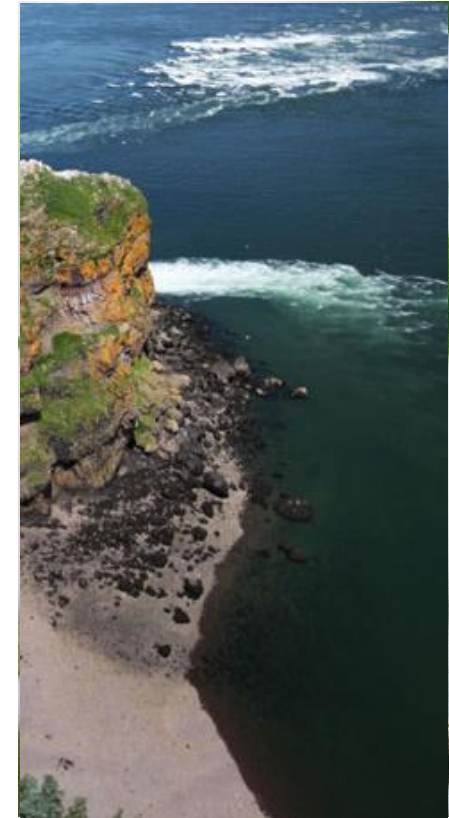




Obstacles in the Path to New Clean Technologies:

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

Craig Chandler, Mersey Consulting Ltd.



Pan-American Marine
Energy Conference

Barranquilla, Colombia
January 22, 2024



PROJECT DEVELOPMENT

20 years of experience working with government, industry and regulators to move projects forward.



ENVIRONMENTAL EFFECTS MONITORING

strategies for environmental monitoring including design of integrated acoustic and visual underwater monitoring systems.



REGULATORY CONSENTING

compliance management for energy and industrial projects, including environmental assessment and government licenses.



GOVERNMENT POLICY

development and management of workshops & studies to aid in public policy development.



PPAs and INTERCONNECTION AGREEMENTS

navigating agreement processes, negotiating commercial terms, and maintenance of agreements.

- 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

- 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



- 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



- **FORCE Test Sites (2008 and 2023):**
 - Minas Pulp & Power / Eau Claire (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	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Alstom	4.0	Green	Green	Green	Green	Red	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey
Nova Scotia Power	4.0	Blue	Yellow	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Atlantis/DP Energy/Rio Fundo (Berth B)	4.0	Grey	Grey	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Black Rock/Sustainable Marine/RE13 (Berth C)	5.0	Grey	Grey	Grey	Grey	Grey	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
OpenHydro	4.0	Grey	Grey	Grey	Grey	Grey	Green	Green	Blue	Yellow	Blue	Red	Grey	Grey	Grey	Grey
DP Energy/Haligonia (Berth E)	5.0	Grey	Grey	Grey	Grey	Grey	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Big Moon Power (Berth D)	4.0	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Green	Green	Green	Green	Green

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

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

- 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)

- 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

CRAIG CHANDLER
Senior Consultant
+ 1 902 830 2226
www.mersey.ca
info@mersey.ca

