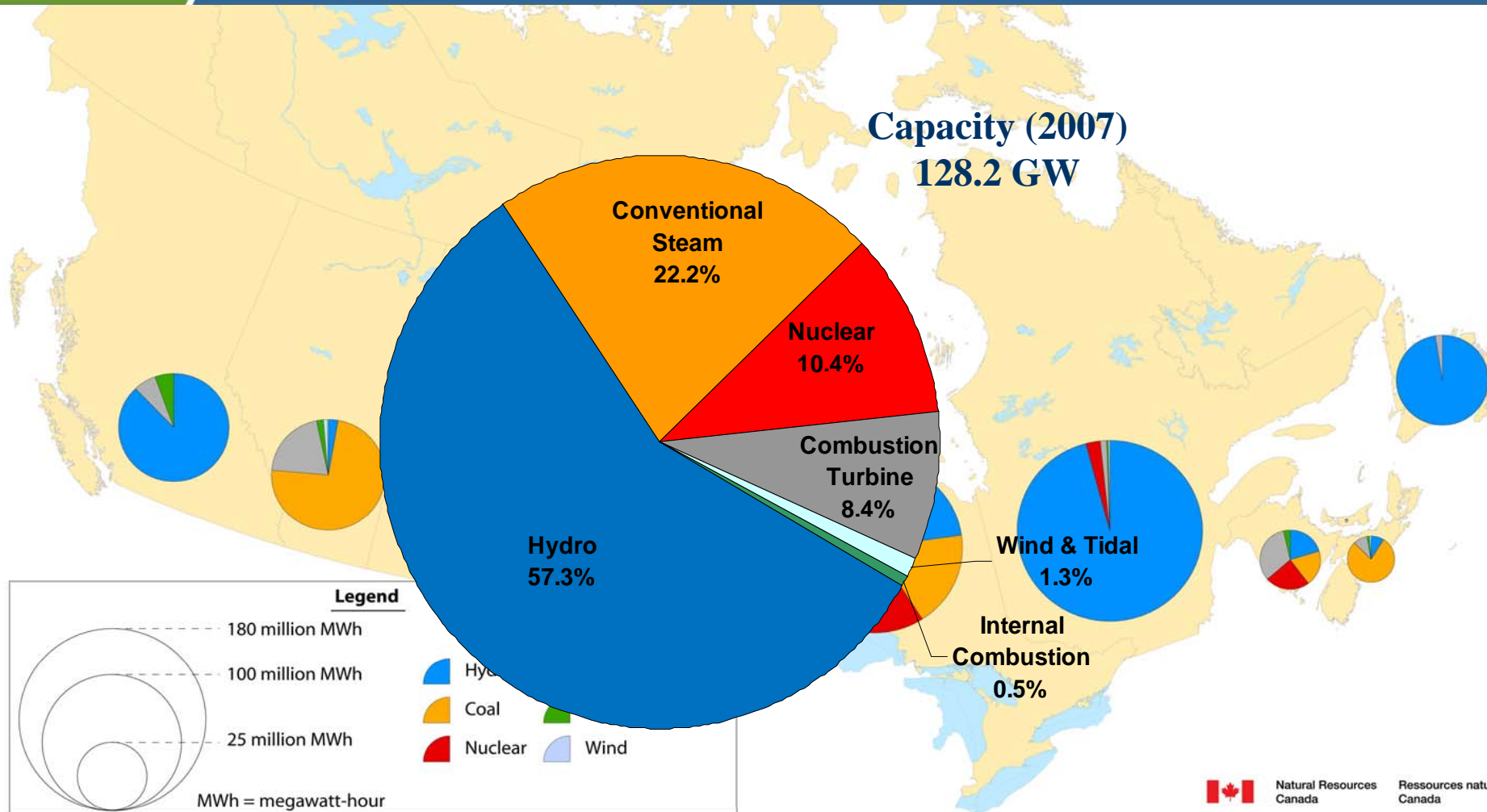
Canada

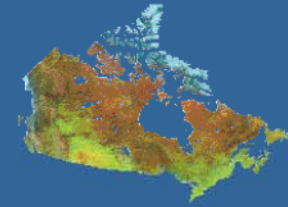


- Canadian Electricity Structure
- Climate Change & Clean Energy
- Context for Marine Energy in Canada
- National & Provincial Programs
- Research, Development & Demonstrations
- Test Centres



Electricity Supply Mix by Province





- Canada's emission reduction commitments:
 - 20% GHG reduction from 2006 levels by 2020
 - 90% electricity supply by non-emitting sources by 2020

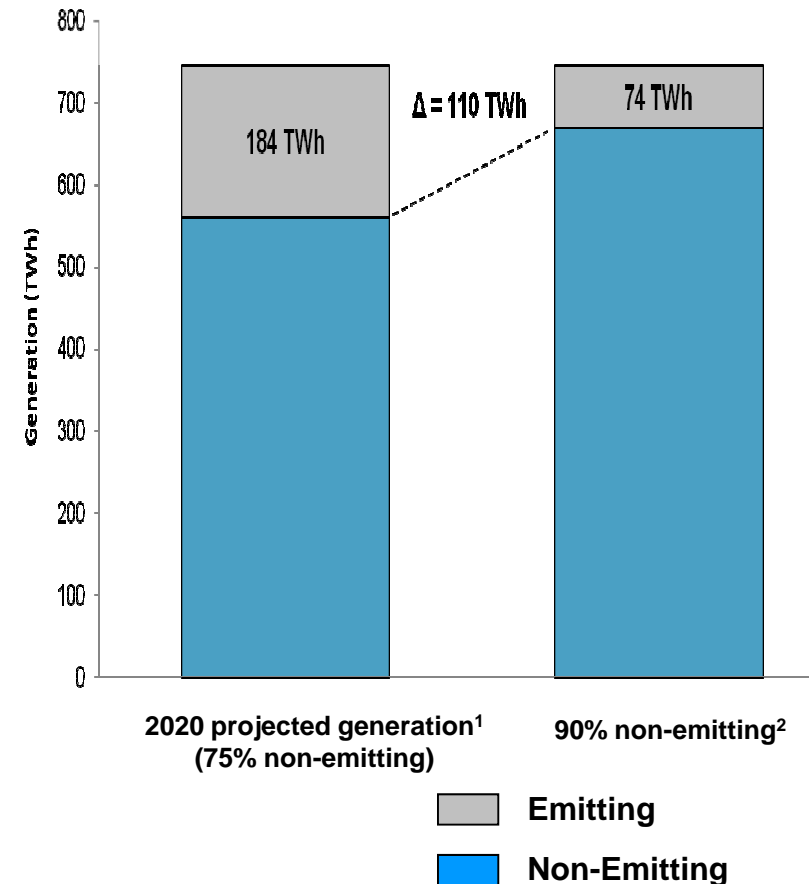
- Provincial emission reduction commitments
 - British Columbia – 33% GHG reduction below 2007 levels by 2020 & 80% below 2007 levels by 2050, (90-100 % RPS)
 - Ontario - 6% GHG reduction below 1990 by 2014, 15% below by 2020 & 80% below by 2050, Green Energy Act
 - Nova Scotia - 10% GHG reduction below 1990 levels by 2020, legislated RPS of 15% by 2010 & 25% by 2020
 - Other provinces/territories have set targets as well



Challenge: Lowering Carbon Emissions of the Canadian Economy



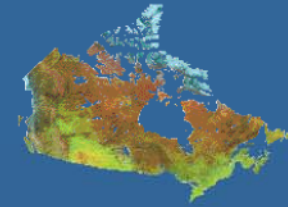
- National increase in electricity demand is forecasted with the electrification of the transportation sector
- Large energy facility's economic life-cycles are approaching requiring significant refurbishment/upgrading
- All new generation will need to be non-emitting and grid infrastructure will need to be enhanced
- Today, approximately 75 percent of electricity generation is non-emitting.
- Approximately 110 TWh (or 15 percent) of emitting generation must be replaced with non-emitting generation by 2020 in order to meet the 90 % objective



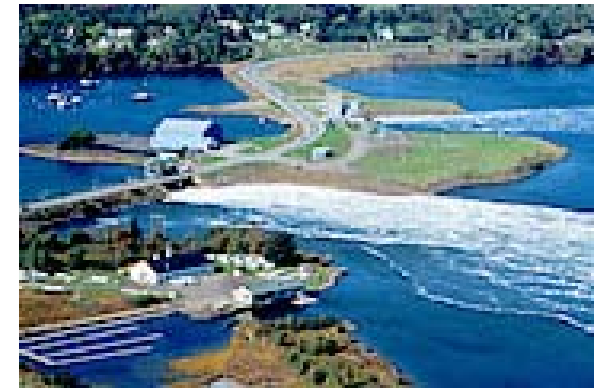
¹ Based on the National Energy Board's forecast *Canada's Energy Future* (2007).

² Generation mix if 90 percent of Canada's generation in 2020 is non-emitting.





- Marine energy can play a role in achieving clean energy objectives:
 - Canada was a pioneer with the first tidal barrage plant built in North America in the early 1980s
 - Vast amount of untapped energy - National Energy Board forecasts about 20,000 MW marine energy capacity³
 - Marine energy can produce non-emitting power generation in Atlantic provinces and remote coastal communities reliant of diesel power generation
 - Emerging sector can stimulate job creation as an exporter of marine energy technologies, projects and services

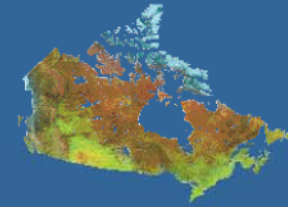


Annapolis Royal Tidal Barrage – 20 MW

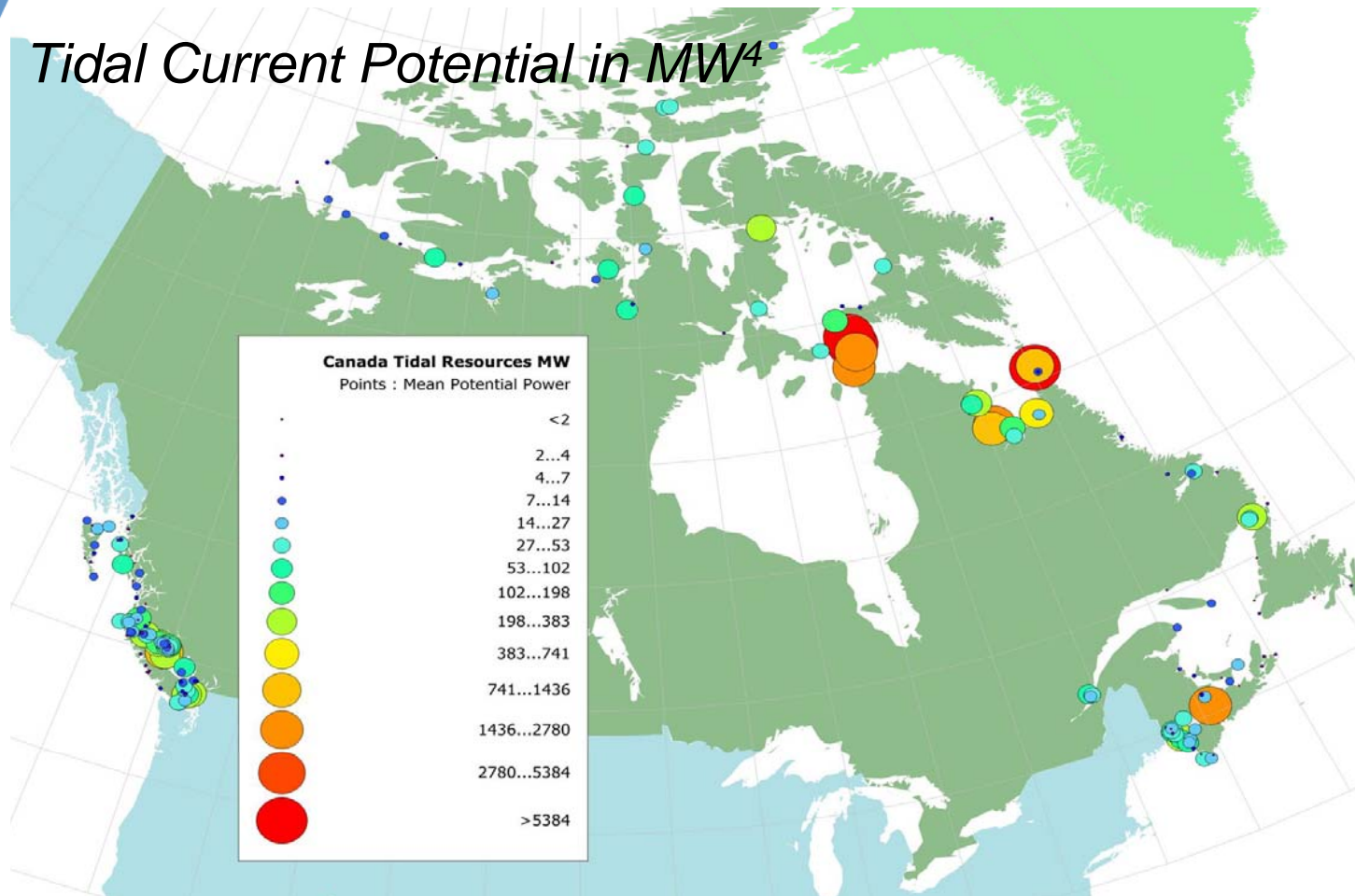
³ Canada's Energy Future, Scenarios for Supply and Demand to 2025, National Energy Board, Public Consultation, 2003



Canadian Tidal Energy Resource



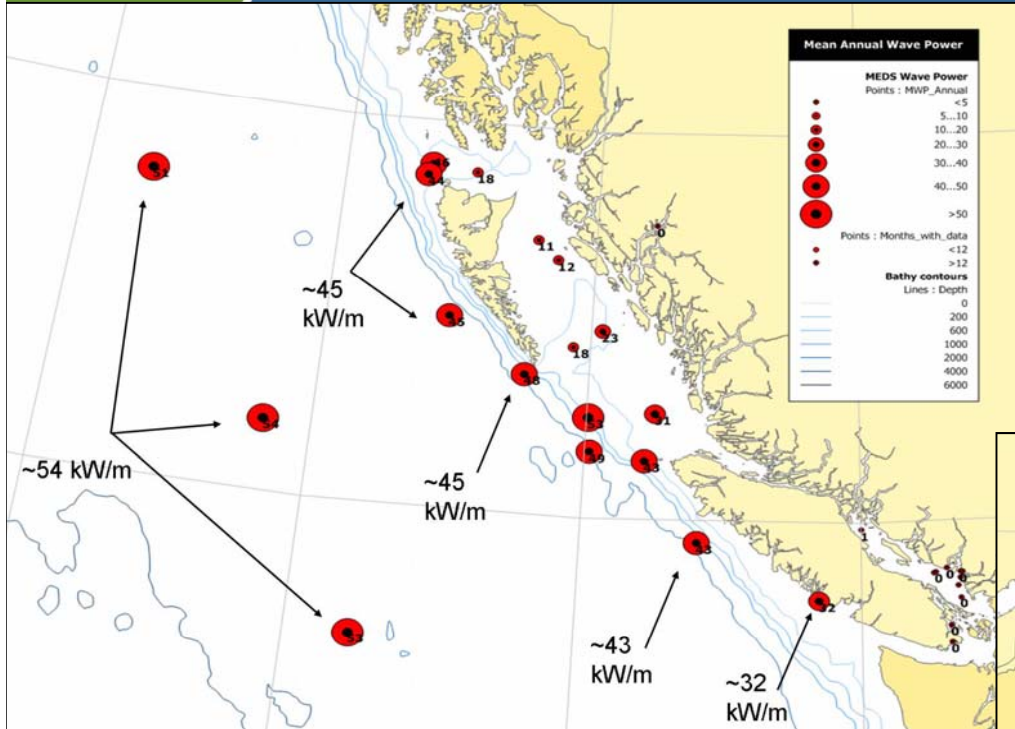
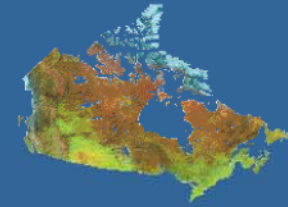
Tidal Current Potential in MW⁴



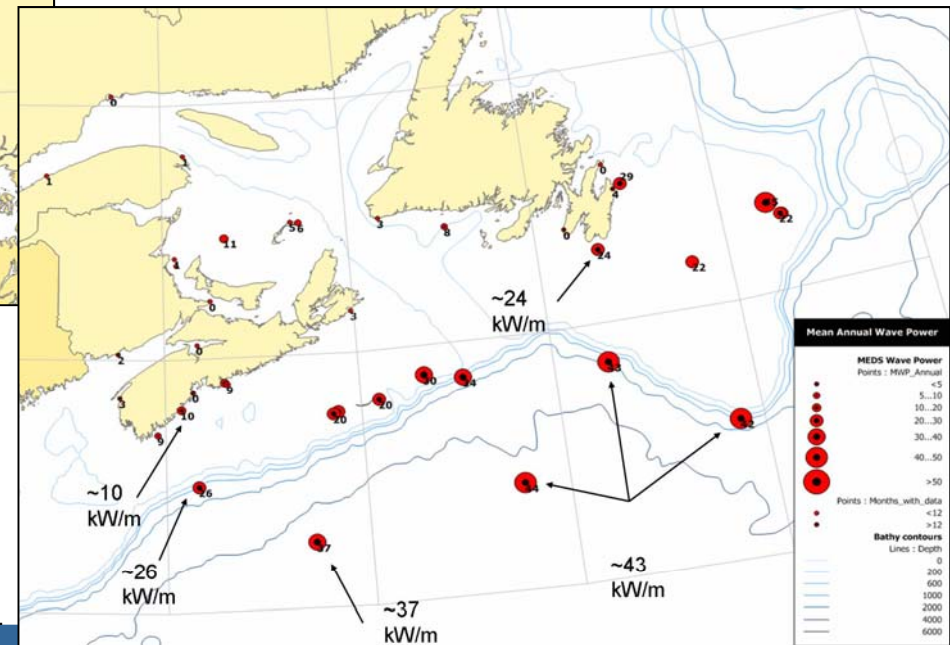
⁴Inventory of Canada's Renewable Energy Sources, NRC-CHC, 2006; Based on theoretical estimates.



Canadian Wave Energy Resource



Measured Resources (Annual Mean wave energy flux) as shown for the Canadian Pacific Coasts⁴

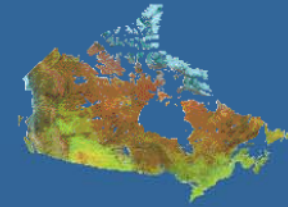


Measured Resources (Annual Mean wave energy flux) as shown for the Canadian Atlantic Coasts⁴

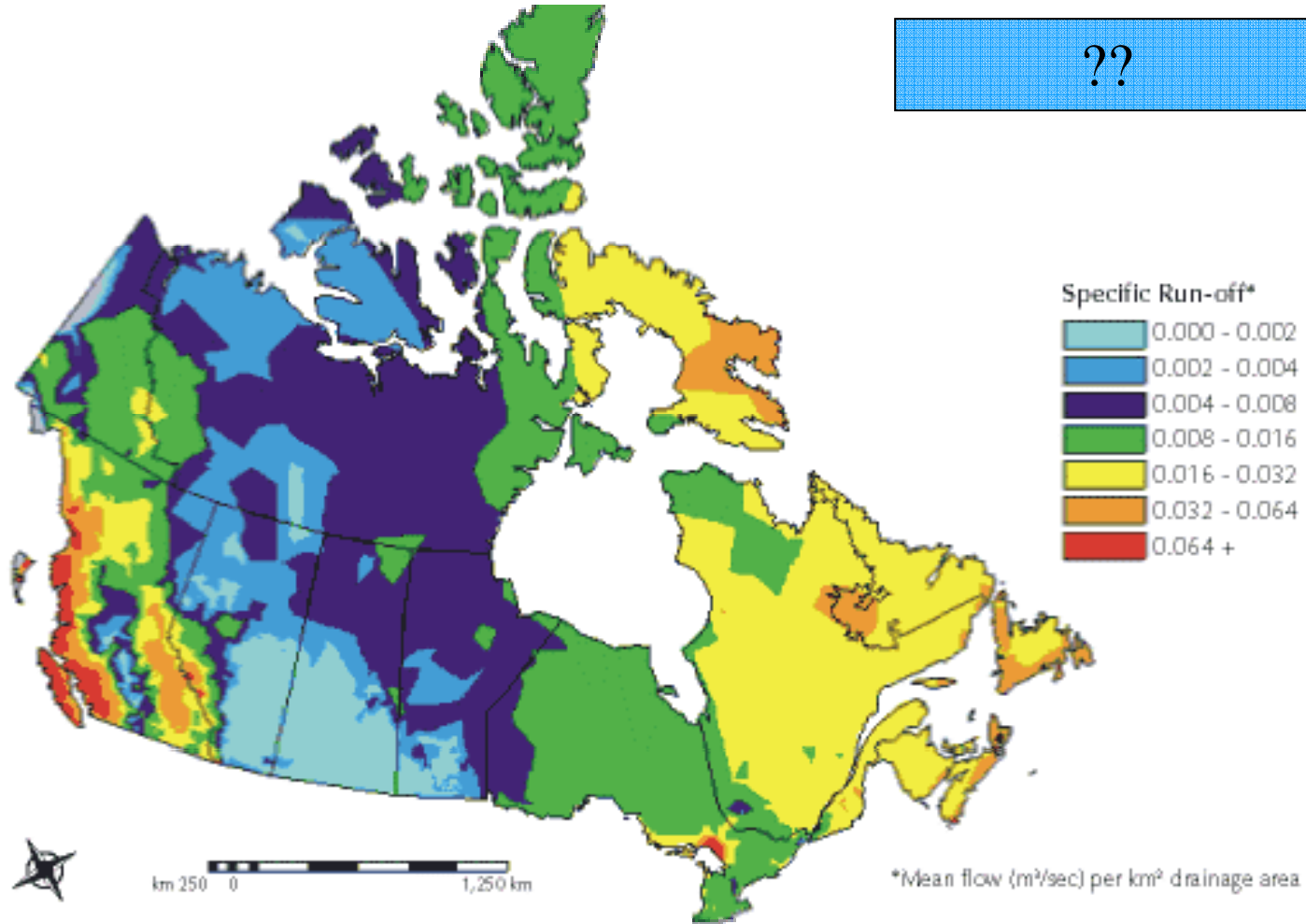
⁴ Inventory of Canada's Renewable Energy Sources, NRC-CHC, 2006; Based on theoretical estimates.



Hydrokinetic Energy Resource

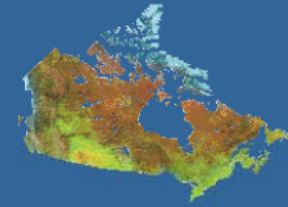


??



⁵RETSscreen





- **Natural Resources Canada**
 - ecoENERGY for Renewable Power
 - \$1.5 billion program to support the development of 4000 MW of low-impact renewable power (1¢ per kilowatt-hour)
 - Tax Measures – Class 43.2
 - 50% accelerated capital cost allowance for investment in renewable energy technologies (wave & tidal included in 2008)
 - Program for Energy R&D (PERD) & ecoENERGY Technology Initiative
 - Support for marine energy R&D conducted by federal and provincial governments in partnership with industry and academia (~ 1.1M/year)
 - Security Prosperity Partnership/Clean Energy Dialogue
 - Over 1M allocated to very low head hydro and hydrokinetic R,D&D
 - Clean Energy Fund
 - Approximately 25M allocated to wave and tidal current demonstrations

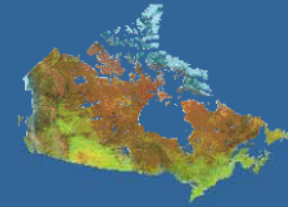
All figures in Canadian Dollars: 1 CAD = 1.39 NZD



Natural Resources
Canada

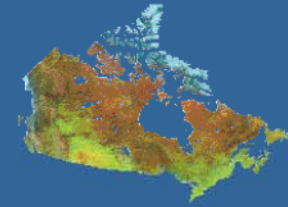
Ressources naturelles
Canada

Canada



- National Research Council - Industrial Research Assistance Program
 - Provides technical and business oriented advisory services along with potential financial support to growth-oriented Canadian small - and medium-sized enterprises.
- Sustainable Development Technology Canada – Tech Fund
 - Supports clean technology development and demonstration – over 20M awarded to marine energy projects (Total = 6)





- **British Columbia Innovative Clean Energy Fund**

- Allocated 6M to two wave and one tidal energy demonstrations



- **Ontario Innovation Demonstration Fund**

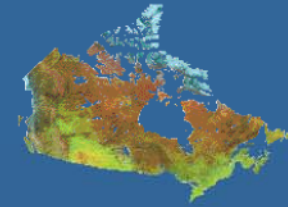
- Awarded 2.2M to a hydrokinetic demonstration project in the St. Lawrence



- **Nova Scotia Department of Energy**

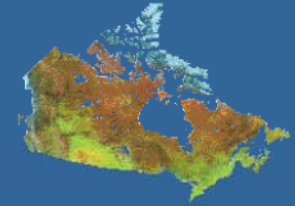
- Awarded over 7.5M to the Fundy Ocean Research Centre and research applications of hydrodynamic models for the assessment of energy resources and the environmental effects of energy extraction





- Fundamental support for federal R&D to address key issues supporting the sector:
 - Standards & technology development
 - Environmental Mitigation
 - Resource Modelling
 - Networks
- Federal partners – Natural Resources Canada, Fisheries & Oceans, Industry Canada, Environment Canada, National Research Council
- Partners – Academic institutions, Utilities, Technology developers, Consultants, Provincial governments





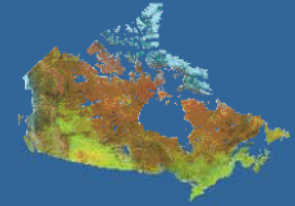
- Modelling of the hydrodynamic changes in high profile sites in Canada
- 3-D model development for sediment dynamics and transport for proposed tidal in-stream power generation
- Data collection, wave prediction and forecasting along Western Coast of Vancouver Island
- Development & model testing of a commercial scale procedure for deployment of a tidal turbine in the Bay of Fundy



Triaxys Directional Wave Buoy
Source: Axys Technologies

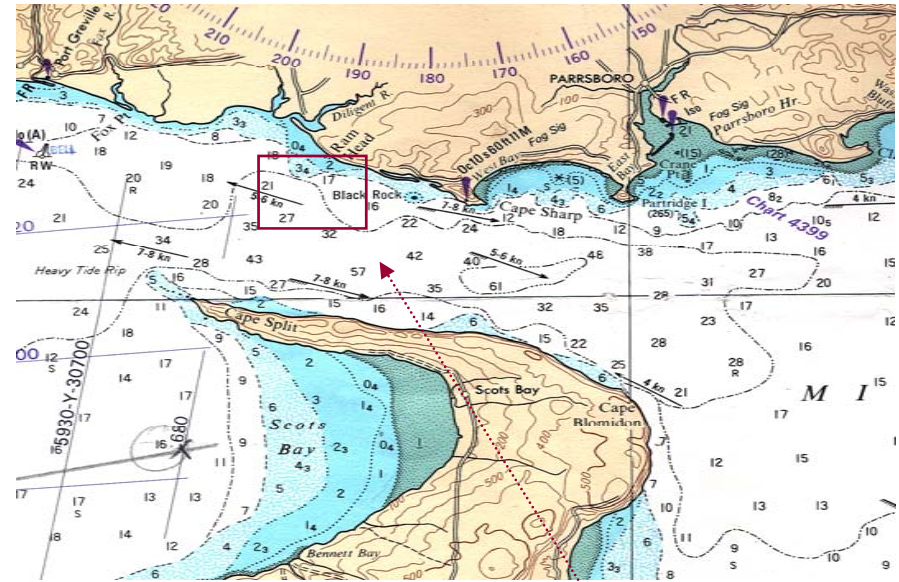
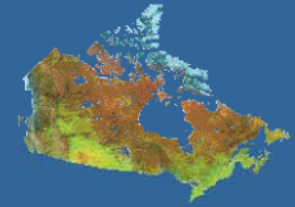


Tidal Testing Facility



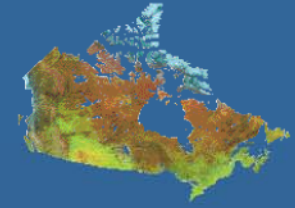
- Fundy Ocean Research Centre for Energy (FORCE) - in-stream tidal testing technology centre in the Bay of Fundy
- Tidal devices to be connected to the Nova Scotia electric grid in late 2011 (5MW)
 - Alstom/Clean Current (using a Clean Current Mark III Turbine)
 - Minas Basin Pulp and Power Co. Ltd. (using MCT Seagen Turbine)
 - Nova Scotia Power Inc. (using an OpenHydro Turbine) – deployed Nov. 2009
- 20-year Crown lease 10 km from direct connection to electrical grid serving Eastern Canada and the US
- Request for subsequent berth holders in progress
- Non-for-profit that is private and publicly funded





FORCE SITE





Thank you for your attention...

Contact info:

Melanie Nadeau, P.Eng.

Manager, Marine & Hydro Energy

CanmetENERGY, Natural Resources Canada

Ottawa, Ontario K1A 0E4

Tel: (011) 613-947-2370

Email: menadeau@nrcan.gc.ca

