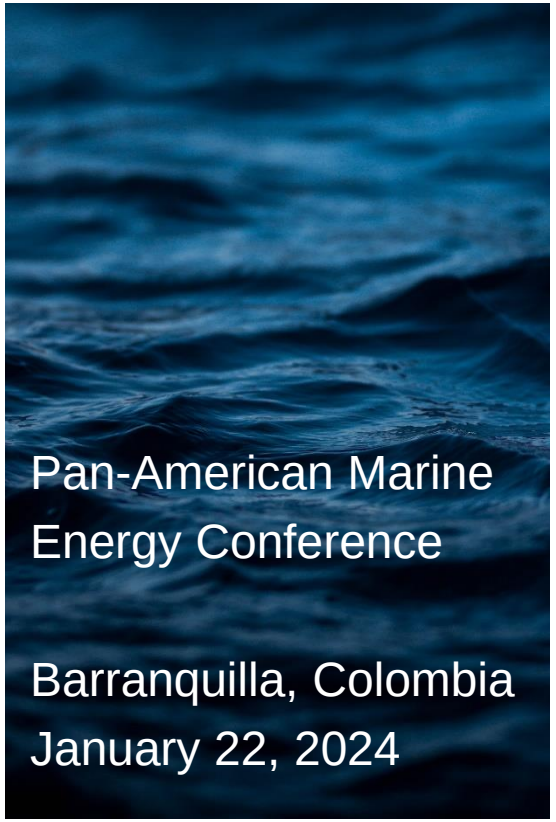


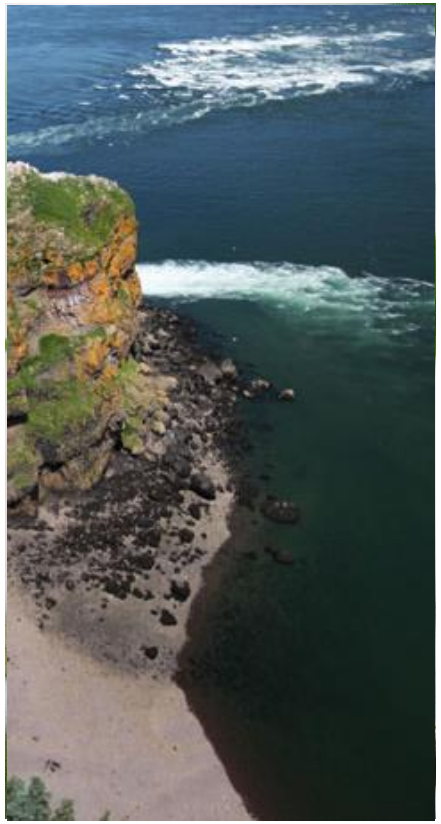
Pan-American Marine Energy Conference

Barranquilla, Colombia
January 22, 2024

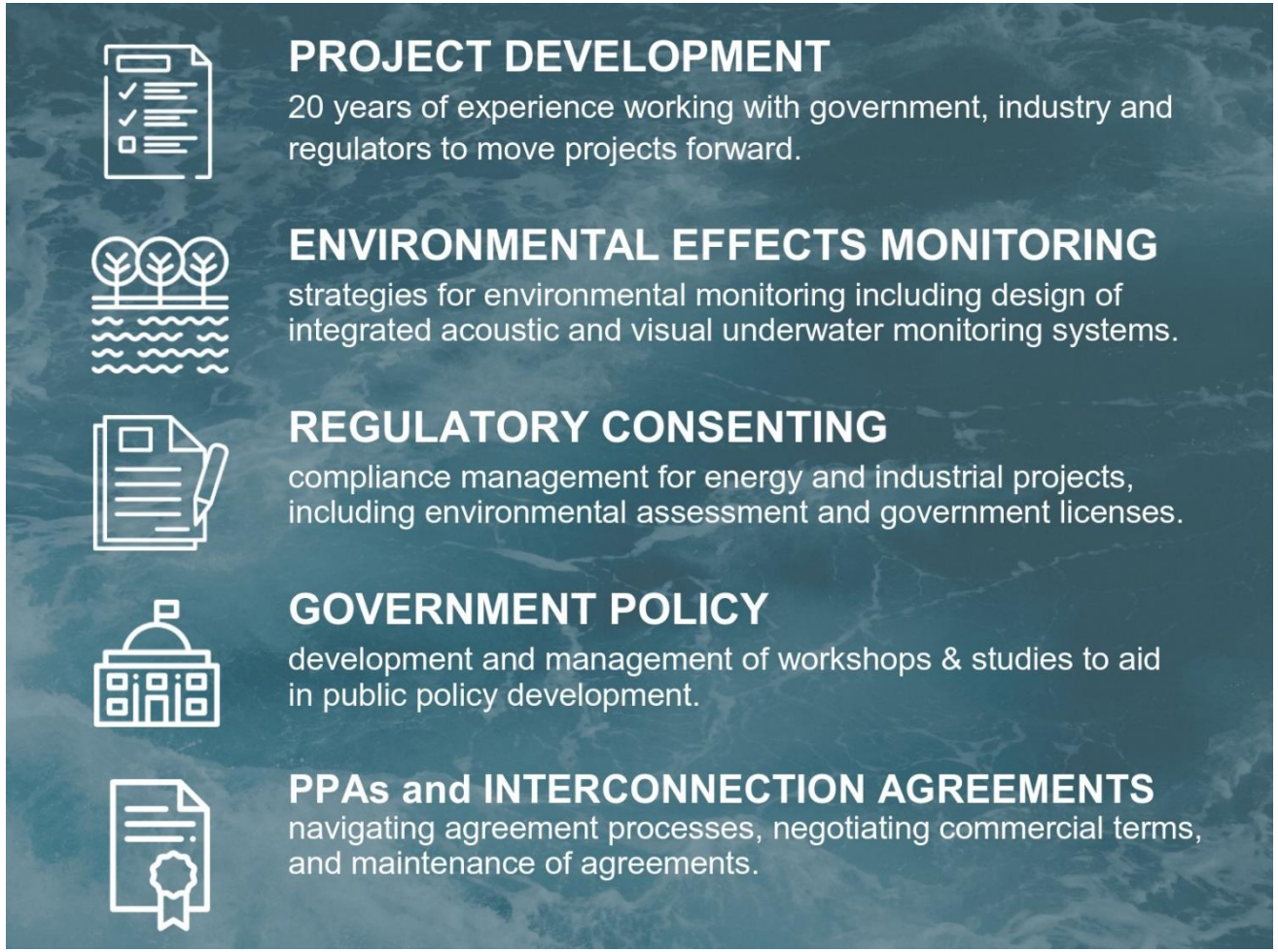
Obstacles in the Path to New Clean Technologies:

An Examination of Challenges for In-stream Tidal Energy Development in Canada's Bay of Fundy

Craig Chandler, Mersey Consulting Ltd.



About Mersey Consulting



- Professional engineer based in Halifax, Canada with over 25 years of experience in local, national & international project experience
- Focus on marine renewable energy project development and environment protection
- Projects with companies including SCHOTTEL, Tocardo, Sustainable Marine Energy and Oneka Technologies
- Participates in international conferences and OES Environmental and ORJIP workshops that focus on social and environmental issues

Background – Tidal Energy

- In-stream tidal energy technologies generate electricity from tidal currents
- Successful projects in Europe and Canada, but technology remains pre-commercial / not widely adopted
- Potential uses are limited to areas with high tidal current flows, sufficiently deep water and nearby users
- Predictability is advantage over other renewables such as wind and solar (only predictable over short timeframes)
- Great for islands and coastal community renewable energy, energy security, economic development
- Bay of Fundy:
  - Highest tides in the world
  - Billions of tonnes of water / fast-flowing tidal currents
  - Unique opportunity for tidal

Background – Nova Scotia Tidal Energy Program

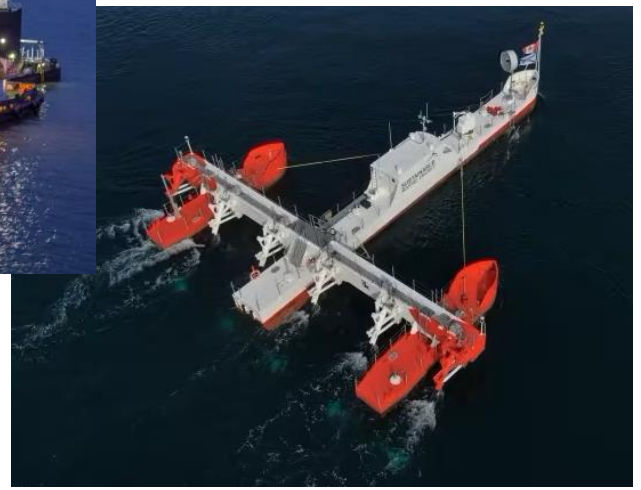
- Nova Scotia developed tidal energy program in 2008 with goals of:
  - local economic activity
  - creation of export opportunities
  - generation of renewable energy
- Fundy Ocean Research Center for Energy (FORCE) created in 2009
- FORCE program - 22MW of permitted projects
- Permit program – maximum of 10MW of projects
- Development of novel marine renewable energy (MRE) devices encompasses many challenges:
  - Technical
  - Financial
  - Permitting / Environmental
  - Organizational Capacity

Purpose of This Study

- Examine permits under Nova Scotia's tidal energy program, initiated in 2008
- Focus on progress and outcomes of projects
- Identify specific obstacles where possible
- Assessment projects based on:
  - published materials
  - author's experience working in the sector
- Make observations regarding relative success or failure of each project

Permit Holders

- FORCE Test Sites (2008 and 2023):
  - Minas Pulp & Power / Eauclaire (various technology partners)
  - Alstom (with technology partner Clean Current)
  - Nova Scotia Power (with technology partner OpenHydro)
  - Atlantis Resources
  - Black Rock Tidal Power
  - Open Hydro / Cape Sharp
  - DP Energy
  - Big Moon Power
- Permit Program (2018 – 2023):
  - Big Moon Power
  - Jupiter Hydro
  - Nova Innovations
  - Sustainable Marine Energy
  - Neweast Energy



FORCE Demonstration Site Proponent	Project Capacity (MW)	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Eauclaire Tidal LP/Minas Tidal LP/Minas Basin P&P (Berth A)	4.0															
Alstom	4.0															
Nova Scotia Power	4.0															
Atlantis/DP Energy/Rio Fundo (Berth B)	4.0															
Black Rock/Sustainable Marine/RE13 (Berth C)	5.0															
OpenHydro	4.0															
DP Energy/Haligonia (Berth E)	5.0															
Big Moon Power (Berth D)	4.0															

Permit Program Proponent	Project Capacity (MW)	Program commenced in 2018	2018	2019	2020	2021	2022	2023
Big Moon Power	5.0							
Jupiter Hydro	2.0							
Nova Innovations	1.5							
Sustainable Marine (non-grid)	N/A							
Sustainable Marine	0.7							
Neweast Energy	0.8							

Key
Initiation - Project Development
Device Deployment
Device Retrieval
Project Termination

Direct Cause of Project Failures

- Difficult to deeply evaluate causes of project inactivity or failure
- Some combination of factors including:
  - Project financing
  - Organizational capacity
  - Technical capacity
  - Regulatory requirements
  - Risk tolerance
- Never only one factor!
- Nova Scotia permit program was designed to be accessible to variety of proponents – but a consequence is a higher level of attrition

Projects that Deployed, then ended:

- Nova Scotia Power: Technical failure of OpenHydro device post deployment
- Alstom: Voluntary termination of permit
- OpenHydro: Bankruptcy - withdrawal of parent company support
- Sustainable Marine Energy (non-connected): Project completion
- Sustainable Marine Energy (connected): Bankruptcy - withdrawal of investor

Assessment Criteria

1. How long did the proponent hold a permit? (objective)
   - Length of time that the proponent has had to progress their projects
2. Did the project fail to launch? (objective, based on subjective criteria)
   - Assessment of capacity or motivation to progress project (>5 years/ended + no deployment)
3. Did device construction or operation take place? (objective)
   - Assessment of progress in project design, financing and project development OR
   - Indication of proponent's motivation to progress the project
4. Was the device successfully operated? (objective)
   - Assessment of proponent's technical, organizational and financial ability to operate project
5. Is the project currently operating? (objective)
   - Assessment of proponent's technical, financial, and organizational capacity
6. What year was the device deployed (if deployment occurred)? (objective)
   - Assessment of duration and timing of proponents' engagement in the industry

Results

- 5 full-scale devices have been deployed in the Bay of Fundy
- 0 devices are currently operating in the Bay of Fundy
- 2 projects are “active” with some or all fabrication work completed
- 0 of 5 deployed devices were Canadian technologies
- 1 of 5 most successful projects involved a Canadian proponent
- 4 of 5 most successful projects use devices with capacity of 1 MW or less
- 4 of 5 most successful projects use technology with high deployment experience
- 4 of 5 most successful projects have medium or large parent / major investor
- 4 of 5 most successful projects led by pre-commercial technology developers
- 4 least successful projects not led by pre-commercial or technology developer
- 5 least successful projects use technology with low deployment experience
  (Exception is project that propose to purchase existing, proven technology)

Conclusions

- Assessment was based on subjective analysis of objective information
- Approximately 1/3 of permits saw a device deployed
- No projects operated in 2023, or are operating in Q1 2024
- Significant success and learning by individual companies
- Technical, regulatory and organizational challenges still limit activity of technology developers
- Project developers may still be challenged by project risks
- Conclusions cannot be drawn from this study regarding the relative likelihood of success of a given project, proponent or technology
- Additional research needed to identify specific factors affecting project success

Thank You

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