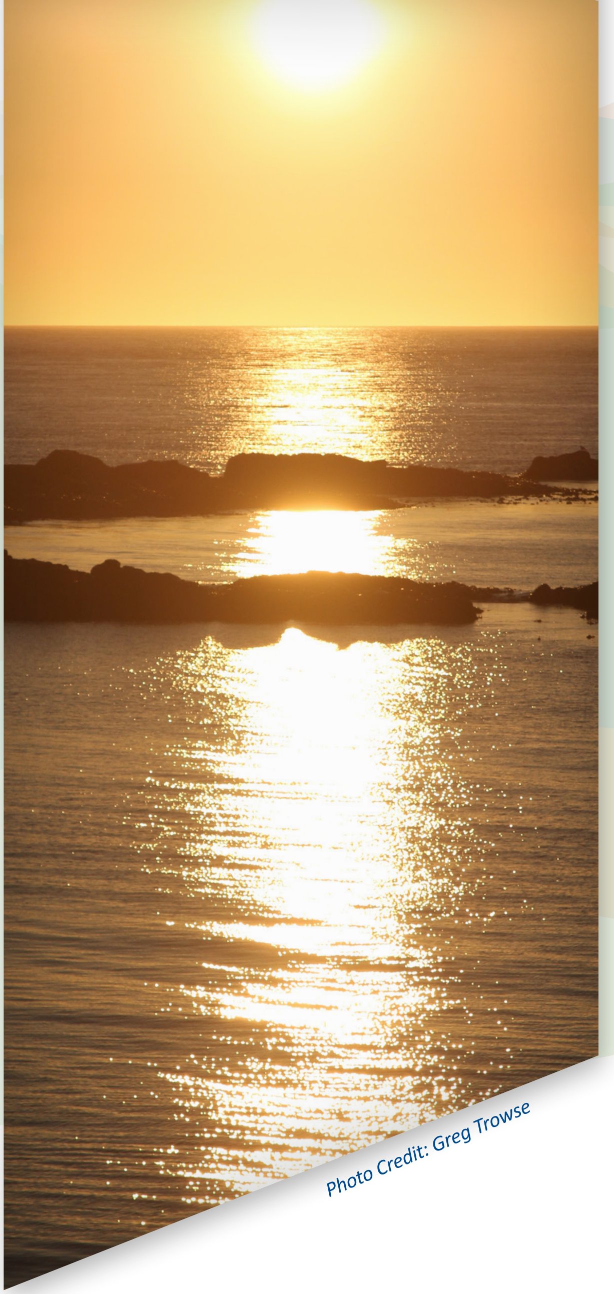

Photo Credit: Greg Trowse

10 FINANCING, GOVERNMENT SUPPORTS, AND MANAGING RISK

10 - FINANCING, GOVERNMENT SUPPORTS, AND MANAGING RISK

Author: Dr. Shelley MacDougall

WHAT DOES THIS MODULE COVER?

Developers, lenders, and investors will require some level of assurance the tidal energy project is likely to be profitable over time. This section identifies sources of financing, government supports, risks, and methods of reducing or spreading the risks of in-stream tidal energy project development.

This module outlines the financial considerations of developing a tidal energy resource:

- What financing can be accessed at various stages of the project?
- What are the risks at the various stages of development, such as technological, delivery, labour, policy, price volatility (materials, production costs), and weather?
- By what means can these risks be mitigated or shared to reduce the exposure of any one party to the risks that would otherwise deter investment?

IS THIS MODULE FOR YOU?

This module is for anyone concerned with the financial viability and risks of tidal energy projects, such as developers, policy makers, insurers, equity investors, and lenders.

10.0 - FINANCING IN THE STAGES OF TECHNOLOGY AND PROJECT DEVELOPMENT

Beyond the engineering challenges and environmental and societal hurdles, a significant barrier to commercializing tidal energy is financing. Through the stages of development of new technology, there are times when financing is scarce. Exacerbating this is competition for funding from other renewable technologies as well as mature technologies that generate electricity from fossil fuels and the absence of a price on carbon dioxide emissions. This section briefly describes the financing typically found at the various stages of development as they apply to tidal energy.

10.0.1 - STAGES OF TECHNOLOGY DEVELOPMENT, PROJECT DEVELOPMENT, AND COMMERCIALIZATION

The stages of technology and project development are defined differently in various reports, studies, and articles. In an attempt to reconcile some of the categorizations and familiarize the reader with various terms used in the industry, Table 10-1 lists the activities undertaken to develop and commercialize new technology and includes two common groupings of the activities. The table also includes types of financing commonly used for these stages of technology development, as well as suitable government supports that provide incentives or assistance to developers or assurances to lenders and equity investors. These sources and supports will be discussed further in subsequent sections.

The process begins with research and development of the technology. The stages of technology development and "Technology Readiness Levels" will be described in a later section.

Following the technology development stage are pre-commercialization activities: feasibility assessments, planning, permitting, community consultation, and project design. All of these activities require financing, which generally comes from the developer's own resources, venture capital, and government supports in the form of loan guarantees, incubators, and tax incentives.

Table 10-1: Stages of Technology and Project Development, Sources of Financing, Government Supports and Incentives

STAGE	ACTIVITIES	ORECCA* STAGES	ECOFYS** STAGES	SUITABLE SOURCES OF FINANCING	SUITABLE GOV SUPPORTS & INCENTIVES
Research & Development (technology)	Energy Conversion technology Energy Storage/ Usage Prototype testing Investment	Pre-feasibility	R&D	Balance sheet financing, angel investment	R&D grants, university funding, government labs, incubators, R&D tax incentives
Feasibility Assessment (project)	Geophysical Oceanographic Heritage Environmental Competing use Financial Feasibility Community consultation		Pre-commercialization	Balance sheet financing, venture capital, private equity	Guarantees, public-private venture capital, soft and convertible loans
Planning	Project planning Permits Insurance Finance Legal Power purchase agreement Community consultation	Design and Development			
Design	Project design Offshore design Mechanical design Hydrodynamic design Electrical system design Civil (onshore design) Control system design				

STAGE	ACTIVITIES	ORECCA* STAGES	ECOFYS** STAGES	SUITABLE SOURCES OF FINANCING	SUITABLE GOV SUPPORTS & INCENTIVES
Manufacture	Moorings Offshore floating structure Energy coupling system Power generation equipment Power transmission equipment Navigation/Common equipment Control equipment Energy storage systems Onshore structures construction Resource assessment equipment Component testing Component verification	Construction	Commercialization	Private equity, bank senior debt, mezzanine (subordinate) debt, project financing	Loan guarantees, contingent grants, stable/long term government policies
Installation	Onshore assembly Cable laying Transportation Offshore construction Civil (onshore engineering) Environmental monitoring				
Operation & Maintenance	Integrity management Performance evaluation Recovery and repair Reliability management Structural monitoring Environmental monitoring	Operation			Feed-in tariffs, renewable energy credits, power purchase agreements

STAGE	ACTIVITIES	ORECCA* STAGES	ECOFYS** STAGES	SUITABLE SOURCES OF FINANCING	SUITABLE GOV SUPPORTS & INCENTIVES
Decommissioning	Offshore disassembly Transportation Recycling/ waste disposal Refurbishment Environmental compliance	Decommissioning	Decommissioning		

*Offshore Renewable Energy Conversion Platform Coordination Action
**Ecofys Investments B.V., headquartered in the Netherlands.
Sources: ORECCA 2011, p51-54; EcoFYS 2011, p.100.

Once the pre-commercialization activities are complete, the go/no go decision is made. Large amounts of capital are required with the decision to proceed. For some projects to be financially feasible, they need to be built in arrays (multiple TEC devices) to benefit from economies of scale. The large amounts of capital and duration of the project put the project beyond the capability of venture capitalists and usually beyond the capability of the developer to go it alone. Equity investors and bank financing are needed. If the project goes ahead (commercialization), the cable is laid, and devices are manufactured and installed. Operations and maintenance are then ongoing for the life of the project, after which time, the equipment is decommissioned (or repowered).

10.1 - METHODS OF FINANCING

This section describes methods of financing that are suitable at the various stages of development and commercialization. In subsequent sections, methods of financing and government supports available in Nova Scotia will be described.

10.1.1 - BALANCE SHEET FINANCING

Balance sheet financing, also known as corporate financing, is simply the project developer investing in the renewable energy project from its own cash, financed either from existing or new equity and debt. The loans are secured by the developer's general assets. This is often the only financing option for technologies without a track record in the R&D and pre-commercialization stages.

Advantages of balance sheet financing include:

- The interest rate on the corporate debt raised is cheaper than it would be on debt raised specifically for the new technology project since it reflects the general credit risk of the developer and its own debt/equity ratio, rather than the risk of the stand-alone project.

- Without involving other investors, balance sheet financing involves fewer parties, so the developer has more control over the project.

- There are no additional loan covenants, only the ones the company must usually adhere to.

FOUNDATIONAL CONCEPT: STAGES OF DEVELOPMENT

For more information on financing at the various stages of development, refer to Weiser & Pickle (1998); Ecofys (2011); ORRECA (2011), www.renewableenergyworld.com, www.windenergythefacts.com.

FOUNDATIONAL CONCEPT: WHAT IS VENTURE CAPITAL?

Venture capital is a subset of private equity capital. Venture capital is provided by a company that acts as a financial intermediary, pooling investors' capital and investing in a portfolio of private companies (i.e. companies whose shares are not traded in the public equity markets). The venture capital organization, or "VC," takes an active role in monitoring and overseeing management activities. The VC takes an equity stake in high-growth potential companies with the expectation of cashing out through either a buyout or initial public offering (IPO) in the public equity market within 4 to 7 years.

Disadvantages include:

- The developer has full exposure to the project risk.
- Many developers do not have sufficient capital to go it alone on the project.
- Many developers do not have a strong track record for large projects (Weiser & Pickle, 1998).

While balance sheet financing is the most common form of financing the early stages of new technology, many developers are simply not large enough nor have sufficient cash flow to carry out all the steps to completion.

10.1.2 - VENTURE CAPITAL

Venture capital organizations (VCs) raise capital from a variety of investors, all of whom have a high risk tolerance, and include insurance companies, pension funds, mutual funds, and high net worth individuals (Ecofys, 2011, p. 231). There are also examples of government-funded venture capital and public-private venture capital.

VCs invest in new technologies or new markets in the early stages. In the case of new technologies, venture capital comes into play at the R&D or pre-commercialization stages (Ecofys, 2011). However, commercializing tidal energy is very capital intensive and involves long investment horizons; most developers and venture capitalists do not have sufficient resources to finance that stage of the project. This is a significant barrier to advancing the development of new technologies such as TEC. For more mature technologies, project financing is an option, but for nascent technologies, it remains hard to get.

10.1.3 - PROJECT FINANCING

For mature technologies, such as wind power, project financing is available. Building a commercial-scale wind energy farm requires very large amounts of capital, well beyond what the developers can finance. Bank loans are needed and project financing is a common arrangement for acquiring debt financing.

Project finance is typically a late-stage means of financing. Banks have little-to-no tolerance for technology risk, so project financing is generally not available for projects until the technology is proven. As well, power purchase agreements, feed-in tariffs and renewable obligation standards usually need to be in place since repayment of the loans depends on the cash flows of the project.

VIGNETTE: ALSTOM HYDRO AND BALANCE SHEET FINANCING

Author: Brandon Greer

In 2009, worldwide hydro power leader, Alstom Hydro, signed a deal with the British Columbia-based Clean Current Energy, a private company specializing in the design and testing of tidal energy technology. The deal gave Alstom an international license for ocean and tidal stream applications for one of Clean Current's patented technologies. The technology is a horizontal-axis ducted turbine with a direct-drive, variable-speed permanent magnet generator, designed to be equally effective in both directions, so as to fully utilize two-way tidal currents. In December 2010, Alstom revealed the characteristics of BELUGA-9, its first tidal energy-generating turbine, to be tested at the FORCE site in the Bay of Fundy.

As a larger company with more resources and access to capital markets, Alstom's support allowed Clean Current, the smaller technology organization, to further develop its technology. While the project received some financial support from Sustainable Technology Development Canada, the majority of the project has been funded from Alstom's balance sheet.

Sources:

Alstom Press Release, 2009. "Alstom enters the Ocean Energy market, reinforcing its renewable energy portfolio," (http://www.cleancurrent.com/media/pressreleasealstom.htm)

Alstom Press Release, 2010. (http://www.cleancurrent.com/media/Alstom%20announcement/Alstom%20Press%20Release%20Dec%203%202010.pdf)

The project developer and equity investors will be looking for as high a debt/equity ratio as possible since the cost of debt is cheaper than equity and is tax deductible. The amount of the loan provided will depend on the estimated energy production and banks will be conservative about the assumed energy projections.

Project financing is generally negotiated as two loans. First is a construction loan. Once construction is completed, the construction loan and interest owing on it is converted to a mortgage-style term loan. There are many more risks during the construction phase (construction risks, supply chain constraints, weather risk, and coordination issues inherent in working with multiple contractors, etc.), so the rate of interest is higher than for the subsequent term loan. It is disbursed in installments as project milestones are met.

NOVA SCOTIA IN CONTEXT: INNOVACORP

Innovacorp is Nova Scotia's early-stage venture capital organization. Its goal is to help emerging Nova Scotia knowledge-based companies commercialize their technologies and succeed in the global marketplace. They are especially interested in the information technology, life sciences, and clean technology industries. Early-stage investment is at the core of their business model, but their team is about more than just money. They provide hands-on business advisory services, tailored to meet the unique – and evolving – needs of each of the promising technology companies in their portfolio. They also give entrepreneurs access to world-class incubation facilities and an international network of expert advisors (Dawn House, Innovacorp).

FOUNDATIONAL CONCEPT: WHAT IS PROJECT FINANCING?

Project Financing is a method by which the renewable energy project is legally set up as separate, stand-alone company. Equity investors and lenders finance the project company. The equity investors, also known as sponsors, include the developer and other investors taking an ownership stake. The lender(s) is a bank or syndicate (group) of banks that provide approximately 60-80% of the financing through a loan. The loan is considered non-recourse: it is secured by the project assets and the interest and principal is paid from the project's cash flows. The lender does not have recourse to the equity investors/developer if the project fails. If the project is unable to service the debt, the lender can seize the assets and either operate the project or sell it to repay the debt. For large projects, the debt can be raised by issuing bonds to institutional investors. The bonds, however, must be rated as investment grade (Baa3/BBB- or better*). The project company can be structured as a corporation, general partnership, or limited partnership, with the sponsors investing and receiving benefits accordingly (dividends, tax credits, cash flow).

*For a description of bond ratings, go to: http://www.bondsonline.com/Bond_Ratings_Definitions.php).

The advantages of project financing include:

- The amount of equity capital needed from the project developer/sponsor is less than with balance sheet financing.
- The loan is non-recourse, thereby limiting the losses the developer/project sponsor must absorb if the project fails.
- Though it is usually more expensive than balance sheet financing, developers consider the reduced risk exposure worth the extra cost.
- The project does not have a substantial impact on the developer's balance sheet or credit worthiness.
- Small- to medium-sized developers can pursue several projects simultaneously.
- Higher debt/equity ratios are possible, allowing for more use of cheaper, tax-deductible debt.

The disadvantages include:

- The interest rates on project finance debt are higher than for balance sheet financing, due to the risk of the project versus the general credit risk of the sponsor.
- Project financing is difficult to arrange due to the number of parties involved and due diligence required. There are large transaction costs of arranging various contracts, such as legal fees (Weiser & Pickle, 1998).
- Availability of project financing has been less in recent years, due to the global credit crisis.

Tidal energy is still at the pre-commercial stage and still has significant technology risk, forcing balance sheet financing by project developers. This is the point at which there is a financing gap, often called the "technology valley of death." Venture capitalists are willing to take on the risk at this stage of technology commercialization, but they usually do not have sufficient funds to undertake such a large project. They also require a quicker return of their capital than the typical renewable energy power project (Bloomberg, 2010). Banks are not willing to take on technology risk, so pre-commercial technologies are not able to obtain project financing until the technology has an established track record. Wave energy is also facing this financing gap, whereas onshore and offshore wind energy have sufficient track records to be able to get project financing.

10.2 - GOVERNMENT FINANCING AND SUPPORTS IN NOVA SCOTIA[1]

In the province of Nova Scotia, there are a number of programs that will support the development of TEC technology and tidal energy projects. They include research and development grants, post-doctoral fellowships, feed-in tariffs, a public-private venture capital fund and investment tax credits. Some are provided by the Government of Canada, and some by the Government of Nova Scotia. Creating the impetus for companies and universities to embrace these, however, was the Environmental Goals and Sustainability Act, which set aggressive targets in Nova Scotia for generating electricity from renewable sources.

The Province of Nova Scotia, through its 2007 Environmental Goals and Sustainability Act and its 2010 Renewable Energy Plan, has committed to deriving more electricity from renewable sources. This renewables obligation is to derive 25% of its electricity from renewable sources by 2015 and 40% by 2020. This legislation obliges Nova Scotia Power, Inc. to both invest in renewable energy production and purchase energy from independent producers to achieve these targets. The renewables obligation provides an important backdrop for other initiatives and incentives and resolves some amount of uncertainty for investors. Government supports available in Nova Scotia from the governments of Canada and Nova Scotia are summarized below.

10.2.1 - COMMUNITY ECONOMIC DEVELOPMENT INVESTMENT FUNDS (CEDIF) – PROVINCE OF NOVA SCOTIA

Community Economic Development Investment Funds (CEDIFs) support economic development in Nova Scotia by retaining investment capital in the region and returning financial benefits to the local community. Though not designed for renewable energy specifically, CEDIFs have been used to develop community-owned wind energy projects in Nova Scotia and are applicable to small-scale tidal energy projects.

A CEDIF is an investment fund, created by selling units to members of a defined community for the purpose of developing local, for-profit corporations or co-operatives. Investors receive a 30% tax credit from the Nova Scotia government in the tax year the investment is made. The investments are also RRSP-eligible. Investors are required to hold their shares for five years (an earlier disposition of the units would require the investor to pay some of the tax credit back to the province). Eligible CEDIFs may generate subsequent tax credits for investors who hold their shares for longer than five years. As shareholders, investors may also receive dividends and capital gains.

CEDIFs play a particularly important role in tidal energy development with the introduction of the Community Feed-in Tariff (COMFIT), announced by the Government of Nova Scotia in 2010.

10.2.2 - FLOW-THROUGH SHARES

Flow-through shares, which have similar attributes to common shares, can help a developer finance a tidal energy project by providing tax savings to flow-through share owners.

Flow-through shares are newly issued shares of an incorporated company whose principal business is, in this case, developing renewable energy. The company is called a principal-business corporation (PBC). A flow-through share is a share of capital stock of the principal business corporation, issued under a flow-through share agreement. Flow-through share owners can be individuals or corporations.

[1] Note: Supports listed here are largely dependent on government policy and as such are subject to change. The information here reflects information available as of January, 2013.

In a flow-through share agreement, the PBC agrees to pass on, or “renounce,” its eligible expenses, along with their associated tax deductions, directly to the investors. Of particular interest are the Canadian Renewable and Conservation Expenses (CRCE). These capital expenditures (Capital Cost Allowance Class 43.1 or 43.2) are subject to accelerated depreciation for tax purposes, as will be discussed later. Whereas the PBC may not have income against which to deduct these expenses, the flow-through share owner can then claim the expenses against his/her/its own income and reduce taxes payable.

For more information on flow-through shares, go to http://www.cra-arc.gc.ca/tx/bsnss/tpcs/fts-paa/menu-eng.html.

10.2.3 - FEED-IN TARIFFS – PROVINCE OF NOVA SCOTIA

A feed-in tariff is a guaranteed rate paid per kilowatt hour for energy to producers whose energy is delivered to the provincial electricity grid. The tariffs are guaranteed for a fixed period of time, thereby reducing price uncertainty for energy project developers and their investors. In 2011, the Nova Scotia government announced the feed-in tariffs for community-owned renewable energy projects. Feed-in tariffs for larger, commercial-scale tidal projects are to be announced in 2013.

The community feed-in tariff (COMFIT) applies to projects being developed by municipalities, First Nations, co-operatives, universities, CEDIFs, and not-for-profit groups. The rates to be paid (tariffs), announced by the Nova Scotia Utility and Review Board in 2011, were established based on estimates of the cost of producing the renewable energy, plus a 15% rate return on investment to compensate investors for the risk. For the development stage of small-scale, in-stream tidal energy projects (generating up to 0.5MW), the COMFIT rate is 65.2 cents per kWh (http://ns.renewables.ca/comfit-communities). This rate will be revisited by the Utility and Review Board in 2014.

The COMFIT program began accepting applications in September 2011 and the first round of project approvals was announced in December 2011. Once a community project is approved for a community feed-in-tariff, the proponents have to complete various feasibility assessments and planning and design activities, engage with affected communities, and arrange financing. To take up the COMFIT, the proponents of small-scale in-stream tidal projects must be delivering electricity to the grid within five years of COMFIT approval.

Information about Nova Scotia Feed-in Tariffs can be found at http://ns.rewnewables.ca . A comprehensive COMFIT guide is available at: http://nsrenewables.ca/sites/default/files/ns_comfit_guide_sept_19_2.pdf.

10.2.4 - MI’KMAQ PARTNERSHIPS AND ACCESS TO CAPITAL

(Co-authored with Eric Christmas, Mi’kmaq Energy Advisor)

The Mi’kmaq of Nova Scotia have been active participants in the renewable energy sector on many fronts. Most significant are the development of policies regarding the creation of Mi’kmaq partnerships and the availability of Mi’kmaq lands that would qualify under the COMFIT program.

The Mi’kmaq Renewable Energy Strategy was developed in 2011 to complement the provincial strategy. It was written to not only enlighten the communities and leadership of the potential renewable energy technologies available (including tidal), but also identify the potential for long-term financial benefits arising from project developments, both on and off Mi’kmaq lands.

The Assembly of Mi’kmaq Chiefs’ work with various levels of government and the corporate sector has secured access to investment capital. Planning is underway for The Mi’kmaq Renewable Energy Development (MRED) fund. The Assembly is also negotiating with government for access to affordable, below-market rate, long-term financing. Information about the Mi'kmaq Renewable Energy Strategy can found at www.mikmaqrights.com.

10.2.5 - CLEAN TECHNOLOGY FUND (VENTURE CAPITAL) – PROVINCE OF NOVA SCOTIA

In 2011, the Nova Scotia government announced a new $24 million Clean Technology Fund for early stage companies developing a "diverse range of products and services intended to provide superior performance at lower costs, while minimizing negative ecological impact and using natural resources responsibly" (Premier D. Dexter, September 2011). The fund is managed by Innovacorp and is targeted at companies that focus on alternative and renewable energy, energy savings, greenhouse gas reduction, capture and storage, environmental remediation, and air quality and emissions management (http://innovacorp.ca/news/news/nova-scotia-clean-technology-start-wins-international-competition, accessed May 22, 2012).

As noted earlier, the financing needed by project developers of tidal energy generally does not fit with the scope and scale of venture capital, due to the large dollar amount needed and the investment horizon.

10.2.6 - SD TECH FUND - SUSTAINABLE DEVELOPMENT TECHNOLOGY CANADA

Sustainable Development Technology Canada (SDTC) recognized the funding gap in the innovation cycle and developed a fund to bridge the gap. The SD Tech Fund contributes to late-stage technology development and pre-commercial demonstration of clean technology. SDTC's aim is to reduce the risk of investing in clean technologies by providing funding and assistance to the point in the innovation process when venture capital or industry will invest. SDTC does not take an equity stake, hold the intellectual property, or require repayment (for more information, please go to: www.SDTC.ca).

10.2.7 - NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL OF CANADA

The Natural Sciences and Engineering Research Council of Canada provides technology R&D support through partnership grants and student funding programs. These are described briefly below.

10.2.7.1 - PARTNERSHIP GRANTS

NSERC Partnership Grants fund collaborations between companies and university researchers to conduct technology research and development activities. The various grants under this category are:

Interaction Grants – The maximum Interaction Grant is $5,000 for researchers' travel to meet with Canadian-based companies to identify a company-specific problem solvable through collaborative research.

Engage Grants - NSERC contributes up to $25,000 for 6 months to fund direct research costs for specific, short-term industrial R&D challenges.

Collaborative Research & Development Grants – This grant covers up to half the costs of R&D projects that provide the company access to specialized facilities, knowledge, and students. The company contributes the remaining funds.

Strategic Project Grants – This program pertains to areas of strategic importance to the country. NSERC contributes a substantial portion of direct costs for the development of strategic knowledge. At the time of writing, areas of strategic interest are: Environmental Science and Technologies, Information and Communications Technologies, Manufacturing, and Natural Resources and Energy (http://www.nserc-crsng.gc.ca/Professors-Professeurs/RPP-PP/SPG-SPS_eng.asp, accessed May 22, 2012).

10.2.7.2 - NSERC STUDENT FUNDING PROGRAMS

NSERC provides funds to hire students and post-doctoral fellows.

Industrial R&D Fellowships Program – NSERC contributes up to $30,000 per year for up to two years to hire doctoral graduates to conduct a research project at the host company's facilities. The host company must contribute at least $10,000 per year.

Industrial Post-Graduate Scholarship Program – NSERC contributes up to $15,000 per year so a company can hire a masters- or doctoral-level science and/or engineering student to conduct research at the company's research facilities. The host company must contribute at least $6,000 and supervise the student's research for at least one day per week.

Industrial Undergraduate Student Research Awards Program – NSERC contributes $4,500 for a 16-week term so a company can hire an undergraduate student to assist with a research and development project.

For more information on NSERC partnership grants, go to www.nsercpartnerships.ca.

10.2.8 - NATURAL RESOURCES CANADA ECOENERGY INNOVATION INITIATIVE (ECOEII)

The ecoENERGY Innovation Initiative program is focused on research projects for government, academic, and private sector projects with external public and private stakeholders. There are five strategic priority areas: Energy Efficiency, Clean Electricity and Renewables, Bioenergy, Electrification of Transportation, and Unconventional Oil and Gas. Both research and development and demonstration projects are funded. Two calls for proposals were made, in 2011 and 2012, with no others announced at the time of this writing (http://www.nrcan.gc.ca/energy/science/2003, accessed June 3, 2012).

10.2.8.1 - PRODUCTIVITY AND INNOVATION VOUCHER PROGRAM (P&I) – NOVA SCOTIA DEPARTMENT OF ECONOMIC AND RURAL DEVELOPMENT AND TOURISM

The Productivity and Innovation Voucher Program (P&I), offered by the Nova Scotia Department for Economic and Rural Development and Tourism, provides small- and medium-sized businesses with "credits" to pay university researchers for their expertise. There are two types of P&I vouchers: Tier 1 vouchers (maximum $15,000); and for previous voucher recipients, Accelerated Program vouchers (maximum $25,000). Recent P&I vouchers have been used for feasibility studies, industrial/process engineering services, applied research, prototyping, product design, eco-efficiency audits, and scientific/technology-related advice and support (http://www.gov.ns.ca/econ/pnivouchers/, accessed Jan. 18, 2013).

Eligible businesses are those registered and operating in Nova Scotia with fewer than 100 employees, part or all of whom reside in the province. Proposals are accepted for review by the Department of Economic and Rural Development and Tourism each September.

10.2.9 - MITACS

Mitacs offers programs that give Canadian companies access to research expertise. The Mitacs-Accelerate program contributes $7,500 toward the cost of hiring a graduate student or postdoctoral fellow for four months to work on a business research project. The Mitacs-Elevate program, presently being piloted in Ontario and British Columbia, co-funds post-doctoral fellowships for work on major industrial research projects. For more information, go to www.mitacs.ca/resources-companies.

10.2.10 - INDUSTRIAL RESEARCH ASSISTANCE PROGRAM - NATIONAL RESEARCH COUNCIL OF CANADA (NRC-IRAP)

The NRC-IRAP provides technical and financial assistance to small- and medium-sized businesses to develop and commercialize technologies. Their services include technical and business advisory services, financial assistance, and networking with industry experts and potential business partners. The IRAP cost-shares salary and contractor costs for an eligible/approved research and development project. For more information on NRC-IRAP, go to http://www.nrc-cnrc.gc.ca/eng/ibp/irap.html.

10.2.11 - PRODUCTIVITY INVESTMENT PROGRAM (PIP) – NOVA SCOTIA DEPARTMENT OF ECONOMIC AND RURAL DEVELOPMENT AND TOURISM

The Productivity and Investment Program (PIP) is designed to help Nova Scotia businesses and workers become more productive and innovative, with the goal of improving global competitiveness. The PIP has two incentives suitable for tidal energy development projects: the Capital Investment Incentive (CII) and the Workplace Innovation and Productivity Skills Incentive (WIPSI). Each of these is described below. More information on these incentives can be found at http://www.gov.ns.ca/econ/pip/.

10.2.11.1 - CAPITAL INVESTMENT INCENTIVE (CII)

The Capital Investment Incentive is designed to assist with the cost of “technologically-advanced machinery, clean technology, equipment, software and hardware” and will contribute 20% toward the cost. “Preference is given to corporations that export out of Nova Scotia, but consideration will be given to non-exporting corporations if a compelling case can be presented.” Eligible industries include those undertaking the development of non-traditional sources of energy. http://www.gov.ns.ca/econ/pip/cii/

10.2.11.2 - WORKPLACE INNOVATION AND PRODUCTIVITY SKILLS INCENTIVE (WIPSI)

The Workplace Innovation and Productivity Skills Incentive can be used by businesses and industry associations to support the costs of training employees for new technology and innovative processes. It is cost-shared (50%) for industry associations and larger businesses, and fully funded for small businesses for the first $10,000, and cost-shared beyond that amount. http://www.gov.ns.ca/econ/pip/wipsi/

10.2.12 - TAX INCENTIVES – CANADA REVENUE AGENCY, PROVINCE OF NOVA SCOTIA

Several tax incentives are in place to support scientific research and development and for clean technology investment. These include investment tax credits and accelerated depreciation for tax purposes. These are each discussed below.

10.2.12.1 - SCIENTIFIC RESEARCH AND EXPERIMENTAL DEVELOPMENT (SR&ED) INCENTIVE

The SR&ED is a federal tax incentive program to support activities to achieve technological advancement or to advance scientific knowledge. It is an investment tax credit, made available to businesses doing research and development in Canada, whether basic or applied, for new or improved materials, devices, products, or processes. The incentive can be in the form of a refundable investment tax credit, which reduces taxes payable. It can reduce the company's current year tax liability, be carried back three years, or carried forward 20 years.

The SR&ED is available to Canadian controlled private corporations, non-Canadian controlled corporations and proprietorships, partnerships, and trusts. The ITC rate for the latter two is 20% of qualified SR&ED expenditures. For Canadian controlled private corporations, the ITC rate is 35% of the company's "calculated expenditure limit" and 20% of expenditures beyond the calculated expenditure limit. The expenditure limit is based on the firm's previous year taxable income and taxable capital. See www.cra.gc.ca/sred for this calculation.

Qualifying SR&ED expenditures are costs of experimental development, applied and basic research and can include salaries and wages, materials, SR&ED contracts, lease costs of equipment, overhead, third party payments, and capital expenditures. Also eligible are the costs of work directly in support of these activities such as engineering, design operations research, mathematical analysis, computer programming, data collection, testing, and psychological research.

To make a SR&ED claim, forms T661 Scientific Research and Experimental Development Expenditures Claim and T2SCH31 (Investment Tax Credit-Corporations) or T2038 (IND) (Investment Tax Credit – Individuals) must be submitted with the year's federal income tax return. See www.cra.gc.ca/sred for these forms. These claims are subject to a technical and financial review by the CRA, conducted by CRA staff. Technical review evaluates the work to ensure it meets the SR&ED eligibility criteria. A financial review looks at the costs to make sure they are eligible expenditures. These reviews may require site visits (Overview of the Scientific Research and Experimental Development (SR&ED) Tax Incentive Program, Canada Revenue Agency, www.cra.gc.ca/sred, accessed May 18, 2012).

10.2.12.2 - NOVA SCOTIA RESEARCH AND DEVELOPMENT TAX CREDIT

The Nova Scotia R&D tax credit is applicable to SR&ED-eligible expenditures. The rate is 15% and is refundable if the amount of the credit exceeds the Nova Scotia taxes payable. The credit is claimed on Schedule 340 of the NS T2 form and is administered by the Canada Revenue Agency. (http://www.novascotia.ca/finance/en/home/taxation/businesstax/corporateincometax/researchanddevelopmenttax.print.aspx, accessed May 18, 2012).

10.2.12.3 - ACCELERATED CAPITAL COST ALLOWANCE FOR CLEAN ENERGY GENERATION

Capital investment expenditures made in tidal power equipment are eligible for accelerated capital cost allowance, or amortization for tax purposes. The CCA rate for this class of equipment (Class 43.2) is 50% per year, on a declining balance basis. This has the effect of deferring some taxes to later in the project's life.

In addition, "certain intangible project start-up expenses (for example, engineering and design work and feasibility studies) are treated as Canadian Renewable and Conservation Expenses. These expenses may be deducted in full in the year incurred, carried forward indefinitely for use in future years, or transferred to investors using flow-through shares" http://www.budget.gc.ca/2010/plan/anx5-eng.html#a27.

10.3 - RISK AND RISK MITIGATION

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There are numerous risks associated with tidal energy projects. The risks vary by the stage of the project and affect its financial viability. Although complete removal of all of the risks is unachievable, mitigation measures can be taken to reduce exposure to the risks to an acceptable level. The appropriate mitigation methods will vary according to the stage of the project and type of risk.

Throughout a tidal energy project, decisions are made that expose the project developer and its investors to risk. The higher the risk associated with a project, the more hesitant investors are about financing it. Since tidal energy is at an early stage of development, the level of risk is a considerable barrier to obtaining financing. Financers want to have answers to questions such as: what can go wrong, what kind of additional costs and delays would result, and who takes the risk (Hamilton, 2006)? To increase investors' confidence, it is important to identify risks and attempt to mitigate and reduce them as much as possible (Drake & Howell, 2011). This section will describe the risks inherent in building, installing, and operating tidal energy devices and ways to mitigate or manage these risks.

10.4 - TYPES OF RISKS

To analyze and mitigate the risks inherent in tidal energy, they must first be identified. Some are related to the technology itself (design), others depend on the maturity of the supply chain (equipment accessibility, cost overruns, damage to property, availability of a capable operator), while still other external risks are beyond the control of the project developer (weather, market risk, political/regulatory risk). Furthermore, there is risk of damage to the environment and risk of damage to the equipment by the elements in the environment.

The various types of risks noted are discussed in this section. Once the specific risks of the project are identified, the appropriate risk mitigation methods can be explored to manage and minimize negative outcomes.

DISCUSSION: RISK MITIGATION

The four methods for mitigating or managing risks are as follows:

- Risk transference,
- Risk minimization,
- Risk avoidance, and
- Risk acceptance.

Risk Transference -- Risk transference is the spreading or sharing of risk. This transference involves passing some or all of the risk to another party to reduce the exposure to an acceptable level.

One way to transfer risk is through insurance. Insurance can give financial protection from damage or delays during the fabrication, transport, construction, and operational stages of the tidal energy project. Insurance can lower the cost of capital by reducing the financial impact of potential setbacks. The damage or delays can be caused by human error, technological reasons, or from the environment. The traditional products insurers cover are contractors' risks, property damage, machinery breakdown, delays in start-up, business interruption, errors and omissions, legal liability, political risks, and some financial risks such as default or currency convertibility (United Nations Environment Programme, 2004).

For an insurance company to take on risk, it must be provided with enough information to predict the likelihood and severity of the losses so it can set a premium (United Nations Environment Programme, 2004). The main criteria for the insurability of risk are: probability of an event occurring, its potential maximum total loss, average total loss, the average time span between two events, the level of insurance premium required, the degree to which the insured can manipulate the risk, legal limitations, and insurance coverage limitations such as deductibles and liability limits. Depending on frequency and severity, the risks may not be insurable. Insurance is determined on a case-by-case basis and usually has a higher price and more terms and conditions for renewable energy projects than conventional energy projects (Marsh & MacLennan Companies, 2004).

There have been challenges with underwriting renewable energy projects. These challenges stem from the newness of the technologies, limited underwriting expertise, lack of actuarial information, lack of suitable risk transfer mechanisms, low transaction sizes, poor loss histories, and location in harsh conditions. Underwriters often see different hazards in different stages and, as a result, tidal energy will demand a stage-by-stage rating approach (Marsh & MacLennan Companies, 2004). Based on a report published in February 2011, there were no insurers at that time who were prepared to underwrite such risks (IEA-RETD, 2011). As tidal energy becomes more established, energy executives are expecting wider availability of more-standardised products, notably insurance and hedging contracts (Economist Intelligence Unit, 2011).

In addition to insurance, there are other methods available to transfer the risk. The risk transference methods include requiring some risks be borne by the relevant sub-contractors, joint venturing, and market hedges (Rodenhuis, 2008).

Sub-contracting is a process whereby the project developer employs a business or person outside of the company to complete work for a larger project. Sub-contracting transfers risk as these business functions are not retained within the company. The sub-contractor may be better able to mitigate the risk or be willing to take on some of the risk in exchange for a higher contract price. For instance, a technology developer can provide a warranty on the technology, or the construction company can provide guarantees the work will be done on time and according to specifications.

A joint venture is a new entity created by two or more parties (usually companies) who have a contractual agreement to achieve specific objectives. They contribute their equity for a certain amount of time, creating a temporary partnership. This helps share the risk between the companies as they will be sharing all revenues, expenses, assets, and risks.

A hedge is an offsetting investment made to neutralize the risk of adverse price movements. Hedging can be used to protect against the uncertainty of currency exchange rates and commodity prices.

Risk Minimization (Reduction) -- The second method of managing risk is minimization. Minimization is reducing or controlling the risk by changing or implementing procedures or changing characteristics of a project to reduce the likelihood of unforeseen events occurring. The risk minimization process typically incurs additional costs.

Methods of risk minimization include pre-feasibility studies and applying research findings and lessons learned from other industries to the tidal energy industry. Such measures can help reduce the risk to an acceptable level to attract investors (Ercoli, Julien, Kristine & Salvtore, 2011).

Deepening industry collaboration is another way to reduce the risk; pooling maintenance equipment and spare parts can help minimize the risk inherent in tidal energy projects. As projects get more complex, such industry partnerships may become essential (Economist Intelligence Unit, 2011).

Risk Avoidance -- The third option for managing risks involves risk avoidance. Avoidance is done by designing risk out of the equipment and processes, or choosing not to accept the risk. Designing the risk out can be achieved by studying and applying lessons from other industries with similar experiences. It may include avoiding a particular activity that carries the risk. The company needs to conduct a cost-benefit analysis to ensure that avoiding the risk is worth the cost.

Risk Acceptance -- The fourth method of managing risk is risk acceptance. Acceptance occurs when it is decided the risk to the organization is within acceptable limits. If the risk is accepted, it is very important to monitor it. Monitoring can be done by setting performance indicators and watching trends that could indicate variances from what was expected.

One reason for accepting risk is information asymmetry. When the insurer perceives the risk of a particular project to be higher than the developer does, risk acceptance becomes more cost-effective than insurance (Economist Intelligence Unit, 2011).

Political and regulatory risks, for example, are generally accepted by developers since limited options are available for transferring them (Economist Intelligence Unit, 2011). A company's risk acceptance decision is the part of the risk management process that establishes what the risks are and to what extent the company should tolerate them as a part of its normal business. The standard approach is to control all the risks management believes it can control within its available resources and accept the remainder (Marsh & McLennan Companies, 2004).

10.4.1 - TECHNOLOGY RISK

Technology risk essentially revolves around two questions: will the device work and will it continue to work? The preferred mitigant to these risks is operational experience. With tidal energy being an emerging sector and owners wanting to benefit from the latest technologies, this may not be possible for some time (IEA-RETD, 2011).

Technology risk is one of the highest risks for tidal energy at present. Various technologies have been tested in tanks, and prototype and full-scale devices have been deployed in the EMEC test facility in Orkney, Scotland. Testing in a range of resource settings helps to determine device reliability and susceptibility to accidents and damage (Resolve Inc. & Schwartz, 2006, p. 17). As more is learned about the technology, the more likely the owner will be able to transfer the risk to an insurer.

Both insurers and financers penalize new or poorly understood technologies and processes with prohibitive premiums and terms (United Nations Environment Programme, 2004). As it is unknown how well the tidal energy technology will endure the natural elements over time, it will take insurers a while to increase their confidence to the level they have with tested and known technologies. Until there is an operating history for tidal turbines, insurers will likely only cover damage that could result from the workers or from defective parts (Marsh & McLennan Companies, 2004, p. 73).

VIGNETTE: TECHNOLOGY RISK IN TIDAL ENERGY – INVESTOR PERSPECTIVES

When asked about investing in tidal energy in the DECC Wave & Tidal Investor survey (2010), a spokesperson at a bank responded, “Technology is probably the biggest issue and funding hot on its heels. Can you prove it will work, and how reliable will it be, that’s clearly the biggest issue for any financier” (DECC, 2010).

As an angel investor stated in the DECC Wave & Tidal investor survey, “We need to build machines that will demonstrate adequately that reliable and consistent electricity can be produced” (DECC, 2010).

10.4.2 - SUPPLY CHAIN RISKS

Beyond the uncertainty associated with new technology is that of the supply chain to manufacture, assemble, deliver, install, and operate the equipment on time and on budget. A nascent supply chain adds a significant amount of risk during the construction stage of a project.

BEST PRACTICES: TECHNOLOGY READINESS LEVELS (TRL)

The National Aeronautics and Space Administration (NASA) developed a scale for technology development that has been adopted by many government departments and businesses. Ranging on a scale from 1 to 9, the technology readiness level indicates the stages of development and testing a new technology has passed through. Originally developed in the 1980s, it is now a fairly standardized system that communicates the technology risk still latent in the project. A version of the TRL levels is provided in the Table 10-2. For more information, go to: http://www.em.doe.gov/pdfs/TRA%20Guide%20Draft%20w%20EM-60%20Comment2.pdf.

10.4.2.1 - EQUIPMENT AND MANUFACTURING ACCESSIBILITY

The large turbines, bases, and cables will require large and costly construction facilities and installation equipment. Before the supply chain is established, there will be a small quantity available. Key equipment includes lifting equipment, piling hammers, and sea-going vessels. If a key piece of equipment breaks prior to, or during, project implementation, the project may be delayed (IEA-RETD, 2011). Even if there are units nearby, those could be committed to other projects for a significant amount of time. In the early days of the tidal energy industry, key equipment may be largely committed to other industries such as offshore oil and gas. These problems can not only result in long delays for building new capacity, they can also cause developers to withdraw from projects entirely (Greenacre, Gross, & Heptonstall, 2010).

The developer can transfer some of this risk by having the risk of construction delays remain with the contractor. A provision for a contingency allowance should also be part of the contract (IEA-RETD, 2011). To minimize the risk, engineers should validate the requirements for spare parts, vessels, and cranes. These requirements should also be a part of defined, long-term operational procedures (Guillet, 2007).

Since tidal energy is a new and developing industry, it cannot be guaranteed the tidal turbine manufacturers will be around in years to come. The turbines may become obsolete. There is also the risk that some designs of tidal turbines could be withdrawn. As a mitigant to these risks, the owners should ensure they will always have access to the components’ designs. This way, if the tidal turbine manufacturer is no longer available, it may be possible to have the components manufactured by another company (IEA-RETD, 2011).

10.4.2.2 - COST OVERRUNS

Often, projects fail to be completed on time and on budget. It is important for the tidal energy companies to analyze the factors that may cause time and cost over-runs and find measures to mitigate these risks.

Cost overruns occur in many projects. However, the more contractors there are involved in the construction and supply, the more potential there is for cost overruns, due to the greater number of interfaces (IED-RETD, 2011). As tidal energy is an offshore project, it is especially complex and will require more coordination and management than onshore projects (Guillet, 2007). Delays or deficiencies by one contractor can affect the entire project's schedule.

The impact of these setbacks on the budget and schedule of the entire project should be assessed by the project developer. A contingency analysis includes identifying what would occur if a particular contractor's work is delayed or not performed. A risk minimization measure for the project developer is to employ an independent expert to evaluate these situations and determine the costs associated with the downside scenarios. In order to properly transfer risk to the appropriate contractors and suppliers, thoroughness must be maintained when negotiating and writing contracts. It is also important to have strong project management, in particular at the interfaces, and to set a contingency budget to provide a buffer for delays and cost overruns (IEA-RETD, 2011).

A turnkey contract can be used to mitigate the risk of cost overruns (Rodenhuis, 2008). Cost savings and quicker delivery times may be achieved, but there is a loss of control over decisions throughout the construction process.

Including performance incentives for contractors is an additional way to mitigate the risk of time and cost overruns. An example of a performance incentive is an additional payment if work is finished before the deadline. Alternatively, penalties for missed deadlines could be used as a deterrent (Rodenhuis, 2008).

Certain delay risks may have insurance available (Rodenhuis, 2008). For financing, banks will require responsibility for the risks to be clearly allocated. This includes clearly defining the hand-over procedure between the contractors at each interface. The procedure should be clearly stated in the contract for every contractor (Guillet, 2007).

The greater the distance the installation is from shore, the further the sea-going vessels have to travel during the trips to install equipment, the more complex the foundations, and the longer the cabling required. These increase the potential for cost overruns. A harsher environment and rough water will also complicate the process (Greenacre et al., 2010; IEA-RETD, 2011). As the distance and depth increase, so too do the risks associated with project development, installation, and maintenance. As a result, a higher contingency budget will be needed (IEA-RETD, 2011).

FOUNDATIONAL CONCEPT: TURNKEY CONTRACT

A turnkey contract is an agreement in which the contractor finishes the entire project and delivers the product in a completed state, rather than in stages. With this contract, the contractor owns the project until it is finished. This provides the contractor with the incentive to finish the project on time and on budget.

10.4.3- DAMAGE TO PROPERTY AND EQUIPMENT

Construction can cause damage to private property, to public wharves, and to underwater transmission cabling. Beneath the water, the interconnection cable may cross other cables and pipes in the water. It is essential to get the details on existing cables and pipes through investigations and discussions with other service owners and the authorities. During the project planning stage, the construction contractor should be held responsible for completing a final survey of the area before starting to dredge and install the cables. If possible, an agreement should be made that if any damages occur to the existing property, remediation is the contractor's responsibility (IEA-RETD, 2011).

VIGNETTE: INCENTIVES TO DEVELOP FURTHER OFFSHORE

In some countries, a higher remuneration is established for contract work that is further offshore, which provides an incentive to develop these projects. For an example, refer to 'Case Study: Water Depth and Impact on Overall Cost Structure and Revenues' on page 63 in IEA-RETD, 2011 (noted in the references at the end of this module). This case study specifically looks at the tariff structure used in Germany as a remuneration technique.

10.4.4 - LACK OF CAPABLE OPERATOR

The capability of the power plant operator is important and needs to be attended to during the planning process. As tidal energy is a new energy sector, there will be few companies, if any, with a track record. As the personnel will not have experience working directly in tidal energy, the developer should determine the suitability of the personnel and operational plans (IEA-RETD, 2011). There will likely be a shortage of skills, as there will be a worldwide competition for service crews from the oil and gas industries and other offshore activities (Greenacre et al., 2010).

Means of mitigating this include performance incentives such as bonuses or equity participation. Alternatively, there can be penalties in the event of poor performance (IEA-RETD, 2011).

10.4.5 - EXTERNAL RISKS

External risks are largely out of the control of the project developer, though there are techniques for mitigating the impact of some. External risks include political and regulatory uncertainty, uncertainty over costs of various factors of production, foreign exchange rates, and weather risks. Each of these is discussed below.

10.4.5.1 - POLITICAL/REGULATORY RISK

Long-term government support mechanisms are generally needed to sustain renewable energy projects. This is a very important way to mitigate real and perceived risks that concern investors in tidal energy. Due to frequently changing national and international policies, investors lack confidence in regulatory policies (United Nations Environment Programme, 2004). New policies and budget changes can arise when a new party is elected to government. While tidal energy is in the early stages and dependent on government support, this adds a great deal of uncertainty.

Regulatory changes, such as to environmental regulations, also present a risk for tidal energy projects. The tidal turbines are sited in public environments and are tapping energy from a natural resource. Consequently, developers face uncertainty about siting and environmental permitting (Milford, Morey, & Tyler, 2011).

Banks accept some amount of regulatory change risk, although to finance a project, the regulatory structure must be completely understood. The banks will require a regulatory framework that makes the projects feasible at the outset (Guillet, 2007). The willingness and capability of provincial and federal authorities to handle the permits and licences will affect the perceived regulatory risks.

Many renewable energy executives say they retain, and thus accept, regulatory risk because they are unable to see any worthwhile alternatives (Economist Intelligence Unit, 2011). Though the executives are retaining the risks, they also want to find ways to minimize them. One way developers can mitigate political and regulatory risk is to strengthen communications with regulators and policymakers (Economist Intelligence Unit, 2011). Strengthening communications can be viewed as risk minimization through increased industry collaboration. Proper confirmation by legal advisors that all permits, licenses, etc. are in place is also important.

DISCUSSION: POLITICAL RISK

All over the world, government support has been crucial to the development of new renewable energy industries (Esteban & Leary, 2009). In 2010, it was observed that as worldwide support in renewable technologies grew, investment decreased significantly in the countries where the government support declined (Economist Intelligence Unit, 2011).

Government policy can help the tidal energy industry achieve returns and reduce risks through incentive mechanisms such as feed-in tariffs and green certificates (Guillet, 2007). To mitigate the risk of funding being removed when the government changes, the support for tidal energy should be designed to be long term, regardless of political changes.

10.4.5.2 - WEATHER RISKS

The weather, storm surges, and strong tidal currents add uncertainty for the installation and maintenance of the TEC devices. The tides themselves limit the times when work can be done on site. The weather and water conditions can cause expensive delays, so installation and operating costs will be uncertain, particularly when there is a need for specialized vessels. Choppy waters further increase risk when installing the turbines and pose a threat to the safety of the workers.

To mitigate weather risks, the contract between the developer and contractors should state the agreements regarding weather risks. Sharing weather risk is typical for these two parties. A usual agreement may have the contractor responsible for “average” weather. It must be defined exactly what falls under “average” weather. Typically, the contractor would get relief from the planned schedule, but would not add the cost of weather days (IEA-RETD, 2011).

In addition, bad weather causing extremely rough waters and storm surges may harm installed turbines. To mitigate these risks, the turbines should be tested in extreme conditions to determine whether they will survive or break apart and become a hazard themselves (Ingram, 2011).

BEST PRACTICES: HEALTH AND SAFETY

When mitigating the risk, it is important to exert additional effort above simply satisfying the local legislation regarding the health and safety of all parties involved. Particular effort should be applied in planning health and safety by ensuring detailed policies and plans for all stages of the project from construction to operation. It is important to regularly audit and provide feedback on these safety procedures and actions (IEA-RETD, 2011).

10.4.5.3 - DAMAGE TO EQUIPMENT BY THE ENVIRONMENT AND OTHER USERS OF THE WATER

Damage to property could occur due to various hazards: biofouling, third party interference, larger than expected currents, or damage due to logs and submerged ice, etc. The damage could occur on the new tidal energy equipment or existing sub-sea equipment. Managing offshore activities is the starting point in mitigating this risk, although insurance is apt to be the key mitigant (IEA-RETD, 2011).

The accumulation of microorganisms, plants, algae, or animals on wetted structures is known as biofouling. As the turbines and transmission cables are in the water, biofouling could damage the equipment. There are many different organisms that can cause biofouling, many surfaces affected by it, and many different solutions to the problem. Anti-fouling is the method of either removing or preventing this accumulation, and can include the use of biocides or non-toxic coatings. To mitigate the risk posed by biofouling, research needs to be done into the best solution, or anti-fouling process, for tidal energy before installation of the turbines (Stanczak, 2004). This research would include examining the toxicity of the paints, hydraulic fluids, and chemicals used to control biofouling (Resolve, Inc. & Schwartz, 2006).

Damage could likewise be caused by a third party, for example, by anchoring in a prohibited area and damaging subsea cables. Again, the mitigant most appropriate for this situation would be insurance (IEA-RETD, 2011).

Damage due to submerged, sediment-laden ice has been a concern but is currently considered a low risk for tidal energy developments in the Upper Bay of Fundy (Sanderson, Redden, & Broome, 2012). Direct observations of ice movements near turbines in Minas Passage would help to determine the likelihood of interaction between submerged ice and bottom mounted turbines. Any collision involving a turbine and submerged debris (e.g. logs, fishing gear) or a large marine vertebrate (e.g. whale) could damage the tidal device. To mitigate such risks, there should be monitoring for large submarine hazards at all tidal device deployment sites. For the long-term, risk mitigation would include engineering the tidal devices to withstand contact with those hazards that would be difficult to completely prevent (Baddour, Byers, & Saunders, 2008).

10.4.5.4 - MARKET RISK

The market creates uncertainty in the cost and price of the inputs for tidal energy and the tidal energy output. There is uncertainty in the costs of commodities and other inputs, as well as in the price paid for electricity (Economist Intelligence Unit, 2011).

The cost of tidal energy is sensitive to currency exchange, commodity, equipment, and labour price changes. The cost of raw materials for tidal energy projects are directly affected by commodity prices. Steel is a major component of the tidal turbines, so steel price volatility makes estimating the costs of the turbines and bases challenging. Accordingly, it is too risky for steel buyers or sellers to lock themselves into fixed price contracts. It is valuable to monitor the price of these inputs to help mitigate the risk of the price changes and hedge when possible (Greenacre et al., 2010).

10.4.5.5 - ENVIRONMENTAL RISK

With the installation of devices in the water, there is potential for damage to the environment. It is important to look at these risks as well as the liability that could result (Economist Intelligence Unit, 2011).

Environmental damage has the potential to occur in a variety of areas. The damage could occur from the turbines in the water or from activities onshore. It is important to study these risks and have appropriate procedures to monitor the environmental conditions. If environmental damage does occur, the project owner could be liable and thus it is imperative to have planned mitigation procedures already in place (IEA-RETD, 2011).

There are several measures companies are currently taking to mitigate environmental risks with renewable energy projects. The most prevalent measure is improving environmental audits. Another measure frequently used is implementing strict environmental standards. Other planned mitigation procedures include staged development, more frequent communication with consumers and environmental groups, and closely monitoring subcontractors' environmental practices (Economist Intelligence Unit, 2011).

Two risk transference methods currently used for environmental risks include insurance and catastrophe bonds. Catastrophe bonds transfer certain risks (usually from an insurer) to investors. Investors will buy these bonds because they generally pay higher interest rates. A smaller group of companies also use self-insurance pools (Economist Intelligence Unit, 2011). This is a method where a calculated amount of money is set aside by the company to compensate for the loss, if incurred.

IN NOVA SCOTIA: REDUCING MARKET RISK FOR TIDAL ENERGY

Legislation in Nova Scotia has helped to reduce market risk for selling electricity generated from the tides. The commitment to generating electricity from renewables (25% by 2015; 40% by 2020) assures demand. Feed-in tariffs for tidal energy provide greater certainty of price for producers. Both are subject to power purchase agreements.

10.6 - SUMMARY

Much work has been done on the development and testing of prototypes and and full-scale devices in tanks and test sites, such as at European Marine Energy Centre (EMEC) in Orkney, Scotland. However, there is not a lot of experience with the commercialization of in-stream tidal energy as yet. Ocean Renewable Power Company (ORPC) in Maine, USA installed turbines and cables in Cobscook Bay in 2012 and is currently delivering electricity to the grid. This was the first commercial in-stream tidal energy project in North America.

Arrays of turbines are needed to achieve sufficient economies of scale to make commercializing tidal energy technologies feasible. However, arrays require very large amounts of capital and very long investment horizons. Device and project developers and government departments are discussing ideas on the needed supports and risk mitigation measures to move the technology beyond the "technology valley of death." The absence of financing, due largely to the inherent risks, size of investment and investment horizons, is a significant obstacle to the progress of the industry around the world.

Tabel 10-2: Technology Readiness Levels (U.S. Department of Energy)

RELATIVE LEVEL OF TECHNOLOGY DEVELOPMENT	LEVEL	TRL DEFINITION	DESCRIPTION
System Operations	TRL 9	Actual system operated over the full range of expected conditions.	The technology is in its final form and operated under the full range of operating conditions. Examples include using the actual system with the full range of wastes in hot operations.
System Commissioning	TRL 8	Actual system completed and qualified through test and demonstration.	The technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental testing and evaluation of the system with actual waste in hot commissioning. Supporting information includes operational procedures that are virtually complete. An ORR has been successfully completed prior to the start of hot testing.
	TRL 7	Full-scale, similar (prototypical) system demonstrated in relevant environment.	This represents a major step up from TRL 6, requiring demonstration of an actual system prototype in a relevant environment. Examples include testing full-scale prototype in the field with a range of simulants in cold commissioning. Supporting information includes results from the full-scale testing and analysis of the differences between the test environments, and analysis of what the experimental results mean for the eventual operating system/environment. Final design is virtually complete.
Technology Demonstration	TRL 6	Engineering/pilot-scale, similar (prototypical) system validation in relevant environment.	Engineering-scale models or prototypes are tested in a relevant environment. This represents a major step up in a technology's demonstrated readiness. Examples include testing an engineering scale prototypical system with a range of simulants. Supporting information includes results from the engineering scale testing and analysis of the differences between the engineering scale, prototypical system/environment, and analysis of what the experimental results mean for the eventual operating system/environment. TRL 6 begins true engineering development of the technology as an operational system. The major difference between TRL 5 and 6 is the step up from laboratory scale to engineering scale and the determination of scaling factors that will enable design of the operating system. The prototype should be capable of performing all the functions that will be required of the operational system. The operating environment for the testing should closely represent the actual operating environment.

RELATIVE LEVEL OF TECHNOLOGY DEVELOPMENT	LEVEL	TRL DEFINITION	DESCRIPTION
Technology Development	TRL 5	Laboratory scale, similar system validation in relevant environment.	The basic technological components are integrated so that the system configuration is similar to (matches) the final application in almost all respects. Examples include testing a high-fidelity, laboratory scale system in a simulated environment with a range of simulants1 and actual waste. Supporting information includes results from the laboratory scale testing, analysis of the differences between the laboratory and eventual operating system/environment, and analysis of what the experimental results mean for the eventual operating system/environment. The major difference between TRL 4 and 5 is the increase in the fidelity of the system and environment to the actual application. The system tested is almost prototypical.
Technology Development	TRL 4	Component and/or system validation in laboratory environment.	The basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared with the eventual system. Examples include integration of ad hoc hardware in a laboratory and testing with a range of simulants and small scale tests on actual waste. Supporting information includes the results of the integrated experiments and estimates of how the experimental components and experimental test results differ from the expected system performance goals. TRL 4-6 represent the bridge from scientific research to engineering. TRL 4 is the first step in determining whether the individual components will work together as a system. The laboratory system will probably be a mix of on hand equipment and a few special purpose components that may require special handling, calibration, or alignment to get them to function.

RELATIVE LEVEL OF TECHNOLOGY DEVELOPMENT	LEVEL	TRL DEFINITION	DESCRIPTION
Research to Prove Feasibility	TRL 3	Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development (R&D) is initiated. This includes analytical studies and laboratory-scale studies to physically validate the analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative tested with simulants. Supporting information includes results of laboratory tests performed to measure parameters of interest and comparison to analytical predictions for critical subsystems. At TRL 3, the work has moved beyond the paper phase to experimental work that verifies that the concept works as expected on simulants. Components of the technology are validated, but there is no attempt to integrate the components into a complete system. Modeling and simulation may be used to complement physical experiments.
Research to Prove Feasibility	TRL 2	Technology concept and/or application formulated.	Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are still limited to analytic studies. Supporting information includes publications or other references that outline the application being considered and that provide analysis to support the concept. The step up from TRL 1 to TRL 2 moves the ideas from pure to applied research. Most of the work is analytical or paper studies with the emphasis on understanding the science better. Experimental work is designed to corroborate the basic scientific observations made during TRL 1 work.
Basic Technology Research	TRL 1	Basic principles observed and reported.	This is the lowest level of technology readiness. Scientific research begins to be translated into applied R&D. Examples might include paper studies of a technology's basic properties or experimental work that consists mainly of observations of the physical world. Supporting Information includes published research or other references that identify the principles that underlie the technology.

Source: Technology Readiness Assessment (TRA) / Technology Maturation Plan (TMP) Process Guide, Office of Environmental Management, U.S. Department of Energy, March 2008, p. 6. Available at: http://energy.gov/sites/prod/files/em/TRAGuideDraftwEM-60Comment2.pdf.

REFERENCES

Baddour, E., Byers, C., & Sanders, R.E. (2008, April). Tidal power and migratory sub-surface ice in the Bay of Fundy, Canada. Retrieved from http://www.offshoreenergyresearch.ca/LinkClick.aspx?fileticket=LSJ4XF62hKw%3D&tabid=199&mid=931

Bloomberg New Energy Finance. (2010). Crossing the Valley of Death: Solutions to the next generation of clean energy project financing. Retrieved from: http://www.cleanegroup.org/publications/resource/crossing-the-valley-of-death-solutions-to-the-next-generation-clean-energy-project-financing-gap

Drake, C., & Howell, A. (2011). Scoping study: Socio economic impacts of tidal energy in Nova Scotia Report: Research synthesis & priorities for future action & research. Fundy Energy Research Network Technical Report #2012-1. Retrieved from http://fern.acadiau.ca/document_archive.html?action=view&id=139

Economist Intelligence Unit. (2011, October). Managing the risk in renewable energy. The Economist Intelligence Unit Limited.

Ercoli, E., Julien, A.S., Kristine, M., & Salvatore P. (2011, September 13). Investment and grant opportunities for offshore renewable energy projects in Europe. Results of the FP7 ORECCA project, work package 2. Retrieved from http://www.orecca.eu/documents

Ecofys Netherlands BV. (2011). Financing renewable energy in the European market, final report. Retrieved from: http://ec.europa.eu/energy/renewables/studies/doc/renewables/2011_financing_renewable.pdf

Esteban, M., & Leary, D. (2009). Climate change and renewable energy from the ocean and tides: Calming the sea of regulatory uncertainty. The International Journal of Marine and Coastal Law, 24, 617-651.

Government of Nova Scotia. (2012). What is a CEDIF? Retrieved from http://www.gov.ns.ca/econ/cedif/background/

Greenacre, P., Gross, R., & Heptonstall, P. (2010, September). Great expectations: The cost of offshore wind in UK waters understanding the past and projecting the future. UK Energy Research Centre.

Guillet, J. (2007). Offshore wind options for non-recourse financing. Dexia. Retrieved from http://www.aspo-spain.org/aspo7/presentations/Guillet-Wind-ASPO7.pdf

Hamilton, K. (2006, November). Investment: Risk, return and the role of policy (Working Paper). UK Energy Research Centre

IEA-RETD. (2011, February). Accelerating the deployment of offshore renewable energy technologies IEA – Renewable Energy Technology Deployment. Retrieved from http://iea-retd.org/archives/publications/adoret

Ingram, D. (2011, March). EquiMar project co-ordinator. Video retrieved from http://www.EquiMar.org/

Kreab & Gavin Anderson Worldwide. (2010, February). DECC Wave & tidal – investor survey. Retrieved from: http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/explained/wave_tidal/799-decc-wave-and-tidal--investor-survey.pdf

Marsh & McLennan Companies. (2004). Scoping study on financial risk management instruments for renewable energy projects sustainable energy finance initiative (SEFI). United Nations Environment Programme.

Menichetti, E., & Wustenhagen, R. (2012, August 4). Strategic choices for renewable energy investment: Conceptual framework and opportunities for further research. Energy Policy, 40, 1-10.

Milford, L., Morey, J., & Tyler, R. (2011, December). Strategies to finance large-scale deployment of renewable energy projects: An economic development and infrastructure approach. Clean Energy Group. Retrieved from http://www.cleanegroup.org/publications/

Nova Scotia Department of Energy. (2012). COMFIT frequently asked questions. Retrieved from http://nsrenewables.ca/comfit-frequently-asked-questions

Resolve, Inc., & Schwartz, S.S. (2006, March 24). Proceedings of the hydrokinetic and wave energy technologies technical and environmental issues workshop. October 26-28, 2005. Washington, DC.

Rodenhuis, E.J. (2008, July 29). Green light for renewable energy investments. A risk analysis tool for renewable energy project development (Graduate thesis). University of Twente, Enschede, The Netherlands.

Sanderson, B.G., A.M. Redden and J. Broome. (2012). Sediment-Laden Ice Measurements and Observations, and Implications for Potential Interactions of Ice and Large Woody Debris with Tidal Turbines in the Minas Passage. Publication No. 109 of the Acadia Centre for Estuarine Research (ACER), Acadia University, Wolfville, NS, Canada.

Stanczak., M. (2004, March). Biofouling: It's just not barnacles anymore. Retrieved from http://www.csa.com/discoveryguides/biofoul/overview.php

Steelonthenet.com. (2012). Retrieved from http://www.steelonthenet.com/

United Nations Environment Programme. (2004). Financial risk management instruments for renewable energy projects (1st ed.). Oxford, UK: United Nations Publication.

Weiser, R. H., & Pickle, Steven J. (1998) Financing investments in renewable energy: The impacts of policy design. Renewable and Sustainable Energy Reviews, 2(4), 361-386.