

Community and Business Toolkit for Tidal Energy Development **A Guide**

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Welcome to the Community and Business Toolkit for Tidal Energy Development Guide!

Introduction

The *Community and Business Toolkit for Tidal Energy Development (Toolkit for short)* is a big piece of work. This *Guide* is intended to help readers self-direct themselves to the parts of the Toolkit that is most useful for them. The entire Toolkit project could not have been possible without the support from our major funding partners – Atlantic Canada Opportunities Agency, Offshore Energy Research Association, Nova Scotia Department of Economic and Rural Development and Tourism and our industry and community funding partners Emera, Municipality of the District of Digby, Cumberland Energy Office, AECOM, Vemco, NortekUSA, Jasco Applied Sciences and Fundy Tidal Inc.

The Toolkit is divided into 11 Modules – each covering a specific subject related to tidal energy development in Nova Scotia. Each Module is written by a different author who has expertise in the subject matter of the Module. As a result each Module is slightly different. The Toolkit was an interdisciplinary project as, engineers, biologists, ecologists, economists, and experts from business, finance, and community development all contributed.

It is recommended that everyone read *Module 1: Overview of Tidal Energy*, *Module 2: Measuring and Assessing the Tidal Resource*, and *Module 3: Tidal Power Extraction Devices* to familiarize themselves with what tidal energy is, Nova Scotia's tidal resources, and the basics of tidal energy devices and power systems.

The intent of the Toolkit is to act as a 'one-stop shop' for those just learning about, or who want to learn more about, tidal energy development in Nova Scotia. Because understanding in-stream tidal energy involves a wide variety of specialized science, engineering, government and community knowledge the Toolkit is a large document. The purpose of this *Toolkit Guide* is to help the reader focus in on those sections that may be most useful to them. While it is difficult to predict exactly who will read the Toolkit (and what they will want to know) we have learned that most readers fall within one of three Groups.

Group A—Interested or Concerned Citizens/Interest Groups.

Group B—Potential Tidal Energy Developers/ Investors.

Group C—Business or Community Interested in the opportunities and benefits of tidal energy

Each Group has specific interests, needs, and constraints. Reading the entire Toolkit is the best way to get a comprehensive understanding of what tidal energy entails, we recognize that a reader may want to focus on a single issue.

We'll be upfront. This *Guide* makes assumptions. Some readers may not fit neatly within each of the three Groups. And what is important to each Group may change over time as technology changes and more experience with renewable energies in Nova Scotia is gained. Depending on what Group you are in, the *Guide* will point you towards specific parts of the Toolkit that may be useful.

The *Toolkit Guide* does not replace reading through the material in the Toolkit, rather it provides some sign posts to find your way through the *Community and Business Toolkit for Tidal Energy Development*. The Toolkit itself is a starting point. Staying informed through organizations and institutes, like the Acadia Tidal Energy Institute, Fundy Energy Research Network, the Halifax Marine Research Institute, Marine Renewables Canada, and the Fundy Ocean Research Centre for Energy, will ensure that you keep up to date on the evolution of in-stream tidal energy in Nova Scotia.



Photo Credit: Greg Trowse

Interested in Tidal Energy?

Are you a...

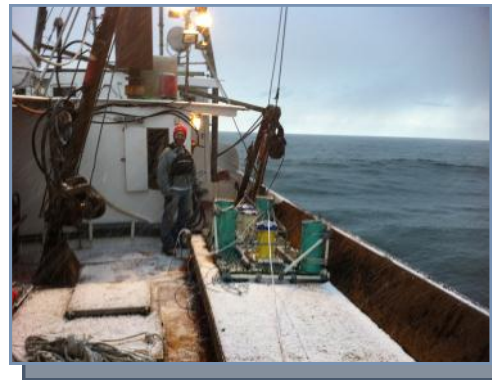
Group A

Curious or Concerned Citizen/Interest Group?



Group B

Potential Tidal Energy Developer or Investor?



Group C

Community or Business Interested in the Opportunities and Benefits of Tidal Energy?



Group A

Curious or Concerned Citizen/Interest Group?



I want to know about...

- **Jobs and Economic Development**
- **Environmental Impacts**
- **Impact on Energy Prices**
- **Where are in-stream tidal devices going to be placed?**

then read...

- ⇒ *Module 8: Opportunities and Strategies for Communities*
- ⇒ *Module 9: Opportunities and Strategies for Businesses*
- ⇒ *Module 11: Assessing the Potential Economic Impacts of a Five Megawatt Tidal Energy Development in the Digby*
- ⇒ *Module 1: Overview of Tidal Energy*
- ⇒ *Module 5: Environmental Risk*
- ⇒ *Module 7: Financial Evaluation and Cost of Energy*
- ⇒ *Module 1: Overview of Tidal Energy*
- ⇒ *Module 2: Measuring and Assessing the Tidal Resource*



Jobs and Economic Development

Tidal energy projects will generate jobs, and support economic development. The challenge is in understanding how many jobs, where, and for how long.

The *Toolkit* outlines the possible economic opportunities that tidal energy could present for communities and businesses across Nova Scotia. There are opportunities for a wide range of contractors, consultants, engineers, skilled tradespeople, and unskilled labour to be involved in in-stream tidal energy projects. Local businesses near a tidal project will also see increased demands for services and products, from office services to food and accommodations. A large amount of job creation activity will likely occur near tidal resources as much of the assessment, testing, construction, and installation work will need to be or will be more economical to be completed at or near the site of deployment. The development process for each tidal project will be different, as currently projects are site and technology specific.

The *Toolkit* outlines economic opportunities as well as strategies to capitalize on them in three separate Modules.

- **Module 8 – Strategies and Opportunities for Communities**
- **Module 9 – Strategies and Opportunities for Businesses**
- **Module 11 - Assessing the Potential Economic Impacts of a Five Megawatt Tidal Energy Development in the Digby Area of the Bay of Fundy**

Module 8: Strategies and Opportunities for Communities– Focuses on what possible benefits could accrue to communities that either engage in a tidal project through the Community Feed in Tariff Program (COMFIT) program, and/or are a community near a tidal project. The individual character of a community (labour market, infrastructure, business environment) and the project (large, small, community owned, partnership, etc.) will impact what benefits communities are able to attain. Read Module 8 – specifically section 8.2 *What are the possible benefits to the community?* to understand the possibilities. To understand the challenges associated with attaining benefits and the possible strategies to overcome them read sections 8.3 *Section 2: Strategies for Communities and Business to Garner Socio-economic Benefits*, 8.5 *Ownership Models*, and 8.7 *Checklist for Communities*.

Module 9: Strategies and Opportunities for Businesses– Outlines business opportunities in Nova Scotia. A large part of the Module is focused on identifying the supply chain elements of the emergent tidal energy industry. Module 9 provides valuable insight for businesses who want to understand where they may fit into the tidal energy supply chain (See 9.2 *Project Stages* for this information). Section 9.3 *Building the Tidal Energy Supply Chain* outlines ways to build the supply chain.

Module 11: Assessing the Potential Economic Impacts of a Five Megawatt Tidal Energy Development in the Digby Area of the Bay of Fundy– This module is a theoretical assessment of what the economic impacts would be from a 5MW tidal facility in the Digby area. The assessment is based on an input/output model which measures the impact of such a development on the whole economy of the Digby area. The assessment is theoretical and is based on the best information available at the time of analysis. Fundy Tidal Inc. currently has a 1.95MW, and two 500kW tidal energy projects planned for the Digby area.



Photo Credit: Elisa Obermann

Environmental Impacts

The long term environmental impacts of in-stream tidal energy are largely unknown at this point. To date, no significant impacts have been reported from any in-stream tidal energy device development site in the world. However, monitoring results from only a few demonstration sites in the US and UK are currently available.

If you are interested in looking at projects outside of Nova Scotia to get a broader perspective on environmental impacts here are some of the projects that have been in the water thus far:

- SeaGen by Marine Current Turbines in Ireland, (Since 2008)
- Verdant Power's Free Flow turbine in the East River in New York (Since 2012),
- Clean Current device at Race Rocks, in British Columbia (2006-2011)
- Ocean Renewable Power Company's TidGen in Cobscook Bay, Maine (Since 2012)

Module 5: Environmental Risk focuses on the possible impacts from in-stream tidal energy development on marine life and the marine environment.

- If you are interested in what the potential environment risks are – go to section *5.2.4 Multi-criteria Approach*.
- If you are interested in the relationships between risks and marine life and environment through different stages of in-stream tidal energy development - go to section *5.0 – Pathways of Effects models*.
- If you are interested in the possible steps for assessing the environmental risks of a proposed project you should read all of section *5.2 Steps to Planning for and Assessing the Environmental Risks of a Proposed Project*.

Additionally *Module 8: Strategies and Opportunities for Communities* briefly covers some potential environmental benefits to communities In section *8.2 What are the possible benefits to the community?*– *Table 8.5*.

Ultimately the main environmental benefits of tidal energy is shifting our energy system from one that is dependent on fossil fuels, to one driven by energy from free and non-polluting resources. The benefits will not be apparent immediately, but through renewables like in-stream tidal energy we are securing a better future.

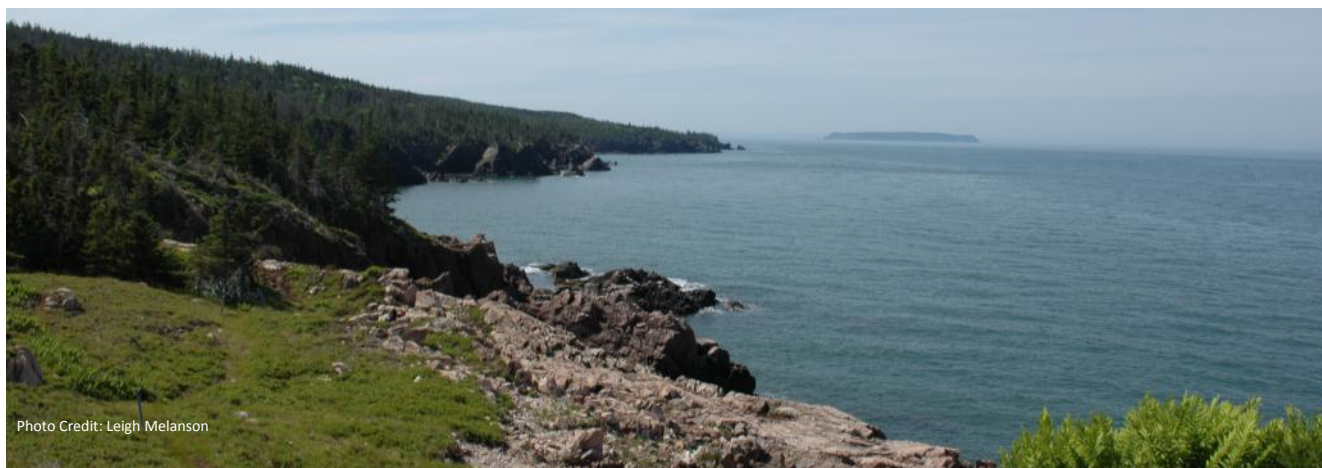


Photo Credit: Leigh Melanson

Impact on Energy Prices

If you are interested in what impact in-stream tidal energy will have on energy prices, you are not alone. Over the course of developing the *Community and Business Toolkit for Tidal Energy Development*, questions around how tidal energy will change the price of energy for ratepayers were very common.

No single section identifies what the impact will be on the cost of energy for ratepayers as tidal energy becomes a larger part of Nova Scotia's energy system. There are many variables that can, and will effect that cost over time, including technological advances, and regulations related to energy production.

If you are interested in the cost of tidal energy and what makes up this cost, you can read *Module 7: Financial Evaluation and Cost of Energy*.

Right now, in-stream tidal energy devices are expensive to build and install, but engineers and others are working to bring the down the costs order to make in-stream tidal energy more economical. The energy, being ever present in the tides, is free, but there are many costs involved in harnessing that energy, converting it to electricity, and getting it to the electrical grid. Equipment needs to be built, installed, and maintained, and data need to be collected and monitored. There are insurance premiums, wages, replacement parts, taxes, etc., to be paid for. In short, the energy will be expensive to start, but it is believed the cost will come down over time to be competitive with other renewables.

Overall though any renewable energy in terms of its costs is preferable to continued reliance on fossil fuels. For example in September 2000, the cost per barrel of crude oil was \$35 (USD) to \$62 (USD) in 2009 to \$105 (USD) a barrel in January, 2013 (International Monetary Fund, IMF Stats, retrieved March 12, 2013) and while prices rise and fall it is clear that there is a trend towards increasingly higher prices for oil. As oil and coal have to come from farther away, from harder to reach places, or require more complex systems to retrieve them, costs for these fuels will continue to rise.



Where will Tidal Energy Convertors be located?

Module 2: Measuring and Assessing the Tidal Resource the main tidal resource areas in Nova Scotia. But as technology and techniques for assessing the resource improve more sites may be identified in the future.

Currently there are five small scale (COMFIT) tidal energy projects planned as well as the testing facility at the Fundy Ocean Research Centre for Energy (FORCE) in Parrsboro. Fundy Ocean Research Centre for Energy (FORCE)— is a testing facility for large scale in-stream tidal energy devices and arrays. FORCE is located in Parrsboro, Nova Scotia. There are four berths available at FORCE for device testing. Three of the four berths currently have planned installations.

- A. Alstom
- B. Atlantis / Lockheed Martin / Irving Shipbuilding
- C. Marine Current Turbines / Minas Basin Pulp and Power
- D. Open for tender

The five COMFIT based projects – all being developed by Fundy Tidal Inc. will be located in Digby County and in the Cape Breton area. Three will be in Digby County—ranging from 500kW to 1.95MW. The sites are:

- Digby Gut,
- Petite Passage, and
- Grand Passage

Two projects are planned for Cape Breton ranging from 100kW to 500kW. The sites are:

- Barra Strait, and
- Great Bras d'Or Channel.

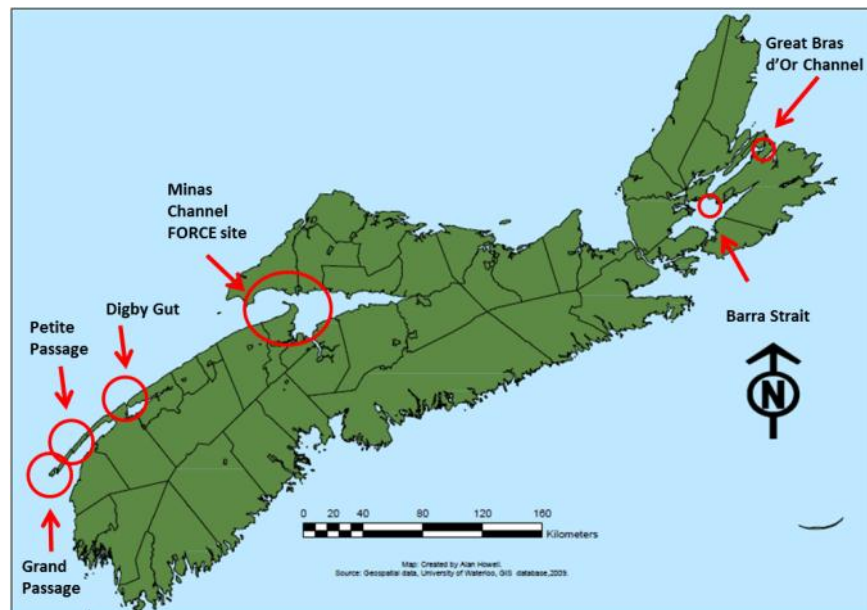


Photo Credit: Richard Karsten

Group B

Potential Tidal Energy Developer or Investor?



I want to know about...

- Regulations, Approvals and Permits
- Understanding what drives the cost of a tidal energy project
- Engaging stakeholders and getting community approval
- Project Risks
- Potential Funding Opportunities

then read...

- ⇒ *Module 4: The regulatory regime for tidal energy*
- ⇒ *Module 7: Financial Evaluation and Cost of Energy*
- ⇒ *Module 6: Stakeholder and Community Engagement*
- ⇒ *Module 5: Environmental Risk*
- ⇒ *Module 10: Financing, Government Supports, and Managing Risk*
- ⇒ *Module 10: Financing, Government Supports, and Managing Risk*



Photo Credit: Elisa Obermann

Regulations, Approvals and Permits

The specifics of the regulatory system for in-stream tidal energy in Nova Scotia are too complex to address in full here. The marine environment, and electricity production and distribution are very complex systems. As a consequence the regulatory system for tidal energy must properly address these complexities. Over time the plan is to make the system as straightforward and simplified as possible. *Module 4: The Regulatory Regime for Tidal Energy* – covers much of the important research and policy development that has led to the current regulatory regime. It also covers how the regulatory system is expected to evolve in the future. Section 4.1 *Snapshot of Provincial & Federal Support in Nova Scotia's Tidal Energy Sector* from Module 4 provides a brief overview of the steps taken in developing a regulatory system for tidal energy.

Currently, there exist three main ways to develop tidal energy projects that transmit energy to the electrical grid:

1. Community Feed-In-Tariff (COMFIT) - focused on small scale development typically under 500 kW
2. Tidal Array Feed-In-Tariff – focused on larger scale development over 500 kW that are transmission connected
3. Enhanced net-metering – for micro-scale development used at the individual household scale.

The COMFIT process has received the most attention and as such has the most comprehensive list of resources, all hosted on the Nova Scotia Department of Energy Renewables website <http://nsrenewables.ca/>

- The COMFIT Guide - Outlines COMFIT requirements and the
- The COMFIT Webinar
- Nova Scotia Power Incorporated interconnection information
- The COMFIT Toolkit
- An Environmental Checklist for COMFIT projects
- The COMFIT Directives (Numbers 3-8 apply to in-stream tidal)

application process.

The FIT Process is subject to many of the same regulatory requirements as the COMFIT process, however it continues to evolve.

Interconnection procedures—To gain access to the distribution (<500kW) or the transmission system (>500kW) developers will have to undergo a series of studies with Nova Scotia Power Incorporated. (NSPI). The purpose of these studies is to be sure that there is available capacity to safely distribute energy in the system. The initial assessments by NS Power does not guarantee a developer will receive the capacity indicated as being available at a given location. Nova Scotia Department of Energy's Renewables website links to much of the information about this procedure <http://nsrenewables.ca/comfit-technical-details>



Photo Credit: Richard Karsten

Environmental procedures — The environmental impacts on marine life and physical systems (flows, sediment movements, etc.) is still not fully understood, as such the environmental regulations for tidal energy are fairly broad.

Individual project proponents are expected to identify the characteristics of the local environment, sensitive areas, and systems and species that are at risk where they plan to develop tidal energy projects. The specifics of the site, and the scale of the project will determine the requirements for an environmental assessment. Currently, under Nova Scotia's Environment Act, projects that are 2 MW or greater trigger an environmental assessment. For more information, see <http://www.gov.ns.ca/nse/ea/>

Understanding what drives the cost of a tidal energy project

Tidal energy projects are currently very expensive to complete. *Module 7: Financial Evaluation and Cost of Energy* describes what must be included in the cost-benefit analysis of tidal energy projects – both small-scale tidal and large. It also describes the levelized cost of energy calculations, an industry-standard measure for comparing costs of energy from various sources. Module 8 also includes information on the various inputs needed for tidal energy projects, specifically sections 7.0.1 *Capital Expenditure (CAPEX)* and 7.0.2 *Operating Costs*

The cost of tidal energy is quite high due to a wide range of factors.

- The environment is quite difficult to operate in and requires specialized skills, vessels, and technologies.
- The cost of installing subsea cables is quite costly.
- There are no ‘off-the-shelf’ solutions for tidal energy, problems and how they are solved are site specific, which means costs for different projects can range quite dramatically.
- Financing is limited for different stages of technology development, meaning the rates to borrow capital to support a project can be prohibitive.

As with most emerging industries the costs and risks associated with tidal energy development are quite high. Over time technologies will improve and more experience will be gained through the successful installation and removal of in-stream tidal energy devices, and through this process costs should decrease.

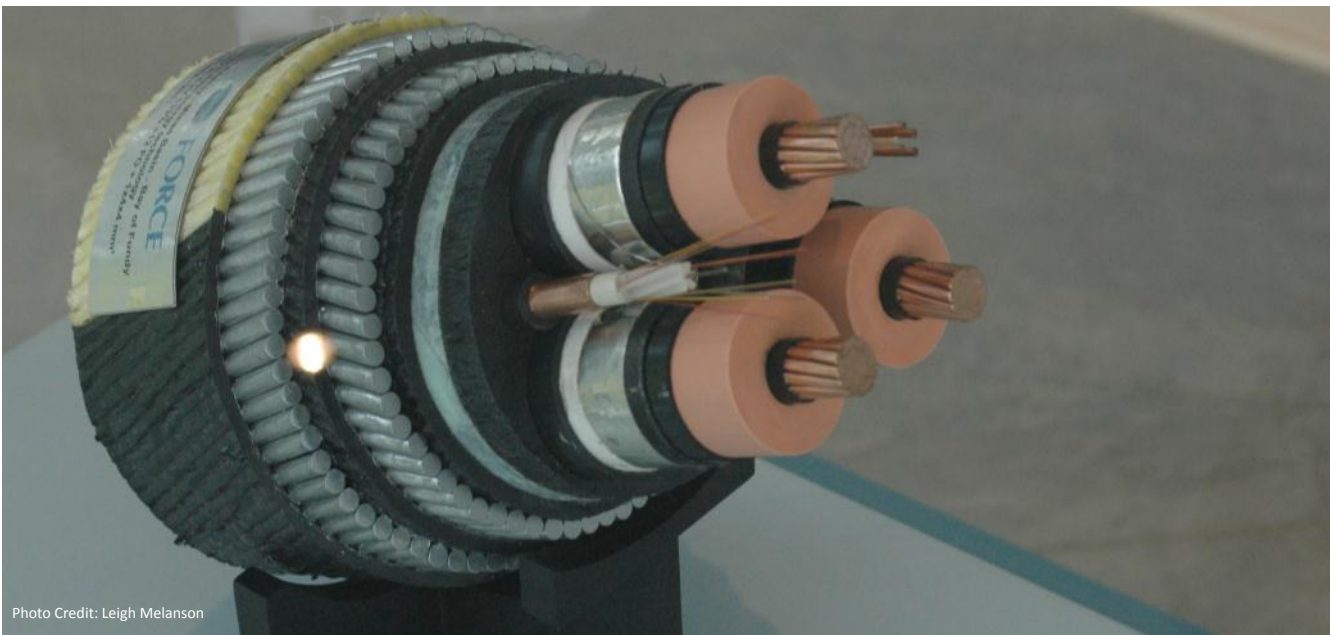


Photo Credit: Leigh Melanson

Engaging stakeholders and getting community approval

Engaging stakeholders is an essential step in ensuring successful projects. Engaging and consulting with stakeholders is now a standard practice in most renewable energy projects. It is also understood as a best practice, as not engaging can lead to significant delays in projects or in some cases the abandonment of a project altogether.

Module 6: Stakeholder and Community Engagement covers a broad range of principles and practices that have been used to support community buy-in for renewable energy projects. Module 6 breaks down engagement into several key sections:

- *6.3 Identifying Stakeholders*—outlines how to identify who to include in the engagement process.
- *6.4 Outlining the Engagement Strategy*—assists by outlining possible approaches to engagement.
- *6.6 Choosing the Right Tools and Techniques for Stakeholder Engagement*—provides examples of tools and methods for successful engagement.

In-stream tidal energy developers are required to engage with stakeholders, and are strongly encouraged to engage with the Mi'kmaq of Nova Scotia. This process is outlined in section *6.3.1 Engaging First Nation Stakeholders*.

The Toolkit also contains several case studies—Ocean Renewable Power Company (ORPC) has been used as an excellent example of excellent stakeholder and community engagement. The case study for ORPC is located in *Appendix B: Ocean Renewable Power Company (ORPC): Case Study*



Photo Credit: Greg Trowse

Project Risks

As an emergent technology and industry, there are many risks associated with in-stream tidal energy development. A brief list of these risks are:

- Site specific risk (characteristic's of a chosen site for development)
- Environmental risk.
- Financial risk.
- Political and Regulatory risk.
- Risk from Public Opposition.

Numerous other risks exist, such as supply chain and labour availability risk, i.e. not being able to get the things and workers you need to complete a project on time, and on budget. To get a good sense of these risks and what they mean for a project you may be planning, there are several sections of the Toolkit you should read.

Site specific risk— each site will be different and will have different challenges and opportunities. Each site must be investigated in detail. There are three Modules that outline some of the risks posed by different types of sites.

- *Module 1: Overview of Tidal Energy*
- *Module 2: Measuring and Assessing the Tidal Resource*

Environmental Risk – *Module 5: Environmental Risk* focuses in on what the possible impacts on marine life and environment from tidal energy development.

- If you are interested in what the potential environment risks are – go to section 5.2.4 *Multi-criteria Approach*
- If you are interested in the relationships between risks and marine life and the environment through different stages of in-stream tidal energy development - go to section 5.0 – *Pathways of Effects models*.
- If you are interested in the possible steps for and assessing the environmental risks of a proposed project you should read all of 5.2 *Steps to planning for and Assessing the Environmental Risks of a Proposed Project*.

Project and Financial Risk

Module 10: Financing, Government Supports, and Managing Risk – describes in detail the possible risks associated with in-stream tidal energy development. Section 10.4 – *Types of Risks* provides a thorough examination of risk.

Risk from Public Opposition and Not In My Back Yard Risk

Module 6: Stakeholder and Community Engagement covers a lot of material on how to avoid public opposition through fostering buy-in and engaging stakeholders and communities.

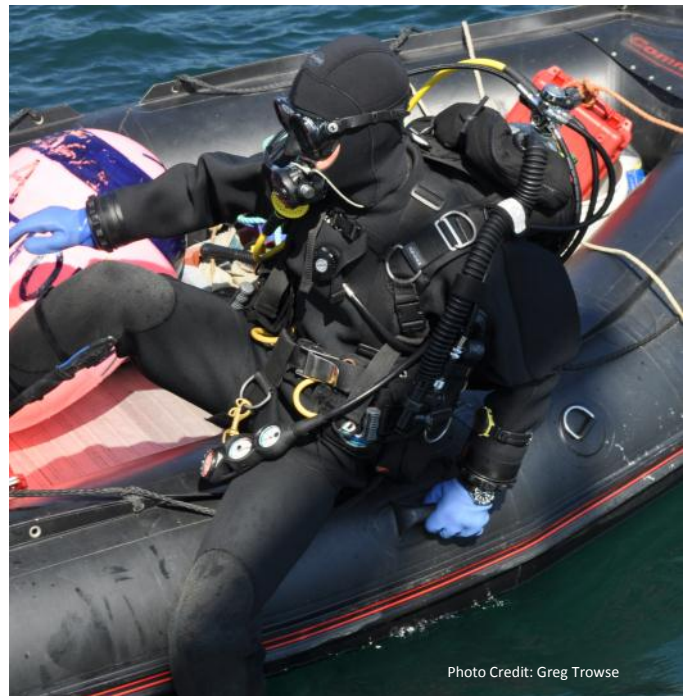


Photo Credit: Greg Trowse

Potential Funding Opportunities

The province of Nova Scotia and the federal government recognize that in-stream tidal energy will be an important contributor to climate change adaptation and regional and local energy security in the long term. At the same time there is the recognition that in-stream tidal will need a little help to get 'off the ground' or more accurately 'in the water'. To assist in the process of assisting technologies and industries that support a cleaner and more resilient society, both levels of government have established forms of funding and research support.

Module 10: Module 10: Financing, Government Supports, and Managing Risk - outlines many of these opportunities – in particular section 10.2 *Government Financing and Supports in Nova Scotia* provides a comprehensive list of currently available supports. As with any government based program they are subject to change and not all may not be available in the future.



Photo Credit: Leigh Melanson

Group C

Community or Business Interested in the Opportunities and Benefits of Tidal Energy?



I want to know about...

- **What benefits could I expect for my community?**
- **Supply Chain Opportunities: Do I have something to contribute to the tidal energy supply chain?**

then read...

- ⇒ *Module 8: Opportunities and Strategies for Communities*
- ⇒ *Module 9: Opportunities and Strategies for Businesses*
- ⇒ *Module 11: Assessing the Potential Economic Impacts of a Five Megawatt Tidal Energy Development in the Digby Area of the Bay of Fundy*
- ⇒ *Module 9: Opportunities and Strategies for Businesses.*



Community Benefits

How will the community benefit? What is in it for us?

We heard these kinds of questions frequently from town councillors, village commissioners, fishers, business owners and community members throughout Nova Scotia. Understandably people were interested in how the development of Nova Scotia's tidal energy resources could support community development.

The answer is not easy. The tidal energy industry is still developing. In practice benefits that may accrue in one area may not be available in another, due to geography, demography, local availability of skills and workers, port infrastructure, and many other factors. But because the industry is developing, there is still ample opportunity to capture economic or other benefits, such as opportunities for niche services, from fabrication to public relations and stakeholder engagement. There are also opportunities for communities to invest in projects—such as municipalities, or as interest groups. Some community benefits can be less tangible but equally valuable to economic benefits, such as greater social cohesion through having a shared vision for a cleaner energy future, or increased knowledge of local needs and concerns through stakeholder engagement. Nova Scotia's maritime tradition of fishing, shipbuilding, marine research, offshore oil and gas, and aquaculture provide a strong foundation to support the emerging tidal energy industry.

Examples of community benefits include:

- Potential for off-season employment for seasonal workers.
- Land rental or lease fees.
- Long term stability of energy prices .
- Research and Development opportunities .
- Detailed information on local biotic and abiotic marine and coastal systems .

There are three Module in the Toolkit that discuss ways that communities may benefit from tidal energy development.

- *Module 8: Opportunities and Strategies for Communities*
- *Module 9: Opportunities and Strategies for Businesses*
- *Module 11: Assessing the Potential*

Module 8: Opportunities and Strategies for Communities in particular focuses on the aspects of tidal energy that can benefit communities and how to best capture benefits or capitalize on opportunities. Module 8 is divided into two sections. The first section focuses on identifying the potential opportunities for communities. The second section *8.3: Strategies for Communities and Businesses to Garner Socio-economic Benefits* discusses community development strategies for harnessing benefits associated with tidal energy development.



Photo Credit: Richard Karsten

Supply Chain Opportunities

Project Development Stages, Infrastructure and Vessels, and Labour Needs

There is currently no singular or group of In-stream tidal energy devices or designs that can be used in all or most conditions. This diversity means that many aspects of tidal energy development is site specific, what works in the Minas Channel, may not be the most appropriate for sites in the United States or Korea. As such all the inputs (tools, infrastructure, technology, cables, etc) and the processes for site assessment, monitoring, and preparation for installation of a device will be different depending on the site.

Module 9: Opportunities and Strategies for Businesses discusses the many stages and inputs that can be required for a tidal energy project. To understand what the tidal energy supply chain consists of read section 9.2: *Project Stages*. Section 9.3 *Building the Tidal Energy Supply Chain* outlines ways to build the supply chain. The table below includes summary information from Module 9 and section 9.2 Project Stages.

| Stages of Development | Infrastructure and Vessels | Labour Needs |
|--|--|--|
| <p>The primary stages of a Tidal Energy Converter project include:</p> <ul style="list-style-type: none"> •Research and development •Site screening and project feasibility •Planning •Project design and development •Project fabrication •Construction, installation, and commissioning •Operations and maintenance •Decommissioning | <p>Infrastructure and vessels can include:</p> <ul style="list-style-type: none"> •Wet and dry ports with lay down areas •Assembly and maintenance yards •Cranes and heavy lifting equipment •Barges and specialized vessels such as dynamic positioning vessels •Underwater Remote Operated Vehicles (ROV's) | <p>Labour needs will include many of the following:</p> <ul style="list-style-type: none"> •Project managers •Engineers (naval, electrical, mechanical) •Biologists, environmental impact assessment professionals, and various other specialists in marine and life sciences •Vessel operators •Marine construction workers •Safety personnel •Core trades – welders, electricians, metal fabricators, tool and die, etc. •Stakeholder engagement facilitators •Financing and business development experts |

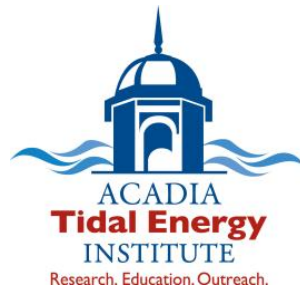


Photo Credit: Leigh Melanson

Thank you for reading.

This *Guide* is intended to help readers navigate the *Community and Business Toolkit for Tidal Energy Development*. Learning about and understanding novel technology and an emerging industry requires a lot of research, time, and inquisitiveness. It is important to note that the industry is just developing and that opportunities will continue to unfold as time passes. Those interested in in-stream tidal energy after reading those portions of the *Toolkit* most relevant to them should meander through the resources and links provided in the *Toolkit*. There is a wealth of knowledge that can be gained from looking at experiences both local and international.

We hope you found what you are looking for through this *Guide*. The *Toolkit* is intended to be a living document, and as such will be updated periodically overtime, so please check back often to see what we are up to.



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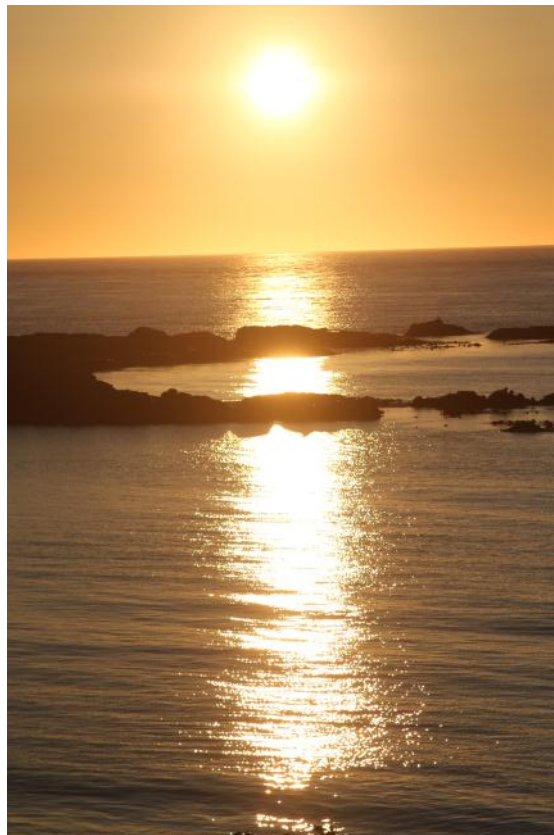


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