Overview of the Socio-economic Impacts of Renewable Ocean Energy Development on the BC Coast

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List of Acronyms

BCEAA	British Columbia *Environmental Assessment Act*
BC EAO	British Columbia Environmental Assessment Office
BC MAL	British Columbia Ministry of Agriculture and Lands
BC MEMPR	British Columbia Ministry of Energy, Mines, and Petroleum Resources
CEAA	*Canadian Environmental Assessment Act*
CORE	Commission on Resources and the Environment
DFO	Department of Fisheries and Oceans
DR	Development region
EA	Environmental assessment
EIS	Environmental impact statement
EMI	Electromagnetic interference
GW	Gigawatt
GWh	Gigawatt-hour
IBA	Impact benefits agreement
ILMB	Integrated Land Management Bureau
IP	Investigate Permit
IPP	Independent Power Producer
JPM	Jobs per million dollars invested
LO	License of Occupation
LRMP	Land and Resource Management Plan
MW	Megawatt
PPA	Power purchase agreement
RA	Responsible authority
RD	Regional district
ROE	Renewable ocean energy
TRTFN	Taku River Tlingit First Nation
WP	Work Permit

Executive Summary

In British Columbia and throughout Canada there is growing interest in the development of renewable ocean energy projects (ROE) that rely on tidal, wave, and wind energy. The Department of Fisheries and Oceans has commissioned this report to:

- review the socio-economic impacts of ROE development and the mitigation measures that can be used to address these impacts;
- identify key knowledge gaps;
- describe the scale of ROE resources of the BC coast;
- describe the extent of planned ROE development on the BC coast;
- scope potential socio-economic impacts of ROE development on the coastal communities and First Nations of the BC coast;
- identify ROE industry best practices; and
- describe the institutional structure and approvals process for ROE on the BC coast.

This report covers these topics and is based upon a literature review and telephone interviews with key stakeholders and experts. Socio-economic impacts are defined as those impacts that affect cultural, economic, and social well-being. Environmental impacts are discussed only to the extent that they are relevant to analyzing socio-economic impacts.

ROE Development Process

Understanding the development process for ROE projects provides the basis for understanding the socio-economic impacts of ROE development. There are five development phases. The first phase of site evaluation involves finding sites suitable for development, acquiring permits to investigate the site, and testing the resources at the site. The second phase of development involves acquiring rights to use the site, attaining a utility license, negotiating a power purchase agreement, completing necessary studies for permits and approvals, and making further arrangements necessary to commence. The third phase of construction involves construction of roads, transmission lines, the power facility, and other necessary infrastructure and equipment. The fourth phase of operation involves the generation of energy and lasts as long as the equipment, leases, or other factors allow. Energy is sold as per the power purchasing agreement and the facility receives ongoing service and maintenance as required. Most ROE technologies are expected to have operating lives of between 20 and 40 years. The final phase is decommissioning. In theory, ROE projects will be decommissioned after their useful life is over. Typically decommissioning of industrial sites involves removal of installed structures and reclamation of the site.

Types of ROE and Scale of Resources on the BC Coast

There are two types of tidal energy: *tidal stream* energy which is the kinetic energy in currents in water caused by tides, i.e., horizontal movement, and *tidal range* energy which is the potential energy from gravity as the tides rise and fall, i.e., vertical movement. These two types of tidal energy require two different types of technology. Tidal stream technologies are generally subsea turbines fixed in place that capture the energy in horizontal tidal movement. There are no commercial tidal stream operations in existence. Tidal range technologies impound large volumes of water in structures similar to hydroelectric dams and capture the energy embodied in vertical tidal movement by releasing the water through turbines during low tide. Tidal range technology is in use in Nova Scotia and France.

Research into the scale of tidal energy resources in BC has estimated that there is 4,015 MW of theoretical tidal energy resource potential, and 89 sites with an average resource size of 45 MW. The majority of this potential is along the coasts of the Vancouver Island and the adjacent Mainland, particularly near Campbell River and the southern tip of Vancouver Island. There is uncertainty as to the scale of the tidal resource as studies thus far have relied upon relatively coarse modelling.

Wave energy is of two types: kinetic energy from the horizontal and rotational movement of the water in waves, and potential energy from the vertical movement of water as waves pass by. No commercial wave energy facilities exist around the world, and wave technology is new and evolving. In Canada, a number of technologies are under development and being tested.

The most recent study of the BC coast's wave energy concluded that BC has "rich" wave energy resources with a theoretical resource along the 1,000 metre isobaths off the BC coast totalling roughly 37,000 MW. The most promising sites are on the western shores of the Queen Charlotte Islands and Vancouver Island. The level of wave energy striking the BC coast is on par with other notable sites around the world such as Europe. As with tidal energy data, current data on the resource is relatively coarse.

Wind energy technologies harness wind energy by using it to turn turbines mounted on towers. While wind energy technology is still evolving, energy from the wind has been produced for many years and is now competitive with other forms of electricity generation. According to 2007 data, Canada currently has 1,856 MW of installed capacity. As of yet, there are no wind energy installations in BC. While most wind energy installations around the world are on land, there are increasing numbers of offshore installations, particularly in Europe.

The most recent study of wind energy in BC examined all sites in BC that had Investigative Permits taken or applied for by developers as of September 2007 and estimated resource potential at these sites using wind speed data and average capacity factors. In the Vancouver Island area (including the Greater Vancouver and mainland areas in the vicinity of the Island), the study found 6 GW of theoretical wind resource spread across 48 sites, or 0.6 GW of practical resource after constraints were considered. In the North Coast region, the study determined that there was a theoretical resource of 5 GW onshore and 13.5 GW offshore, or 0.5 GW onshore and 1.4 GW offshore of practical resource after constraints were considered.

Planned ROE Development on the BC Coast

Industry has numerous tidal, wave, and wind projects planned or underway for the BC coast. Our examination of publicly-available data determined that there are 156 sites on the BC coast with ROE activity. These sites are either projects under construction or development, or are sites being investigated for generation potential. Activity is mostly on and around Vancouver Island and the North Coast area:

- There is one tidal project in the operational phase, two in the development phase, and 19 tidal power sites under investigation. With the exception of the Race Rocks tidal power demonstration project in operation on south-west Vancouver Island near Victoria, all tidal power sites are on the south-east and east sides of Vancouver Island.

- There are eight different sites being examined for wave energy, and all are on the west coast of Vancouver Island in the Tofino and Ucluelet areas.
- We have identified 126 sites with wind project activity, both onshore and offshore, though of these sites, we estimate that only about 70 different projects are envisioned. Nine of the 70 projects appear to be in the development/permitting phase, with two having received environmental assessment approval; the rest appear to be in the site evaluation phase. Of the 70 projects, 22 are in the North Coast area, and the remaining 48 are on or around Vancouver Island.

Socio-economic Impacts of ROE Development on the BC Coast

Table ES-1 provides an overview of the potential socio-economic impacts of ROE development. Most of these impacts are likely to occur on the BC coast as ROE development proceeds, though only a subset are likely to be of significant concern. The most important and/or serious impacts concern the effect of ROE development on: employment, revenue, other economic sectors (the communications, fisheries, marine navigation, and tourism industries), the energy supply of remote off-grid communities, health, recreational opportunities, and First Nations traditional activities and interests. Note that in a number of cases, impacts are positive.

There are many mitigation measures that governments, ROE developers, and First Nations can employ to minimize negative impacts and maximize positive impacts. In addition to the many measures unique to the type of impact, early planning with stakeholders and impact benefit agreements are key measures.

Permitting and Approval Process for ROE Development on the BC Coast

Developing ROE projects in BC involves a variety of permitting and approval processes. ROE developers must pass through provincial, local, regional, federal, and First Nations processes, including environmental assessment.

As 94% of the land base in BC is Crown land, the permitting process under the *Land Act*, 1996 requires ROE developers to apply for and acquire permits to evaluate sites, construct and operate projects. While gaps in knowledge remain in terms of how offshore wind, tidal, and wave projects will be processed, ROE developers will typically require Investigate Permits, Licenses of Occupation, Work Permits, and general area Licenses of Occupation or leases. Each type of permit entails application and annual rental fees, time limits, and other limitations and requirements. Many of these permits also entail varying levels of public involvement in decision making.

Local and regional governments, as empowered by the provincial *Local Government Act*, 1996 and *Community Charter*, 2003, may require ROE developers to apply for Building Permits and Temporary Use Permits and may entail re-zoning of lands.

Table ES-1. Overview of socio-economic impacts of ROE development and key uncertainties.

Impact Receptor	Description of Impact	Key Uncertainties
Coastal Defence	Reduction in damage to coastal features	Extent of effect
Cultural Resources	Damage to historical and/or archaeological resources	
Economic – Employment	Direct and multiplier employment impacts	Extent of impacts (inexperience, novelty of technology, how many projects will proceed)
Economic – Revenue	Earnings to governments, communities and First Nations through taxes, fees, leases, and partnerships	Extent of impacts (inexperience, novelty of technology, how many projects will proceed)
Economic – Boom and Bust Phenomena	Mostly negative effects due to rapid rise/drop-off in economic activity and worker population	
Economic – Aviation	Hazard to low-flying aircraft from wind energy installations	
Economic – Aquaculture Industry	Possible conflict over marine space	
Economic – Communication Industry	Interference with radio, radar, VHF, etc.	Effect on certain technologies and overall effect on communications technology
Economic – Fisheries Industry	- Negative impacts on fish from noise, activity, vibrations, etc. - Exclusion of fishers from fishing grounds - Positive effects of artificial reefs and no-take zones	Overall effect on fish and fisheries
Economic – Forestry Industry	Exclusion and/or obstruction of forestry activities	
Economic – Marine Navigation and Ports	- Exclusion and/or obstruction of shipping and other marine travel - Collision risk - Enhancement of marine safety - Increases in business of marine industries and at ports	Overall effect on marine users and ports
Economic – Mining Industry	Exclusion and/or obstruction of mining activities	
Economic – Offshore Oil and Gas Industry	- Conflict over existing leases - Exclusion and/or obstruction of activities	- Effect of leases held by oil companies on ROE development - Extent that future oil and gas activities would be excluded or obstructed
Economic – Property Values	Effect on values	Extent of effect
Economic – Tourism Industry	- Aesthetic (visual and noise) impacts - Degradation of tourist's recreational experiences - Attraction of tourists	Overall effect on tourism
Energy Supply	Potential to improve the energy supply of the BC coast in terms of cost, quantity, reliability, etc.	Degree to which the improved energy supply will stimulate economic growth
Health Benefits	- Reduction in air pollution and noise - Emotional benefits from association with green power	
Recreation	Degradation/improvement in recreational experiences	Overall effect on recreation
Rural Demographics and Migration	Possible reduction in rural-to-urban migration pattern	Extent of population loss from rural areas
Traditional Activities and Interests	- Infringement of Aboriginal Rights and Title - Obstruction of Traditional activities and culture	Extent to which the land claims process will affect the growth of the ROE industry

In BC, many ROE projects will be subject to an environmental assessment under the *Environmental Assessment Act*, 2002. In the event of a trigger of a federal environmental assessment, a harmonized environmental assessment process will ensue through the *Canada-British Columbia Agreement on Environmental Assessment Cooperation* of 2004. This agreement integrates federal and provincial processes and streamlines the assessment process due to their wide overlap.

A key issue for environmental assessment is First Nations jurisdiction over lands, waters, and resources that ROE projects may use or impact. First Nations in British Columbia have unextinguished treaty and Aboriginal rights that may include Aboriginal title and a right in the land itself. Actions of the government such as legislation, regulation, and permitting resource use and development may infringe upon treaty and Aboriginal rights. Protections under the *Constitution Act*, 1982 and case law mandate meaningful consultation with First Nations, accommodation of First Nations, and decision making power to First Nations.

Conclusion

This report shows that the ROE industry is likely to undergo substantial expansion in BC and can make an important contribution to the economic and social well-being of the BC coast. However, there will be significant and diverse impacts associated with this expansion. Given the relative newness of the ROE industry there is also considerable uncertainty regarding impacts. The regulatory process is also complex due to legal and jurisdictional uncertainties between First Nations and the federal and provincial governments. Consequently, the proposed expansion of the ROE industry needs to be carefully planned and managed.

Of the many mitigation strategies identified in this report, several deserve emphasis. First, development of the ROE industry requires extensive stakeholder collaboration to ensure benefits are maximized and impacts are mitigated. Consultation should include the completion of comprehensive Impact Benefit Agreements with First Nations. Second, a marine and coastal planning process based on the successful BC LRMP model should be completed to ensure that development occurs in a coordinated fashion that protects other economic and environmental interests. Third, mitigation measures contained in this report need to be incorporated in the plans for ROE development. Fourth, extensive research needs to be undertaken on the potential impacts of ROE development in a BC context to reduce the current uncertainty and address the substantial knowledge gaps.

1. Introduction

In British Columbia and throughout Canada there is increasing interest in development of renewable ocean energy (ROE) projects that rely on tidal, wave, and wind energy. In light of this, the Department of Fisheries and Oceans (DFO) commissioned this report to review the potential socio-economic impacts of tidal, wave, and offshore wind energy on the communities and First Nations of the coast of British Columbia.

The specific objectives of the report are to:

- review the socio-economic impacts of ROE development and the mitigation measures;
- review key knowledge gaps with respect to the socio-economic impacts of ROE development;
- identify industry best practices with respect to ROE development;
- describe the extent of current and planned ROE development on the BC coast;
- scope potential socio-economic impacts of ROE development on the coastal communities and First Nations of the BC coast; and
- describe the institutional structure and approvals process for ROE on the BC coast.

To do so, we completed a literature review and a series of telephone interviews with key stakeholders and experts. The literature review involved examining publicly-available government, industry, academic, and non-governmental literature. To confirm findings in the literature and to provide additional information specific to the BC context, we conducted a series of interviews with key government, industry, and First Nations representatives. The questions asked and a list of interviewees is provided in Appendix 1. Finally, we applied our professional judgement in examining and estimating the socio-economic impacts of planned ROE development on the BC Coast's communities and First Nations.

We define socio-economic impacts as those impacts that affect cultural, economic, and social well-being. We covered the environmental impacts of development only to the extent that they are relevant to analyzing socio-economic impacts.

2. ROE Development Process

Understanding the development process for ROE projects provides the basis for understanding the socio-economic impacts of ROE development. There are five phases to the ROE development process.

The first phase of **site evaluation** involves looking for locations with characteristics suitable for development such as the availability of viable energy resources, access to the electricity transmission grid, and community support. Once a suitable location is found, permits for investigation of the site are acquired, assessments for connection to the electricity grid are made, and the resource is tested for viability. This phase may involve installation of a small test facility to assist in evaluating the resource or to help inform developers and regulators of environmental impacts, costs, or other details. With wind energy projects, phase one typically takes between 12 to 18 months (Table 1).

Table 1. Timelines of typical wind energy projects.

Phase	Wind
Site Evaluation	12-18 months
Development	1-3 years
Construction	6-12 months
Operation	20-40 years
Decommissioning	1-2 years

Sources: Aeolis (2005), Wittholz and Pan (2004), Ball (2002).

The second phase of **development** involves acquiring the site, attaining a utility license, negotiating a power purchase agreement (PPA) with the local utility or electricity purchaser (in BC this is BC Hydro), completing environmental assessment and other approval processes, completing engineering studies, procuring equipment contracts, and making financing agreements. The key milestone for this phase is the acquisition of a PPA – once a PPA has been acquired, then a developer is most likely to proceed (Aeolis 2005; Griffiths 2008). This second phase usually takes one to three years in wind energy projects (Table 1).

In the third phase of **construction** the developer builds the power facility and other necessary infrastructure and equipment. Upon completion of construction, the facility is tested. In wind energy projects, this third phase usually takes between six to twelve months (Table 1). Proponents may also have to conduct environmental impact monitoring during this phase or other activities as specified in their permits and approvals.

The fourth phase of **operation** involves the generation of energy and lasts as long as the equipment, leases, or other factors allow. Energy is sold as per the PPA and the facility receives ongoing service and maintenance as required under terms of warranty and service agreements. Most ROE technologies are expected to have operating lives of between 20 and 40 years (Table 1). As with phase three, permits and approvals may also require the proponent to conduct monitoring or other activities during this phase.

The final phase is **decommissioning**. In theory, ROE projects will be decommissioned after their useful life is over. Typically decommissioning of industrial sites involves removal of installed structures and reclamation of the site. This phase is expected to take a year or two (Table 1).

3. Overview of ROE

3.1 Tidal Energy

Tidal energy is energy created by the gravitational pull of the moon and the sun on the waters of the earth. There are daily, monthly, half-yearly and longer period cycles that cause tidal changes, but the daily cycle is the most important for energy development (CRES 2006). The strength and energy embodied in tides is a function of the speed of the tidal movement and local conditions such as friction effects of local subsea geomorphology/bathymetry, the position of the site on the earth, and the point in time (Baddour 2004; SDC 2007).

There are two types of tidal energy. *Tidal stream* energy is the kinetic energy in currents in water caused by tides (horizontal movement). *Tidal range* energy is the potential energy from gravity as the tides rise and fall (vertical movement).

The two different types of tidal energy require two different types of technology. Tidal stream technologies are typically subsea turbines fixed in place that capture the energy in horizontal tidal movement. Tidal stream technologies are new and evolving (Ball 2002; ETNWE 2003). To date, there are no commercial operations using tidal stream technology in existence. Tidal range technologies impound large volumes of water in structures similar to hydroelectric dams and capture the energy embodied in vertical tidal movement by releasing the water through turbines during low tide. Tidal range technology is proven and is in use in Nova Scotia and France (Baddour 2004; CRES 2006).

Tidal energy has two key advantages, in addition to the other benefits of renewable energy (CRES 2006). First, tidal energy is highly predictable. Second, tides have the capacity to generate large amounts of energy.

3.2 Wave Energy

Wave energy is the product of wind blowing consistently across the ocean, which itself is caused by the uneven heating of the earth by the sun. Waves store the energy of the wind and transfer the energy over long distances (CRES 2002; CRES 2006).

Waves hold two types of energy: kinetic energy from the horizontal and rotational movement of the water in waves, and potential energy from the vertical movement of water as waves pass by (CRES 2006). The amount of energy in waves is generally a function of the size of the waves and the nature of interactions with shorelines (CRES 2002; Baddour 2004; CRES 2006). Waves suitable for energy generation are generally created by offshore storms and are stronger in the winter (Baddour 2004).

Wave technology is new and evolving (Ball 2002; ETNWE 2003; OREG 2004). There are over 1,000 wave energy technology designs patented around the world (CRES 2006), but generally all can be classified as shoreline, near-shore, or offshore designs (CRES 2002). In Canada, a number of technologies are under development or are being tested (IEA OES 2003). There is currently no commercial wave energy generating facility anywhere in the world.

A key disadvantage of waves as a source of energy is their irregularity and unpredictability (CRES 2002; Baddour 2004). While waves regularly strike the world's coasts, their characteristics (which affect their energy content) are not constant.

3.3 Wind Energy

Wind energy is the product of uneven heating of the earth by the sun, which causes movement of air from high pressure to low pressure areas. Winds blow all year round, but they tend to be stronger in the winter, coinciding with seasonal demand patterns of energy use in Canada (Aeolis 2005). Wind energy technologies harness wind energy by using it to turn turbines mounted on towers.

While wind energy technology is still evolving, energy from wind has been produced for many years and is now competitive with other forms of electricity generation. Currently, wind energy is generated across Canada and the world. According to the Canadian Wind Energy Association (CanWEA 2007a), Canada currently has 1,856

MW of installed capacity, enough to power 560,000 homes and equivalent to 0.8% of Canadian electricity demand. As of yet, there are no wind energy installations in BC.

While most wind energy installations around the world are on land, there are increasing numbers of offshore installations. According to Pottinger Gaherty (2007), there are 16 operational offshore wind farms in Europe: three in the UK, seven in Denmark, two in the Netherlands, one in Ireland, and three in Sweden. Offshore wind installations are either mounted on the sea floor or on floating structures. Offshore winds are generally stronger than onshore, providing for higher capacity factors, and thus are generally more efficient for energy generation (NaiKun 2007b; BWEA Undated).

4. ROE Resources of the BC Coast

A variety of studies have been conducted in the last decade characterizing the scale and scope of opportunities for ROE in BC. This research has been conducted by government agencies, BC Hydro, non-governmental organizations, and industry. In BC a key driving force has been the latest BC *Energy Plan* (BC MEMPR 2007) which continues a commitment to support ROE development.

Before describing the potential for ROE development in BC, it is helpful to consider several points. First, there is a difference between theoretical, technical, and practical resources. The UK Sustainable Development Commission (SDC 2007) defines the three types of resources as follows:

- theoretical resource: the energy contained in the entire resource
- technical resource: the proportion of the theoretical resource that can be exploited using existing technology options
- practical resource: the proportion of the technical resource that can be exploited after consideration has been given to external constraints (e.g. grid accessibility, competing uses, environmental sensitivity, and economic feasibility).

4.1 Tidal Energy

There have been two studies estimating tidal energy potential along the BC coast. Most recently, Cornett (2006) determined that there is 4,015 MW of theoretical tidal energy resource potential, and identified 89 sites with an average resource size of 45 MW.[1] The majority of this potential is along the coasts of Vancouver Island and the adjacent Mainland, particularly near Campbell River and the southern tip of Vancouver Island (Table 2; Figure 1). The rest of this potential is spread along the Pacific Mainland North and the Queen Charlotte Islands. Cornett noted that current data resolution is relatively coarse and thus limits our understanding of tidal power availability. He recommended finer resolution modelling of the Georgia and Johnstone Straits. The results of the Cornett study are presently being used in a study by BC Hydro's Powertech Labs to examine the practical tidal resource of BC (Khan et al. 2008).

In an older study, BC Hydro (2002) identified 55 sites in BC that could in theory yield roughly 20,000 GWh. Of the 55 sites, BC Hydro identified 12 that were most feasible for development and estimated that these could produce 2,700 GWh per year.

[1] These results are also presented in Tarbotton and Larson (2006).

The best sites were in the Strait of Georgia and Johnstone Strait, in part because they were both close to main centres of consumption.

Table 2. Theoretical tidal current resources in BC (Cornett 2006).

Region	Theoretical Energy Potential (MW)	# of Sites	Average Size (MW)
Vancouver Island & Mainland	3,580	62	58
Pacific Mainland North	353	18	20
Queen Charlotte Islands	81	9	9
British Columbia Coast	4,014	89	45

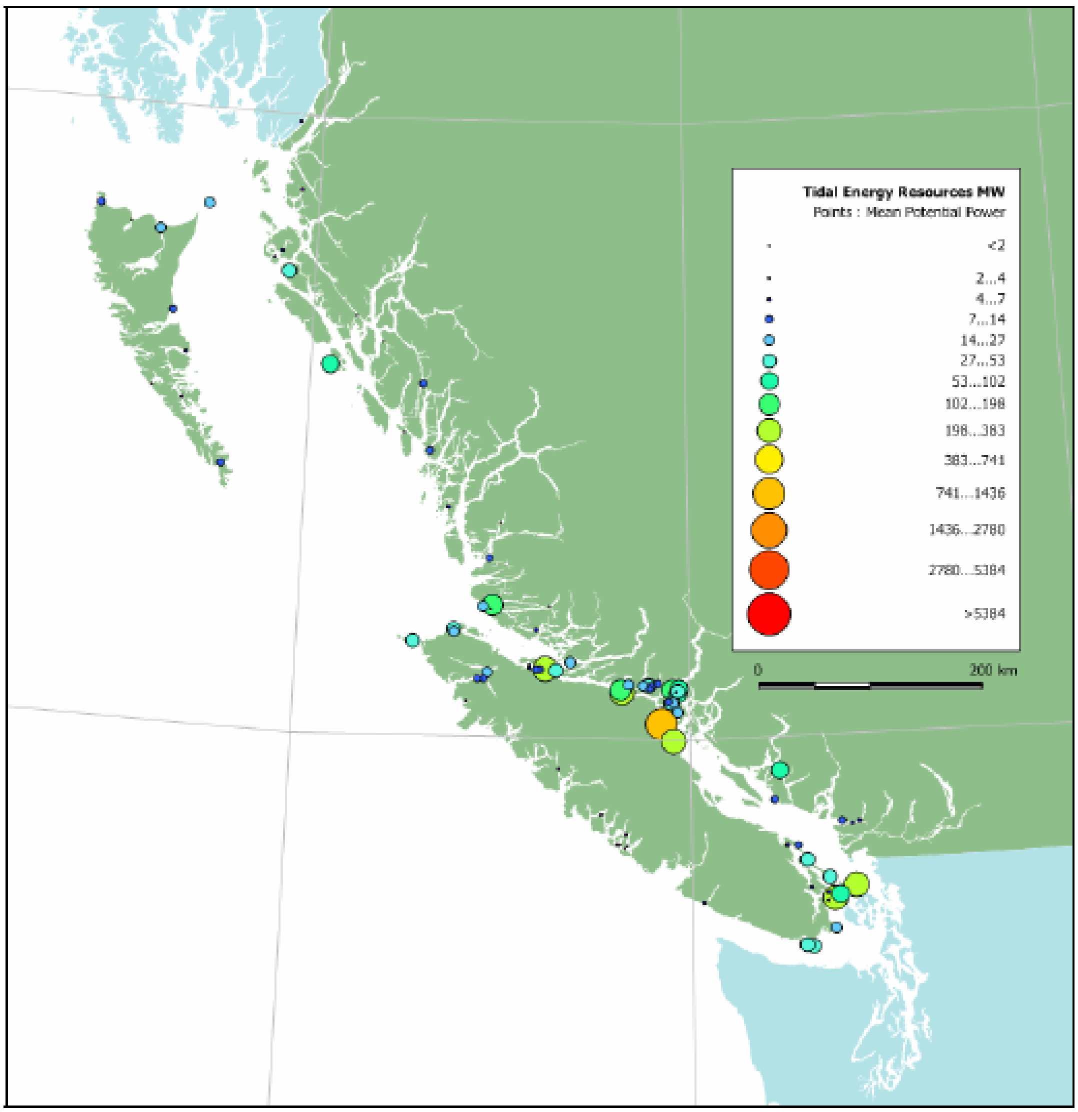

Figure 1. Tidal current power sites on the BC coast as identified by Cornett (2006).

4.2 Wave Energy

The most recent study by Cornett (2006) concluded that BC has "rich" wave energy resources with a theoretical resource along the 1,000 metre isobaths off the BC coast totalling roughly 37,000 MW. According to Cornett, BC's waves are on par with other notable sites around the world such as Europe. Cornett did note, however, that more detailed research on wave resources should be conducted – present data are based upon models that ignore the effects of islands and local bathymetric factors, both which may accentuate or degrade power. Wave power research has focused on offshore resources and wave power in waters of depths less than 200 metres remains poorly defined. Therefore, Cornett recommended new modeling studies of nearshore wave energy resources where wave energy potential is greatest. He recommended such analysis be conducted for four key areas in Canada including the western shores of the Queen Charlotte Islands and Vancouver Island.[2]

An older 2001 BC Hydro study (2001) found that the west coast of Vancouver Island has an "excellent" wave energy resource. The study found that western Vancouver Island has a theoretical resource of approximately 825 GW and that two specific sites – Winter Harbour and Ucluelet – each have over 200 MW of potential installed capacity.

4.3 Wind Energy

The most recent study of the BC coast's wind energy potential was conducted by Holt and Eaton (2007). Holt and Eaton examined all sites in BC that had Investigative Permits (IP) taken or applied for by developers as of September 2007 and estimated resource potential at these sites using wind speed data and average capacity factors. In the Vancouver Island area (including the Greater Vancouver and mainland areas in the vicinity of the Island), the study found 6 GW of theoretical wind resource spread across 48 IP sites. After current transmission capability, environmental planning constraints, and expected power demand were considered, Holt and Eaton concluded that about 0.6 GW of total rated capacity existed.[3] In the North Coast region, Holt and Eaton identified 37 sites, including large offshore areas off the coasts of Queen Charlotte and Porcher Islands. They found a theoretical resource of 5 GW onshore and 13.5 GW offshore. After current transmission capability, environmental planning constraints, and expected power demand were considered, they concluded that about 0.5 GW of onshore and 1.4 GW of offshore total rated capacity existed.

A 2002 BC Hydro study (2002) found that BC had 10 notable sites for wind power, adding to 730 MW of potential installed capacity and offering 1,600 GWh of production. The study identified the northern portion of the coast is one of three prime areas in the province for wind energy development (the other two are in the Interior of BC). The study only looked at prime areas for near term development, and identified the best places on the coast to be Mount Hays and Ridley Island, both near Prince Rupert. The study also noted that locations on the northern end and west coast of Vancouver Island looked promising.

[2] The other two areas recommended for further investigation include south-eastern Newfoundland and south-eastern Cape Breton.
[3] This measure of total rated capacity is roughly equivalent to the practical resource.

A 2002 study by Helimax Energy (2002) examined three areas for their wind energy potential: Port Hardy, Port Alice and Prince Rupert. concluded that the three areas presented a theoretical wind resource of roughly 4,800 MW and that the majority of this energy potential (3,700 MW) was in the Prince Rupert area. If economics and marketability were considered, Helimax concluded that only about 1,200 MW of the theoretical potential was realistic. Of this practical resource, 1,100 MW was on Vancouver Island in the Port Hardy and Port Alice areas, and 120 MW was in the Prince Rupert area. The remaining 3,600 MW of the theoretical capacity was on the two islands of Banks and Porcher and was challenged by lack of transmission to market. Note that the areas examined by Helimax were pre-selected by the study's sponsors for socio-economic reasons and thus this study did not examine the wind energy potential of BC's entire coastal region.

4.4 Summary

Proponents, government, and associated non-governmental organizations routinely characterize the BC tidal, wave, and wind resources as large. At present, the greatest constraints to developing these resources are lack of transmission capability and immaturity of the technology (Campbell 2008; Griffiths et al. 2008; Turner 2008). But with time, in the words of Chris Campbell, executive director of the Ocean Renewable Energy Group, Vancouver Island and the Queen Charlotte Islands could be "powerhouses" (2008).

5. ROE Development on the BC Coast

Industry has numerous tidal, wave, and wind projects planned or underway for the BC coast. According to information on developer websites, on the website of the BC Environmental Assessment Office[4], and the website of the Integrated Land Management Bureau[5], and other sources, there are 156 sites with ROE activity. Some of these sites are projects under construction or development, i.e., are in the permitting stage, but most are sites being examined for feasibility. As many proponents will take out permits to investigate many different sites in the same area, this count of 156 separate "projects" likely overestimates the actual number of projects envisioned by proponents and that will actually be developed. Activity is largely on and around Vancouver Island, and to a lesser extent the North Coast area. There are 23 different proponents involved. We provide a summary of all ROE sites on the BC coast in Appendix 2.

There is one tidal project in the operational phase – the Race Rocks demonstration project near Victoria – as well as two in the development phase on the east side of Vancouver Island. These latter two are in the process of acquiring permits and approvals. There are 19 tidal power sites currently under investigation for possible development, mostly located on the eastern side of Vancouver Island. Four different proponents are involved in tidal energy in BC.

There are eight different sites being examined for wave energy, and all are on the west coast of Vancouver Island in the Tofino and Ucluelet areas. Three different proponents are involved.

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[4] http://www.eao.gov.bc.ca/epic/output/html/deploy/epic_home.html
[5] http://www.arfd.bc.ca/ApplicationPosting/search.jsp

It is very difficult to estimate the number of wind projects under development. We have identified 126 different sites with wind project activity, both onshore and offshore, though of these sites, we estimate that only about 70 different projects are planned. Nine of the 70 projects appear to be in the development/permitting phase, with two having received environmental assessment approval; the rest appear to be in the site evaluation phase. Of the 70 projects, 22 are in the North Coast area, and the remaining 48 are on or around Vancouver Island. Two onshore wind projects are being investigated in the Lower Mainland area, one of them in the Point Grey part of the City of Vancouver. There are four offshore projects being planned or investigated – one in the so-called "Haida Energy Field" in east side of Hecate Strait off the north-east part of Haida Gwaii, two in the waters on the east side of Hecate Strait, and one off of Vancouver Island. Eighteen different companies are involved in wind energy development on the BC coast.[6] Figures 2 and 3 show the IP sites studied by Holt and Eaton (2007). While these maps do not show all sites that we have identified, they give a good indication of the geography of wind energy development.

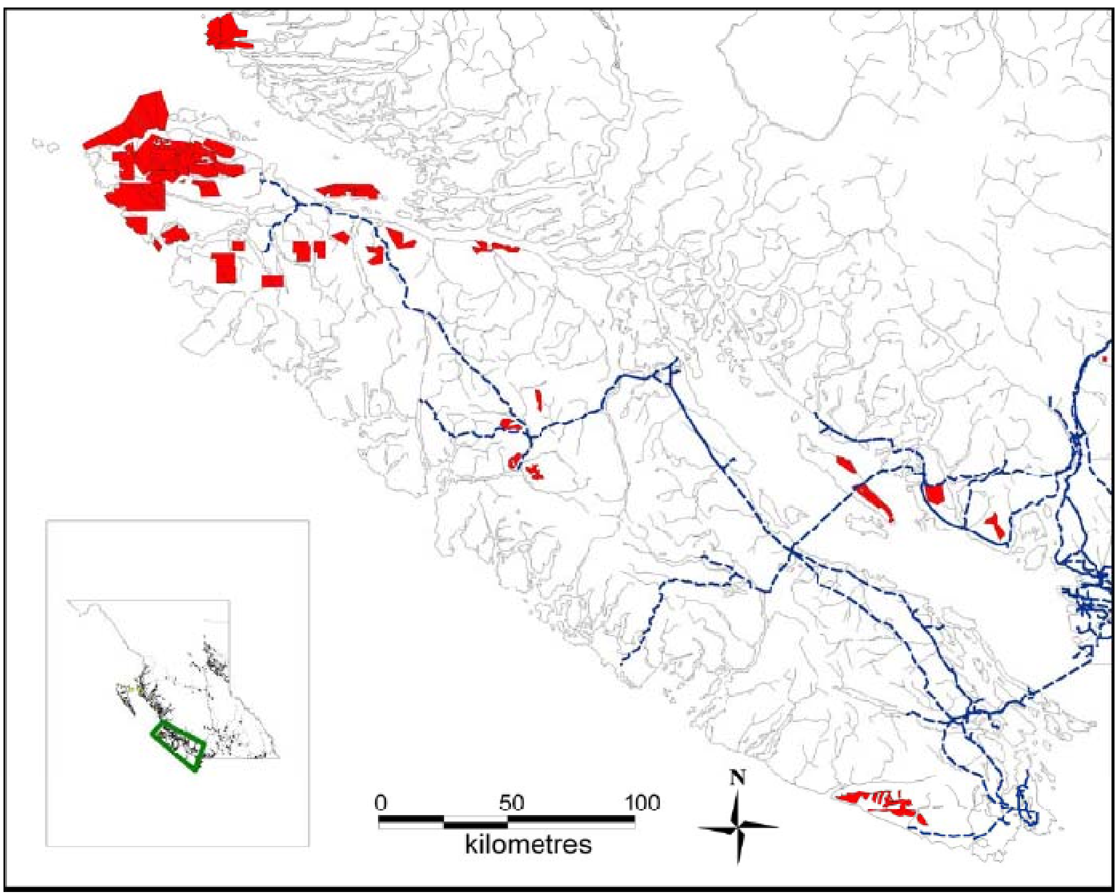

Figure 2. Map of IP sites where wind energy projects are planned as identified in the Vancouver Island area by Holt and Eaton (2007).

[6] The sum of the number of proponents involved separately in tidal, wave, and wind sum to greater than 23 because some proponents are involved in more than one type of energy development.

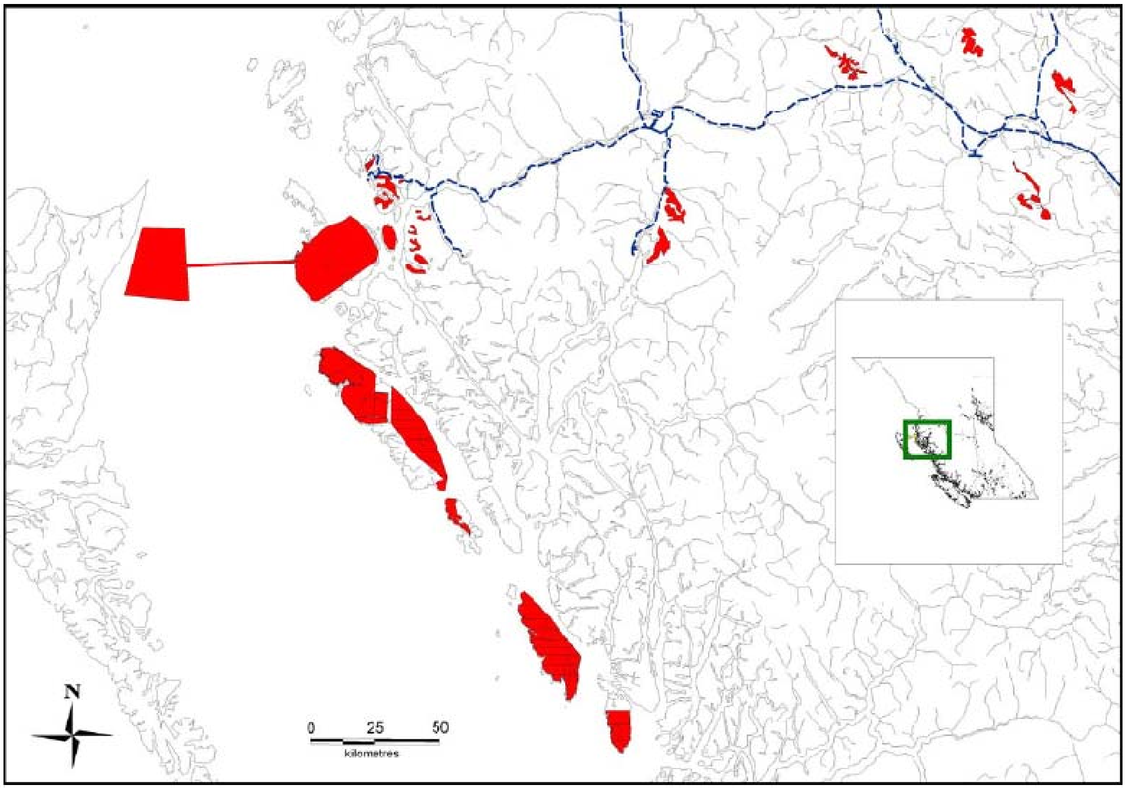

Figure 3. Map of IP sites where wind energy projects are planned as identified in the North Coast area by Holt and Eaton (2007).

6. Socio-Economic Overview of the BC Coast

To help understand socio-economic impacts, it is important to understand the cultural, economic, and social context of the region in question. In this section we provide a brief overview of socio-economic conditions, economic interests, and First Nations interests on the BC coast, with a particular focus on the mostly rural portion of the coast away from the Lower Mainland and Victoria areas. For much of this review, we rely upon BC Statistics' on-line database (Undated). Statistics and trends discussed in this section are from this database unless otherwise indicated.

BC Statistics considers the BC coast to be composed of three Development Regions (DRs):

- Vancouver Island/Coast, composed of the Alberni-Clayoquot, Capital, Central Coast, Comox-Strathcona, Cowichan Valley, Mount Waddington, Nanaimo, and Powell River Regional Districts (RDs);
- Mainland/Southwest, composed of the Fraser Valley, Greater Vancouver, Sunshine Coast, and Squamish-Lillooet RDs; and the
- North Coast, composed of the Kitimat-Stikine and Skeena-Queen Charlotte RDs.

The BC coast – these three DRs and their 14 constituent RDs – are shown in Figure 4.

Figure 4. Regional Districts of BC (BC Statistics Undated).

6.1 Key Socio-economic Indicators

6.1.1 Population

Seventy eight percent of the BC population (3.4 million people) lives on the BC coast. Of this population group, 66%, or 2.9 million, live in the Lower Mainland and Victoria areas. Only about 535,000 people live along the BC coast outside of the major urban centres in the south. Away from the southern urban areas are many small communities of less than 100 people as well as larger centres such as Nanaimo (79,000), Campbell River (30,000), and Prince Rupert (13,000) (CR&DCC 2001; City of Prince Rupert Undated; RDN Undated).

First Nations compose a significant portion of the coastal population. According to the 2001 Census, there were 98,000 First Nations people living on the BC coast. Forty-two percent of First Nations on the BC coast, or 41,000, live outside of the Lower Mainland and Victoria areas. In some RDs, the proportion of First Nations to non-First Nations is high. For example, in the Central Coast RD, where about 3,300 people in total live, First Nations compose 59% of the population.

According to BC Statistics (Undated), the total BC coast population is going to grow 168% over 1990 levels to 4.2 million by 2030. This rise will mostly be seen in the southern RDs. For example, the Greater Vancouver RD population is projected to grow by 87% (Figure 5).

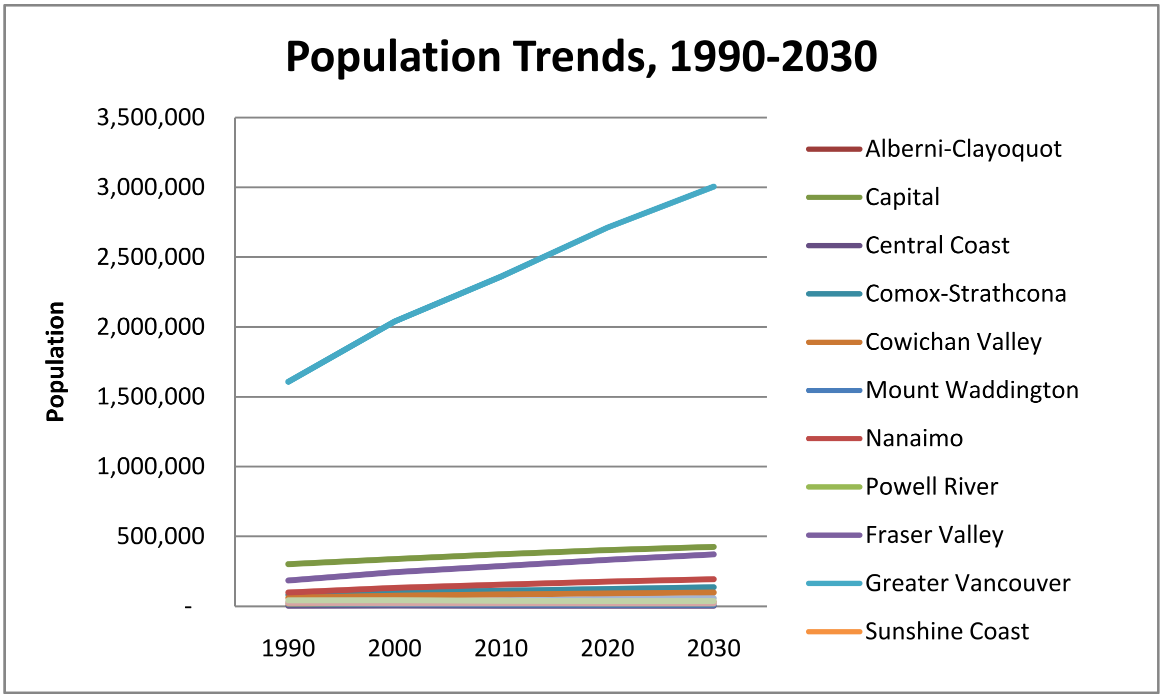

Figure 5. Population trends in Regional Districts of BC, 1990-2030 (BC Statistics Undated).

However, a decline in population is forecast for six RDs in the BC coast: the Alberni-Clayoquot, Central Coast, Mount Waddington, Powell River, Skeena-Queen Charlotte, and Kitimat-Stikine. The greatest proportional loss is expected in the Mount Waddington RD – a decline of 4,138 people, or 29% of the population relative to 1990. Population trends in RDs with forecasts of decline are shown in Figure 6.

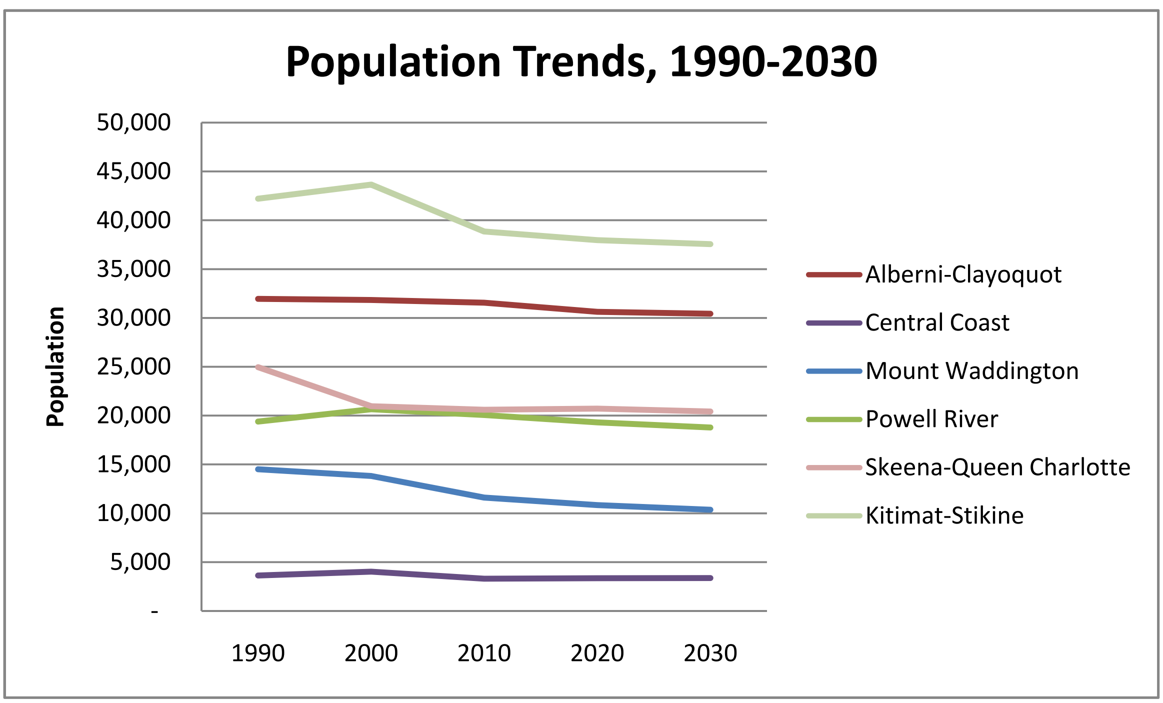

Figure 6. Population trends in six rural Regional Districts, 1990-2030 (BC Statistics Undated).

The First Nations population in BC grew by 22% between 1996 and 2001, while the total BC population only grew by 5% (Statistics Canada 2006). However, there was an overall decline in population on reserves in the central and northern areas of the BC coast between 1996 and 2001 (BC Statistics 2002).

6.1.2 Employment

The largest employing sector is non-government services, followed by manufacturing, primary goods, government, and construction (Table 3). The data show that some of the regional districts have a much higher proportion of their employment in the primary and manufacturing sectors.

Table 3. Labour structure of the BC coast (%)(BC Statistics Undated).

Regional District	Primary	Manufacturing	Construction	Non-Government Service	Government
Alberni-Clayoquot	11.2	17.5	4.5	59.9	6.8
Comox-Strathcona	12.9	7.3	6.1	66.7	7
Cowichan Valley	7.8	11.9	6.3	67.5	6.6
Mount Waddington	23.9	14.1	2.8	52	7.3
Nanaimo	4.2	7.7	7.2	75.3	5.6
Powell River	10.1	14.1	6.6	64.9	4.2
Sunshine Coast	7.9	10.4	8.3	69.4	4.1
Squamish-Lillooet	5	5.1	8.9	75.1	5.9
Skeena-Queen Charlotte	10	15.5	4	60.6	9.8
Kitimat-Stikine	7.7	17.8	6.8	59.5	8.2
Capital/Fraser Valley/Greater Vancouver (average)	4.1	8.4	6	73.4	8.1

Note: Data unavailable for the Central Coast RD.

As can be seen in Table 4, the majority of employment is in the service sector. Manufacturing is highest in the North Coast DR (in wood products), and construction is also a large employer. Forestry, fishing, and mining employ significant numbers in the North Coast DR, and the least number in the Mainland/Southwest DR.

Table 4. Labour structure by industry of the BC coast (%)(BC Statistics Undated).

Development Region	Agriculture	Forestry, Fishing, and Mining	Utilities	Construction	Manufacturing	Service Sector
Vancouver Island/Coast	1.0	2.6	0.4	9.5	5.1	81.4
Mainland/ Southwest	1.1	0.8	0.4	8.2	9.2	80.3
North Coast	0	6.7	0	5.3	17.1	67.5

The north of the province is expected to have the fastest employment growth in the province, largely because of major resource-based development projects, e.g., pipelines, mines, etc. Some of these jobs will be in the BC coast region. BC Statistics expects a 3% growth rate in employment in the North Coast DR versus 2% in the Mainland/Southwest DR and 1.3% in the Vancouver Island/Coast DR. Table 5 presents growth expectations by industry for the three DRs of the BC coast. It can be seen that there is expected to be substantial growth in agriculture (which includes aquaculture) across all three DRs, growth in construction and wood products manufacturing in the North Coast DR, but also declines in fishing, forestry and paper manufacturing in all DRs.

Table 5. Projected annual growth rates in employment demand on the BC coast (%)(BC Statistics Undated).

Development Region	Agriculture	Forestry	Fish/ Hunt	Oil & Gas	Mining	Utilities	Construction	Mfg - Food	Mfg - Wood	Mfg - Paper	Mfg - Metal	Trade	Trans port	Business: Lo&Hi	Education	Health	Communications	Accom & Food	Government
Vancouver Island/ Coast	6	1	-3	2	2	1	3	3	0	-3	3	1	2	1	1	2	1	2	1
Mainland/ Southwest	6	1	-3	2	3	2	3	3	0	-3	3	2	3	2	2	3	2	2	1
North Coast	6	1	-3	2	3	3	13	4	8	-3	3	3	3	5	0	4	3	3	1

The greatest unemployment rates occur in the North Coast DR – 8% versus a provincial average of 4.2%. While there is strong growth in First Nations employment in northern BC (BC Statistics 2005), First Nations have a high unemployment rate of 10.8% (BC Statistics 2007). BC Statistics also noted that:

- First Nations men have higher unemployment rates than women;
- the employment rates for non-First Nations have been stable since 2004 but for men there is increasing unemployment and for women there is decreasing unemployment; and
- First Nations earn, on average, less than non-First Nations (2007).

6.1.3 Education

The population in less urbanized regions has the lowest levels of education on the BC coast (Figure 7). The Alberni-Clayoquot, Skeena-Queen Charlotte, and Kitimat-Stikine RDs each have fewer than 42% of 20 year-olds with post-secondary education compared with the Capital, Greater Vancouver, Sunshine Coast, and Squamish-Lillooet RDs which each have greater than 50%. In a similar fashion, university education levels are below 10% in each of the Alberni-Clayoquot, Fraser Valley, Kitimat-Stikine, Mount Waddington, Powell River, and Skeena-Queen Charlotte RDs compare to over 15% in the Capital, Greater Vancouver, and Squamish-Lillooet RDs. RDs with over 20% of residents without high school educations include Alberni-Clayoquot, Comox-Strathcona, Fraser Valley, Kitimat-Stikine, Mount Waddington, Powell River, and Skeena-Queen Charlotte.

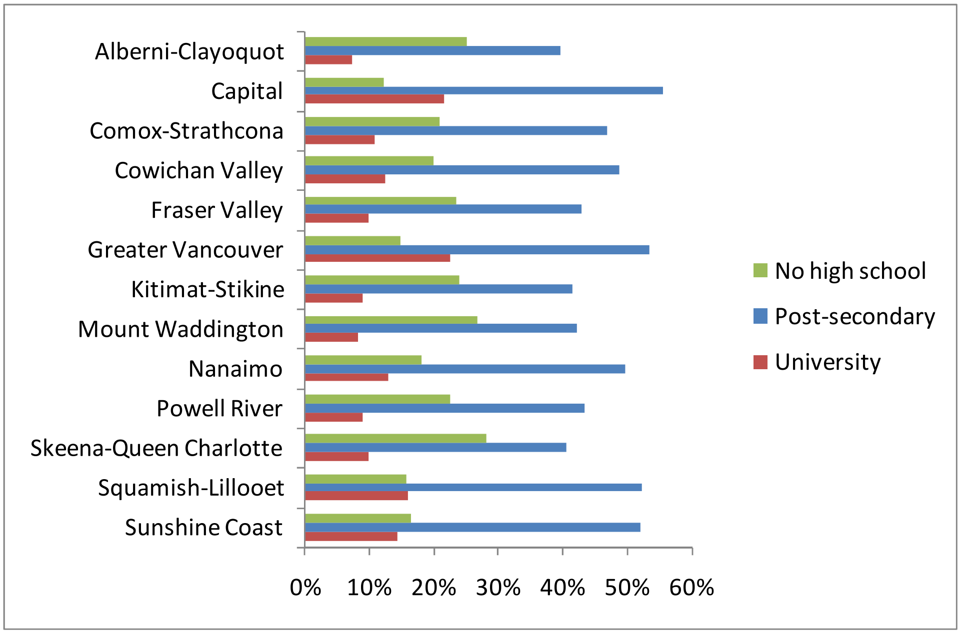

Figure 7. Education levels on the BC coast (%)(BC Statistics Undated).

According to BC Statistics (2007), there is a large gap in education between First Nations and non-First Nations people. The gap has been decreasing, but remains substantial. In 2006, 27% of 15-64 year old First Nations did not have high school or post-secondary education (excluding those studying) and only 6% had a university degree (vs. 23% in the non-First Nations population). First Nations women have higher educational attainment than men. First Nations youth have a lower high school and post-secondary completion rate than non-First Nations (35% versus 21%).

6.1.4 BC Statistics Socio-economic Indices

BC Statistics has a series of indices to describe RDs in terms of their overall socio-economic condition. Indices exist for economic hardship, crime, health, education, as well as for overall conditions. The overall indicator suggests that the "worst" socio-economic conditions are in the rural hinterland areas, specifically the Alberni-Clayoquot, Mount Waddington, and Skeena-Queen Charlotte RDs. The best conditions are in the southern RDs: Capital, Sunshine Coast, and Squamish-Lillooet.

6.2 Economic Interests

Income dependency – the proportion of a community's or region's basic income[7] stemming from a particular economic sector – is illustrative of the economic vulnerability and interests of communities and First Nations along the BC coast. Data from Horne (2004) and BC Statistics (Undated) indicate that the public sector and forestry are the main sources of income throughout coastal BC, i.e., most dollars stem from one of these

[7] According to Horne (2004), basic income is defined as income that flows into a community or region from the outside world in the form of either employment income or non-employment income. Basic employment income flows from jobs that produce goods and services that are exported elsewhere, from jobs that produce goods and services for the tourist sector, or from jobs in the public sector where the income is flowing in from senior governments. Basic non-employment income is income flowing from transfer payments from senior governments, such as welfare payments or investment income.

two sectors (Table 6). Forestry includes logging, sawmilling, wood product manufacturing, paper manufacturing, etc. Public sector activities include health care, education, defence services, public administration, etc. Tourism and construction are also large contributors of basic income. The "other" category is mostly non-resource manufacturing but includes a variety of other industries.

Table 6. Income dependencies (% of basic after-tax income attributable to sector) (Horne 2004).

Region	Forestry	Mining & Min Processing	Fishing	Agric & Food	Tourism	High Tech	Public Sector	Construction	Film Prod'n	Other	Transfer Payments	Other Non-Empl. Income
Vancouver Island/Coast	17	1	3	2	6	1	26	5	0	4	20	16
Mainland/Southwest (excl. Greater Vancouver)	12	1	0	4	8	1	26	8	1	9	18	12
North Coast	23	6	4	0	5	0	32	4	0	3	18	6

Notes: Rows may not sum to 100 due to rounding. Transfer payments and Other Non-Employment Income includes welfare payments, pensions, tax benefits, annuities, investment income, etc.

We can see from Table 6 that the rural areas of the BC coast, particularly in the north, are the most dependent upon forestry and the public sector. It is also evident that fishing is an important source of basic income in the central and northern areas of the BC coast, agriculture and food (including aquaculture) is important in the central and southern areas, and that tourism income is fairly evenly distributed (and important) throughout the BC coast.

When reviewing these data it is important to remember the employment demand statistics presented above in section 6.1.2. While forestry is a significant contributor to the BC coast economy, expected growth in employment demand in forest product industries are low and in some cases declining. Fishing is an important contributor to basic income in the central and northern areas of the BC coast, but employment demand for this industry is also expected to decline in the coming years. Construction and tourism are two other important contributors to the BC coast economy, and they are expected to increase in terms of employment demand.

A complimentary indicator of the economic interests of the BC coastal region is the information contained in land use plans. In the last 16 years, regional resource and land use plans have been completed for nearly the entire provincial land base through stakeholder-driven, consensus-based processes. The North Coast Land and Resource Management Plan (LRMP) (BC 2005) is illustrative of the economic interests of the stakeholders and First Nations. The North Coast LRMP described numerous economic objectives for the area including:

- to increase jobs, standard of living and quality of life in the area while maintaining sustainability;
- expanding, enhancing, and diversifying the region's industry and business community, including growing locally-based businesses;
- encouraging mineral, aggregate, and energy-based economic development, including low-impact energy development;
- maintaining the forest industry but enhancing its capacity to provide stability, long-term benefits to local communities;

- maintain opportunities for non-timber forest product industries;
- further developing tourism that provides long-term benefits for communities but also is environmentally sound and increases First Nations participation;
- increasing the flow of benefits to local communities, including First Nations;
- conducting economic development in a more environmentally-mindful manner;
- expanding upon opportunities to address community needs and environmental health and integrity; and
- enhancing non-commercial recreation activity and opportunities.

The North Coast LRMP highlights the importance of forestry and tourism. Forestry has historically been one of the primary economic activities in the North Coast planning area and continues to be an economic mainstay as logging evolves its techniques to access timber in the mountainous topography of the area. Tourism is well-established and growing in the North Coast and based upon the natural scenery of the area, the abundance of fish and wildlife, the diverse range of opportunities to practice outdoor recreation, and the vibrant First Nations culture. Additionally, the visual value of the area is viewed as a key tourist draw. Areas noted for their scenic value include the Grenville Channel Corridor, the Ecstall River/Kitkiata Inlet, Aristazabal Island, Porcher Island, among other locations. Popular tourist activities include sport fishing, often based out of fishing lodges or using boat charters, as well as wildlife viewing, kayaking, and activities that explore First Nations culture.

6.3 Traditional Interests

The BC coast is traditional territory for many First Nations (BCTC 2007a). First Nations living in the northern portion of the coast include the Tsimshian Nations (Kitselas, Kitsumkalum, Lax Kw'aalams, Metlakatla, Gitxaala, and Gitga'at), the Haida, Haisla, Heiltsuk, and Oweekeno nations. In the Vancouver Island and southern coast area, there are the Ditidaht, Hamatla/Laich-Kwil-Tach, Homalco, Hul'qumi'num, Hupacasath, Klahoose, K'omoks, Maa-nulth, 'Namgis, Nuu-chah-nulth, Pacheedaht, Sechelt, Sliammon, Snuneymuxw (formerly Nanaimo), Te'Mexw, Tlowitsis, Da'naxda'xw Awaetlatla (formerly Tanakteuk), Gwa'Sala-'Nakwaxda'xw, Quatsino, Tlatlasikwala, and Kwakiutl nations. In the Lower Mainland/Fraser Valley area, there is the Katzie, Musqueam, Squamish, Sto:Lo, Tsawwassen, Tsleil-Waututh, and Yale nations.

First Nations have economic interests in the BC coast that overlap with many of the economic interests of non-First Nations on the BC coast. Key economic interests include shellfish aquaculture, tourism, forestry, commercial fishing, and energy and transportation development (Wouters 2008).

In addition, First Nations have many traditional interests. The most fundamental interest is the maintenance of their culture, which necessitates access to their traditional territories and resources, and the maintenance of environmental health (Wouters 2008). First Nations' interests are fundamentally connected to control of their traditional territories, sovereignty in decision-making over these territories and the resources therein, and self-determination. The Tsimshian Nations, for example, state that:

> the use of land in its natural state is a primary element of Tsimshian culture. Therefore, access in its natural state must be ensured. Without this land, there will be no Tsimshian culture (BC 2005, 30).

There are many traditional activities and resources that also help define First Nations culture, including:

- fishing, hunting, and trapping;
- gathering of materials, medicines, and plants and other forest products;
- gathering of mineral resources;
- travel and habitation of areas, often in concert with the seasons;
- language(s) and social activities;
- ceremonial and spiritual activities; and
- archaeological sites of First Nations origin.

6.4 Summary of Key Socio-Economic Issues

The economy of much of the coastal region is primarily based on resource industries and the public sector. While there is uncertainty and decline in many natural-resource based industries, there is employment growth in the north associated with major projects. The greatest levels of unemployment occur in the rural regions, and are notably higher among First Nations. Education levels and other socio-economic indicators point towards worse conditions in rural central and northern parts of the coast.

A key socio-economic issue is that of First Nations interests. On top of their economic interests, which are largely similar to non-First Nations living along the coast, First Nations have a strong interest in maintaining their culture. Access to their traditional territories and resources is a high priority for First Nations.

7. Socio-Economic Impacts of ROE

There is now a substantial literature on the socio-economic impacts of both onshore and offshore wind energy development, and a growing literature on the impacts of tidal and wave energy development. In the sections below we discuss these impacts in the contexts of both the international experience and the BC coast.

7.1 Coastal Defence

Installation of turbines in air and water for the purposes of generating energy takes energy out of the wind and ocean (Couch and Bryden Undated). Withdrawal of energy may provide coastal defence benefits, e.g., reduction of erosion on shorelines, reduction of wave damage on wharfs, etc. (Scottish Natural Heritage 2004; ABP 2005; FM&M 2007). The degree to which ROE installations will assist in coastal defence is dependent upon many locational characteristics. No measures have been suggested in the literature regarding enhancing coastal defence benefits, and there is substantial uncertainty regarding the overall effects of withdrawing energy from the ocean.

The majority of the BC coastline is rocky and loss of beaches and other desirable coastal features does not appear to be a significant issue in BC. Therefore, coastal defence benefits of ROE are not likely to be an issue on the BC coast.

7.2 Cultural Resources

Numerous studies and impact assessments have noted that ROE development may damage cultural resources, e.g., historical and archaeological artefacts and sites (METOC 2000; AMEC 2006; DT&A 2006; ENTec 2007; FM&M 2007; SDC 2007). A recent environmental assessment scoping exercise for a wave demonstration project in the UK, for example, noted that the project might damage marine archaeological resources through construction and cable laying, destabilization of sites through alteration of sedimentary regimes, and/or damage and contamination of sites through pollution or sediment disposal (PMSS 2005; FM&M 2007). ROE development could also impact onshore cultural resources due to the construction of roads, transmission lines, and other onshore infrastructure. Furthermore, ROE development may negatively impact marine archaeology stakeholders by virtue of use and occupation of marine areas (ETNWE 2003).

The BC coast has a rich resource of historical and archaeological sites, from shipwrecks to ancient First Nations camping sites, as well as "cultural landscape" areas with no physical traces of use but of significance to First Nations or other groups. These resources reflect past and present First Nations and non-First Nations uses and help maintain the connections that many First Nations and non-First Nations have to the area. These sites and areas occur all along the BC coast and include onshore locations and landscapes as well as marine and underwater locations and seascapes.

The environmental assessment documentation of ROE projects under development on the BC coast has highlighted the possibility that cultural resources may be impacted. The environmental assessment for the Knob Hill Wind Farm, for example, determined that some of the project area overlaps areas of archaeological potential but concluded that there would be no significant effects as surveys and assessments found no cultural resources in the area (BC EAO 2004b). Similarly, regulators did not expect the Holberg Wind Energy Project to have any impacts on historical or archaeological resources as nothing was found in the project area through record searches, ground truthing, and consultations with the Quatsino Nation (BC EAO 2004a). In the documentation of both the NaiKun offshore wind farm and the Banks Island North Wind Energy Project, consultants indicated that the projects may impact both terrestrial and offshore archaeological sites (Golder 2007; Pottinger Gaherty 2007).

Mitigation Measures

To minimize negative impacts on cultural resources, numerous measures can be undertaken.

1. Involve history and archaeology interests, First Nations, relevant government associations, academia, and any other associated interests early in the ROE planning, impact assessment, and siting processes. (ETNWE 2003; Dillon 2006; FM&M 2007; USDOI MMS 2007)
2. Locate projects in areas not known and least likely to have cultural resources. (ETNWE 2003; FM&M 2007; USDOI MMS 2007)
3. Encourage or require proponents to include cultural resource assessments as part of the approvals and permitting process. (ETNWE 2003; AMEC 2006; Dillon 2006; FM&M 2007)

7.3 Economic Impacts

One of the principal benefits of ROE development is the economic impact in the regions in which development takes place. Economic impacts are primarily of two forms: employment and revenue. Employment and revenue accrue both to those directly involved in the projects, and through "multiplier effects".[8]

Multiplier effects are of four types. Forward linkages are activities such as processing natural resources prior to export. Forward linkages in the context of ROE development could include new economic activities stimulated by the increased availability of energy. Backward linkages involve the production of inputs for the industry, such as the manufacturing of tidal stream turbines. Final demand linkages are due to activities such as the production of consumer goods and services to meet the regional needs of those employed by the ROE industry. Finally, fiscal linkages occur when the profits and rents generated by the renewable energy industry are spent in the region. Forward and backward linkages are commonly referred to as "indirect impacts," and final demand and fiscal linkages are commonly referred to as "induced impacts."

A description of a wind energy project in Colorado gives some indication of the linkages and multiplier effects that are possible:

> At the height of construction, subcontractors employed nearly 400 workers, providing a boost to local businesses. Local companies that provided services also benefited. Herling Construction built 25 miles of roads and excavated 108 turbine foundations. Mortensen employed 87 people to pour 35,000 yards of concrete. Gate City Steel employed as many as 14 people to install 45,000 pounds of rebar in each foundation. Christensen employed 46 people at the height of construction to install 20 miles of underground cable and build the substation. Wilson Construction employed 25 people to install more than 50 miles of buried cable and 44 miles of poles and cables to the new substation. Ridge Crane devoted two cranes to the project for three months. All-Rite Paving & Redi-Mix, Inc. supplied concrete for 32 miles of poles and for the substation. Country Acres Motel and RV Park, which provided housing for construction workers, was booked solid for months. Wallace Gas and Oil provided up to two truckloads per day of fuel and lubricants for the vehicles and heavy equipment on the site. The Hay Stack Steak House experienced a 30% increase in business. Movie rentals at the local Movie Gallery increased 20% (USDOE 2004).

Several other examples from the US help show that in most cases wind energy development results in appreciable economic benefits. Pedden (2006) reviewed 13 studies of rural regions' experiences with wind energy development and found that the impacts on the economies of rural communities were "large," especially in those with few supporting industries. She concluded "investment in wind power creates a positive impact on rural economics in the form of an increase in jobs, income, and taxes" (2). After reviewing the economic impacts of wind energy development on 16 western US states, Tegen et al. (2007) concluded that the benefits were "significant" and noted that impacts would be greatest if manufacturing of ROE componentry expanded in the states. An examination of three rural counties in the US that underwent wind energy development found "modest" to "moderate" boosts in economic activity in the areas (NWCC 2004).

[8] Note that the majority of the discussion below on the economic impacts of ROE development is based upon the experience of the European and US wind energy industries. Given the pre-commercial status of tidal and wave energy, very little information has been published on the economic impacts of these industries.

Sizeable impacts were also noted by Hoffer (2002) in his study of the impacts of wind development in Vermont.

On the BC coast it is likely that ROE development would also have an appreciable economic impact. Much of the BC coast is rural with economies largely dependent upon forestry and the public sector, and the forestry and the fishing industry is likely to decline. Much of the BC coast also has high unemployment. It thus seems likely that ROE development could provide needed employment, revenue, and economic diversification.

The projects in the development phase are anticipated to involve substantial investment (Table 7). The estimated capital costs of projects in the development phase where proponents have provided this information amount to $2.2 billion with an average cost of $1.87 million per MW on installed capacity. If we apply this crude estimate of costs per MW to all projects in the development phase where the estimated installed capacity is known, then there could be $4.2 billion or more spent on ROE development over the coming years. These very rough estimates provide an order of magnitude estimate of the economic impacts of ROE development on the BC coast.

Table 7. ROE Projects in the development phase and their capital costs. Costs in italics are estimated by authors.

Project / Developer	Location	Installed Capacity (MW)	Capital Cost ($ million)
Holberg Wind Energy Project	North Vancouver Island	58.5	120
Knob Hill Wind Farm / Sea Breeze	North Vancouver Island	450	700
Banks Island North Wind Energy Project / North Coast Wind Energy Corp.	East Hecate Strait	700 (initially, 3,000 at full build-out)	1,400
NaiKun / NaiKun Wind Energy Group	Hecate Strait	320 (initially, 1,750 at full build-out)	*598*
Campbell River tidal project /BC Tidal Energy & Marine Current Tech	Campbell River	3.6	*7*
Canoe Pass tidal project / Canoe Pass Tidal Energy Corp.	Quadra Island	?	?
Mount Hays Wind Farm / Katabatic	East Hecate Strait	25-30	*50*
Nahwitti Wind Farm Project / Nomis	North Vancouver Island	200	*374*
Nahwitti wind project / Sea Breeze	North Vancouver Island	?	?
Shushartie wind project / Sea Breeze	North Vancouver Island	450	*841*
Nimpkish wind project / Sea Breeze	North Vancouver Island	71	*133*
Total			4,224

7.3.1 A Note of Caution

Before any further discussion of the economic impacts of ROE development, a critical distinction must be made between incremental and non-incremental economic impacts. When a project is undertaken, some of the investment, employment, and revenue impacts are incremental from what would have happened otherwise, while some of the impacts are simply shifts of resources (including labour) from other sectors in the economy. For example, when employment levels are near full, as they are in many parts of Canada, any new project will for the most part simply reallocate labour and capital. Employment created by new projects is not therefore incremental but simply indicate shifts of labour. However, in particular regions in Canada, particularly where unemployment levels are high, projects have the potential to provide incremental employment for the region by reallocation of labour and capital from other regions. Although there may be no overall incremental employment in Canada, there will be incremental employment gains in some regions offset by employment losses in other regions. With this distinction in mind, the social net benefit of a project in terms of employment impacts is the incremental jobs created, and any incremental income earned by those previously employed above what they earned in their previous jobs. Thus, to understand the economic impacts of ROE development, observers must consider the incremental nature of the impacts and the opportunity costs of investment and labour, i.e., what was lost elsewhere at the expense of the employment of funds and labour in the project in question. It is notable that of all of the economic impact literature that we have reviewed for this report, we have not located any that distinguishes between incremental and non-incremental impacts. We nonetheless suggest that readers keep this consideration in mind when reviewing the information that we provide in this report.

7.3.2 Employment

Numerous studies have examined employment impacts of renewable energy development. There is a large variation in findings that reflects different methodologies and assumptions used by researchers, different scales of studies (i.e., in terms of the extent of the supply chain analyzed), different scopes of studies (i.e., extent of coverage of direct, indirect, induced, displaced jobs, etc.), the years in which the analyses were conducted, and variation in economic conditions in the impacted regions (i.e., labour conditions, extents of local supply chains, leakages, etc.) (Campbell et al. 1997). As such, the employment impacts of projects will be unique to the locale, and thus results are not directly applicable to the BC coast. Nonetheless, it is helpful to review the results of studies of other regions to get an appreciation of employment impacts provided by ROE development.

As a note of caution, readers should be careful when interpreting employment impact data presented as “person-years of employment.” If a project is estimated to provide 100 person-years of employment during the operating phase and the lifespan of operation is expected to be ten years, then there will be only 10 operational jobs or 10 average annual person-years of employment. As this example demonstrates, it is critical to understand the unit that is used to measure employment to get a clear assessment of employment impacts.

Employment Impacts Abroad

The early phases of renewable energy projects tend to employ few people. Border Wind (1998 in Ball 2002) estimated 0.17 direct jobs are created per MW of installed capacity during project design and development in the offshore wind industry in the UK. Other, less comparable, employment impact data on the direct employment impacts of the site evaluation and development phases can be found in Horne and Campbell (2006).

Most studies find that the construction phase generates the most employment impacts in a given year. Studies from Europe (Border Wind 1998 in Ball 2002) and the US (NWCC 2004) have found employment ratios typically between 0.87 and 1.76 direct jobs per MW of installed capacity, but also as low as 0.08. A proponent of a (relatively small) 26 MW onshore wind farm in Newfoundland estimated the construction phase would employ 33 people in a variety of jobs types (Box 1)(Top Pond 2006). This works out to a ratio of 1.3 direct jobs per MW. Other, less comparable, employment impact data on construction direct employment impacts can be found in Singh and Fehrs (2001), Kammen et al. (2004), Horne and Campbell (2006), Hoffer (2002), and Pedden (2006). It is important to emphasize that the employment created during the construction phase is temporary employment and thus will not provide long term economic stimulus.

The long-term jobs in renewable energy are generated in the operations phase. Given the capital intensive nature of ROE, few permanent operational jobs are created. Proponents of the 26 MW onshore wind farm in Newfoundland estimated that only 7 employees would be needed during operations – down from 33 in construction (Box 1) (Top Pond 2006). Studies from Europe (ETNWE 2003), the US (SEED Coalition and Public Citizen's Texas Office 2002; Kammen et al. 2004; NWCC 2004; Pedden 2006), and Canada (Horne and Campbell 2006; Jamison et al. 2007) found that the operation phase provides between 0.03 to 1 direct job per MW of installed capacity. Other, less comparable, employment impact data on direct employment impacts during operations can be found in Singh and Fehrs (2001).

An interesting facet of ROE development that enhances the employment value of the operations phase is that projects tend to require more regular operations and maintenance than other forms of electricity generation (Campbell 2008). For example, hydroelectric dams and fossil fuel-fired generating stations tend to operate for relatively long periods of time and then require shut down for periods of maintenance. In contrast, ROE projects tend to be composed of multiple devices – wind

Box 1. Anticipated Jobs on the Top Pond Wind Farm, Nfld

Construction	**#**
Construction Manager	1
Secretaries	1
Professional Engineers	5
Land Surveyors	1
Civil Engineering Technologists and Technicians	2
Drafting Technologists and Technicians	2
Contractors and Supervisors, Carpentry Trades	2
Contractors, Supervisors, Other Construction Trades, Installers, Repairers and Services	2
Electricians	2
Cement Finishers	2
Heavy –Duty Mechanic	1
Truck Drivers	2
Heavy Equipment Operators	2
Construction Trades Helpers and Labourers	4
Other Trades Helpers	4
Total	**33**

Operations	**#**
General Managers	1
Project Engineer	1
Maintenance Supervisors	2
Secretary	1
Electricians	2
Total	**7**

From Top Pond (2006)

farms, for example, are composed of multiple turbines – and these devices require frequent repairs and maintenance, requiring a permanent operations and maintenance workforce.

The greatest employment impacts in the ROE industry tend to be in the manufacturing of turbines and other equipment, i.e., indirect jobs. Border Wind (1998 in Ball 2002) determined offshore wind in the UK would generate between 2 and 2.5 jobs in manufacturing per MW of installed capacity, while the European Wind Energy Association assumed 6 jobs per MW of installed capacity are generated (Ecotec 2002). In the 2006 *Global Wind Energy Outlook*, authors reported that offshore wind in Europe would generate 16 direct jobs in manufacturing per MW of installed capacity in the next decade or so and then fall to 11 jobs per MW of installed capacity (Greenpeace and GWEC 2006). An earlier study of Canadian and US wind energy found that between 3 and 8 jobs would be generated per MW of installed capacity from manufacturing (Campbell et al. 1997). A study by Helimax (2002) on wind energy development in BC suggested that there would be 14.6 job-years/MW in manufacturing (if such facilities were established). Other, less comparable, employment impact data on manufacturing employment impacts can be found in Singh and Fehrs (2001), Kammen et al. (2004), Horne and Campbell (2006), and Pedden (2006). Note that manufacturing employment associated with any specific ROE project is generally short term – it occurs only during the manufacturing of the equipment – and usually occurs in large centres far away from the region where the project is being constructed.

Some studies have investigated the total employment impacts of renewable energy development, i.e., the total of direct, indirect, and induced jobs. In Europe, several studies on offshore wind have found an average of about 4.5 jobs per MW of installed capacity (Ball 2002; ETNWE 2003). The European Thematic Network on Wave Energy estimated that initially there would be about 10 jobs per MW of installed capacity of wave energy but as the wave energy industry evolved the employment ratio would drop to a rate similar to offshore wind of about 4.6 (ETNWE 2003). Note that the studies from Europe assume manufacturing taking place within the "region." In the US, analysts have found total employment impacts ranging from 0.36 to 22.7 jobs per MW of installed capacity (Hoffer 2002; Pedden 2006). From available information in these studies, it is not apparent why such high employment factors were found in the US studies. Other, less comparable, employment impact data on total employment impacts can be found in Singh and Fehrs (2001), Kammen et al. (2004), and Ball (2002).

Indirect multipliers for wind power range from 1.6 in Canada (CanWEA in Industry Canada Undated) to 1.15 in the US (SEED Coalition and Public Citizen's Texas Office 2002) to upwards of 5 in Europe (Ecotec 2002). In examining the multiplier effects of wave energy in Scotland, the European Thematic Network on Wave Energy (ETNWE 2003) concluded that multipliers would be similar to a range of other industries in Scotland like Agricultural Machinery (1.82), Construction (2.09), Electric Motors and Generators (1.48), Iron and Steel (1.98), Metal Containers (1.79), and Shipbuilding and Repair (1.97) and thus they settled on a range of 1.4 to 2.2.

The variety of results from studies of the employment impacts of renewable energy highlights the uncertainty that exists in predicting these impacts. In the introduction to this section we discussed a variety of factors that contribute to the variety in results of different studies. An additional and increasingly potent influence is the effect of technology. The European Thematic Network on Wave Energy (ETNWE 2003) noted that predicting the socio-economic benefits of renewables is technology-specific, and with the wide variety of wave and tidal energy designs around the world today, it is very difficult to estimate multipliers. Referring specifically to wave energy, they noted that "until [these technologies become] established and the industrial demands for building the designs in the quantities required are known any estimate of job creation would be very uncertain" (ETNWE 2003, 326).

It may be more useful to examine the employment impacts in terms of investment. A popular measure is jobs per year per million dollars invested (JPM). An early study by Campbell et al. (1997) found that wind generates between 1.8 and 8 direct, indirect, and induced JPM in North America, and renewables on average generate 12.2 direct, indirect, and induced JPM (Table 8). A 1998 study by the Danish Wind Energy Association found 22 JPM ($ USD), but Denmark holds the majority of the world's wind energy manufacturing, and so its economic impacts may not be comparable to those of Saskatchewan or Iowa.

Table 8. Estimates of total jobs per million $ CDN invested (unless otherwise specified).

Employment Estimate (JPM $ CDN)		Reference
8	(onshore wind, Saskatchewan)	Campbell et al. (1997)
1.8	(onshore wind, Iowa)	Campbell et al. (1997)
22[1]	(USD $; wind; 17 in manufacturing, 5.5 in installation)	Danish Wind Turbine Association (1998 in Helimax 2002)
12.2	(renewables)	Campbell et al. (1997)

Note: 1. Uncertain if total jobs or just direct jobs.

These data can be further put in perspective by comparing them to JPM data for other sectors. Campbell et al. (1997) reviewed the economic impacts of renewable and fossil-fuel based energy generation and found that, on average, fossil fuel-based generation offered 7.3 JPM compared to 12.2 JPM provided by renewables. Campbell et al. provided a variety of JPM statistics to put the employment impacts of renewable energy into perspective. A selection of their results is presented in Table 9. Campbell et al. found that in most cases renewable energy development generated more jobs than conventional energy generation, but less than investments in a number of other sectors.

Table 9. Estimates of total jobs per million $ CDN invested (after Campbell et al. (1997)).

Sector	Employment Estimate (JPM $ CDN)
Renewable energy average	12.2
Saskatchewan wind energy	8
Iowa wind energy	1.8
Alberta oil	6.5
Alberta oil sands	14.6
Saskatchewan Natural Gas Electricity Generation	5.8
BC Large Hydro-Electric	2.6
Canadian New Residential	27.9
Canadian Retail	42.5

These results have been confirmed by more recent studies that have found that renewable energy provides more employment than conventional energy generation. A 1998-9 study for the European Commission found that renewables provide more jobs than conventional energy due to the labour intensity of renewables, even after job losses in the conventional energy industry that were displaced and losses from subsidies were accounted for (Ecotec 2002). However, the same study found that renewable energy development did lead to a net loss in employment during operations because renewables do not require fuel production (Ecotec 2002). Studies of electricity generation in the US states of Nebraska, California, Pennsylvania, Washington, New York, Arizona, Colorado, and Michigan have also found that renewables generate more jobs than conventional energy (TUSDAC 2001; Heavner et al. 2003; Washington 2003; USDOE 2004; Pedden 2006; Tegen 2006; Kammen et al. 2004).

Factors Affecting Employment Impacts

A major factor influencing the scale of employment impacts in a region is the structure of the supply chain in the region for providing supplies and equipment for ROE development. Denmark is a prime example of the substantial economic impacts that can be gained in the renewable energy industry when a complete supply chain exists within the region. Denmark implemented a plan to become the world leader in wind technology. According to a 2005 study, Denmark's ROE sector provides 40% of the world's wind turbines, employs 20,000 people, and earns almost 3 billion Euros annually (PBA & ESBI 2005). Denmark designs and manufactures wind turbines, as well as installs and uses wind energy technology. Jobs range from high paying positions in management, research, design, and engineering to positions in manufacturing, installation, construction, operations and maintenance. While the higher paying jobs in ROE can be more cyclical (ETNWE 2003), these types of jobs can be sustained when they exist in a region supplying other regions with the technology. Denmark demonstrates that great economic benefits can arise from the development of the expertise to develop the resource, not the development of the resource itself (Ecotec 2002; PBA & ESBI 2005). A UK study concluded that the "greatest prospects [for employment gains] are in manufacturing and export" (TUSDAC 2001).

In contrast, in regions where the supply chain is truncated, employment benefits are generally more limited. Without manufacturing, there is only project development, construction, and operations and maintenance. Many of the development and construction jobs are taken by workers residing outside the region where development is taking place and move from project to project, and there is also substantial leakage of impacts due to high propensities to import components manufactured elsewhere. Rural regions therefore tend to receive few of the employment benefits generated by ROEs because their small, undiversified economies cannot supply inputs for ROE development (Campbell and Pape 1999; ADAS 2003; NWCC 2004; Ouderkirk and Pedden 2004; Pedden 2006; ENTec 2007).

Several recent studies of wind power development in Canada are illustrative of this pattern. Industry Canada (Undated) found that there is only one blade manufacturer in Canada, no turbine manufacturers, one manufacturer of regulators and several manufacturers of mounting towers. Not surprisingly, researchers at the Canadian Tourism Research Institute (CTRI 2006) estimated that with 1,650 MW of installed capacity planned for south-eastern Alberta over the next few years, only 23% of the spending on turbines would occur within Alberta, and most of this amount (76%) would be in construction. According to Wittholz and Pan (2004), 65-70% of the cost of wind energy is in turbines, yet Canada imports all large turbines and components with the exception of towers. Thus, the vast majority of the spending on wind energy development goes to manufacturing firms outside of Canada.

Studies from the US further illustrate the point. A study by the US National Wind Coordinating Committee (NWCC 2004) examined three rural counties' experiences with wind energy development and found low multipliers and high leakages of spending (and employment impacts) due to the low diversification of the rural economies. The only substantial linkage found was in terms of induced employment in the local trade and services sectors. In each case, the owners of the projects were non-local, and so earnings left the region (and thus could not generate induced employment impacts in the region where development was taking place). Similarly, Ouderkirk and Pedden (2004) found that a rural region in Oregon where wind energy development was taking place had a narrow, agriculture-based economy and had to import most of the inputs from other regions. Rural regions tend to have very truncated supply chains that clearly reduce employment impacts.

A second major factor affecting employment impacts is the skills present in a region's labour pool relative to the skills required for a given project or phase of development. According to its most recent survey of the industry, the Canadian Wind Energy Association (CanWEA 2007b) estimated about 75% of jobs in the industry are skilled jobs including managers, consultants, engineers, scientists, and trades people. A recent study of the wind energy industry in Canada by Industry Canada (Undated) determined that there are roughly 150 members of which about one third are consultants and the rest are component manufacturers, developers, distributors, and dealers (aka designer/installers). The majority of these positions are based in urban centres, not rural areas, and so, most jobs in ROE tend to flow to larger urban areas outside the rural region.

Experience around the world bears a similar pattern of employment impacts flowing to non-rural residents. The European Thematic Network on Wave Energy (ETNWE 2003), for example, noted that while civil construction jobs for the construction of offshore wave energy projects in Europe would go to local contractors, key jobs such as the erection of wind turbines would likely be performed by specialists from the country that manufactured the devices.

Similarly, several studies have observed that much of operations and maintenance work tends to be conducted by manufacturers, distributors and other specialists located outside the regions where development is taking place (ADAS 2003; ETNWE 2003; ENTec 2007; Industry Canada Undated). ADAS (2003) noted that offshore wind projects should have higher employment impacts than onshore projects given their added complexity, but that many of these additional jobs would typically be of a high skill nature (i.e., divers, geologists) and thus are not likely to accrue to labour in rural areas. ADAS felt that these patterns and factors would hold in the case of wave and tidal projects. This is consistent with findings of other studies of development projects in rural regions that found that locals tend to miss out on jobs due to skill mismatches (Yamaguchi and Kuczek 1984; Cocklin and Kelly 1992). It is notable, though, that the Canadian Tourism Research Institute (CTRI 2006) reached a contrasting conclusion in their study of wind energy development in Alberta. CTRI estimated that about 75% of turbine warranty and maintenance expenditures for new wind energy development in the southeast region of Alberta would occur within the region (CTRI 2006).

At present there is limited training available in Canada to support the ROE industry. While there are now several renewable energy post-secondary training programs (e.g., Certificate in Renewable Energy from the University of Toronto, Renewable Energy Technology Certificate from Malaspina University College in Nanaimo, BC) and the Canadian Wind Energy Association offers a training course on the East Coast, according to Industry Canada (Undated) there is poor coverage of ROE topics in engineering programs in universities. This lack of specialized training exists despite demand for labour with such skills from the renewable energy industry (Griffiths et al. 2008; Industry Canada Undated).

A final factor contributing to low employment impacts in rural areas is that rural residents may prefer alternative employment or subsistence activities such as hunting and fishing. Employment schedules in the energy industry can conflict with fishing and hunting schedules leading to lowered participation of rural residents in projects (Detomasi 1997).

Rural regions thus tend to receive few of the employment benefits of renewable energy projects. Nonetheless, as noted by ADAS (2003), even a small number of jobs in a rural area can be very significant for the people and communities there.

Employment Impacts on the BC Coast

With as many projects underway and planned as there is along the BC coast, appreciable employment impacts should be expected. These impacts are particularly important given the stagnation and/or decline in some of the major industries on the BC coast and given the unemployment rates present in many of the areas. Unfortunately, limited information is available on specifics of these employment impacts in BC.

Direct Employment – Planning Phases

The majority of the ROE projects in BC are in the site evaluation and development phases and so for the most part are employing managers, consultants, scientists, and other high-skill labour. Many of these jobs are based in the large urban centres in the south of the BC coast. There is also some direct employment for residents of the rural areas applying their skills and resources to ROE projects in the early phases. In Ucluelet, for example, locals have been trained to maintain the buoys that are collecting wave data (Turner 2008). Fishers may also be employed transporting ROE developers to sites in their boats, local hunters may get employment helping on wildlife surveys for environmental assessments, etc. (Campbell 2008).

Direct Employment – Construction Phase

Table 10 provides construction employment impacts for the projects where this information has been published. The limited information that is available shows that if all the projects that are currently under development go ahead as planned, and if developers are required to focus their hiring in the local areas where the projects are being developed, then there should be substantial employment impacts, though short-term, in rural areas during the construction phases of projects.

Several factors will contribute to the nature of construction employment impacts on the BC coast. First, given the clustering of ROE development that is occurring on north Vancouver Island, around the Campbell River area, and on the North Coast, there are likely going to be many jobs in construction and it is possible that many of those involved may be able to work on more than one project (as not all projects will undergo construction at once). For example, in the Port Hardy area of Vancouver Island, numerous onshore wind projects are slated to be built in the coming years, e.g., Knob Hill, Holberg, Shushartie, etc. The large number of spatially-concentrated projects may allow for the development of local construction expertise that can provide long term employment sustained over a succession of projects. A second factor influencing construction employment impacts is the degree of specialization in labour skills. There is a variety of opinions among BC observers as to the degree to which specialized skill needs will constrain local employment. While some feel that much of the assembly of wind turbines and other large componentry is likely to be done locally due to logistical advantages, others feel that the novelty of the technology in BC is likely to require specialized labour and will thus reduce the employment impacts to low-skilled labour pools of rural areas in BC (Sea Breeze 2004; Campbell 2008; Griffiths et al. 2008; Turner 2008). A third factor affecting construction employment impacts is the influence of specific componentry designs (Griffiths et al. 2008). Some models of wind turbines, for example, demand more of one type of employee than another (which rural areas may or may not be able to supply). Overall, more information on the sizes of projects, their construction schedules, the technologies that will be employed, the labour demands of emerging tidal and wave technologies, etc., is required to accurately forecast impacts.

Table 10. Construction employment impacts on BC coast.

Project	Employment Impacts
Knob Hill / Sea Breeze	• ~30 workers on-site and some jobs off-site during each of three subsequent two-year construction phases • majority of workers expected to come from the area • employment in construction trades, equipment operation and mechanics, engineering, surveying, environmental monitoring, general labour, carpentry, truck driving, safety, and forestry • developer will give preference to competitively-priced local labour • assembly and erection of wind towers requires specialized labour not available locally, but likely in other areas of the BC coast
Holberg Wind Energy Project	• 100 person-years over the estimated 17 months of construction • developer expected to hire locally including from Quatsino Nation
Banks Island North Wind Energy Project	• construction will employ 250 people
NaiKun offshore wind	• Prince Rupert would be the staging area for assembly and construction • 3.5 full-time equivalent jobs per MW capacity constructed over 25 years of development

References: Sea Breeze (2004), BC EAO (2004b), BC EAO (2004a), Holberg Wind Energy (2004), Golder (2007), Umedaly (2006).

Direct Employment – Operations Phase

The operations phase for the projects that are under development should provide long term employment in the coastal regions of BC. Helimax has estimated that there should be at least 2.6 job-years per MW for operation of wind energy in BC (2002).

Wouters (2008) suggested that First Nations should see “significant” employment benefits from ROE development in the operations phase.

Table 11 provides employment impact data for projects on the BC coasts during the operations phase. Overall, little information is available.

Table 11. Operations employment impacts on BC coast.

Project	Employment Impacts
Knob Hill / Sea Breeze	• ~45 annual person-years over the estimated operational life of 25 years • control centre jobs in Port Hardy • developer policy of hiring locals and expects that the majority of workers will be hired from the local area • jobs during operations will be in mechanics, construction and electrical, engineering, office support and accounting, environmental services, forestry, communications, and in supervision and management • developer has approached educational institutions in northern Vancouver Island regarding the development of a wind energy training course or program so that at time of operation there will be locals with the necessary skills
Holberg Wind Energy Project	• up to six annual person-years • developer expected to give preference to local residents and up to three Quatsino members
Banks Island North Wind Energy Project	• operations will employ 70 people

References: Sea Breeze (2004), BC EAO (2004b), BC EAO (2004a), Holberg Wind Energy (2004), Golder (2007).

As with construction, there are several factors that should be considered in weighing the employment impacts of operations of the projects planned for coastal BC. First, the clustering of ROE projects could provide for meaningful employment impacts during operations simply because of the low population and relatively high unemployment rates in the areas where multiple ROE projects are planned, i.e., the North Coast area, north Vancouver Island, and the Campbell River area in particular. The first two of these areas have relatively small population bases and high unemployment. The clustering may lead to the establishment of firms specialized in wind turbine maintenance or other operations duties.

A second factor affecting employment impacts during the operations phase is the novelty of the technology. Turner (2008) suggests that there will likely be little operations and maintenance work with wind because the technology is relatively mature, but with wave and tidal technology there are many more kinks to be worked out leading to greater needs for operations and maintenance work. The Race Rocks tidal energy demonstration facility has demonstrated numerous problems and challenges that have resulted in increased maintenance employment for divers, engineers, and others. However, developers may employ specialized outsiders for the early years and only bring on majority local staffing later as the technology matures (Griffiths et al. 2008).

A third contributing factor is the level of training of locals associated with these projects. Sea Breeze, for example, anticipates training locals for operations jobs and expects that this will result in long term employment for the local labour force (Sea Breeze 2004; Griffiths et al. 2008).

Altogether, it is difficult to tell how much of the operations employment will flow to rural residents where ROE projects are planned, and how much will flow to those based out of the large urban centres in the south of the BC coast (i.e., Vancouver, Victoria, etc.).

Indirect Employment - Manufacturing

Limited manufacturing of ROE technology exists in coastal BC and thus few jobs in manufacturing are expected. While Helimax estimated that BC could gain an average of 14.6 job-years per MW of manufactured capacity, these results are contingent upon manufacturing facilities actually being established in BC. Wind energy projects will most likely license much of their technology from firms out of province or country (Turner 2008). The maturity of the industry means also that BC should expect little export potential from sales of know-how and technology in wind energy abroad (Campbell 2008).

There may be more manufacturing and export potential with wave and tidal energy technology. There are several wave and tidal energy companies with bases in BC, and wave and tidal energy industries are relatively nascent throughout the world. In the coming years, BC companies may succeed with their designs leading to manufacturing jobs, and these companies may succeed internationally and thus provide longer-term manufacturing employment impacts through export (Campbell 2008).

It is also possible that existing industries will spread their business into the ROE industry. There are many firms in BC involved in the shipbuilding, fish farm, and marine engineering industries based mostly in the Vancouver and Victoria areas. It is thus likely that some manufacturing of ROE components may be captured by these firms, leading to boosts in employment.

Finally, as the industry expands, it is possible that there will be sufficient economies of scale to bring about the establishment of domestic manufacturing firms in coastal BC or to encourage foreign firms to locate satellite manufacturing plants in the region.

Total Employment

Little information exists from proponents on total employment impacts of ROE development. However, the study of the instalment of 1,650 MW of wind power capacity in Alberta discussed earlier in this report does provide some useful information to gauge of the order of magnitude jobs that might be expected in BC (CTRI 2006). The study concluded that the $3.89 billion in capital spending over the five year construction period would result in 1,836 direct person-years of employment, mostly in construction, and a total of 6,801 direct, indirect, and induced person-years of employment. Thus on any given year during this period there would be about a fifth, or 1,500 direct, indirect, and induced jobs. In the operations phase, which should last at least 25 years, the study estimated that there would be 132 direct annual person-years of employment (operational jobs per year), and a total of 787 direct, indirect, and induced annual person-years of employment in Alberta. Available data indicates that about 2,000 MW of wind capacity is currently planned for the BC coast, i.e., is in the project development phase or further. Based on the Alberta employment ratios, this scale of development would lead to about 2,225 direct and 8,244 direct, indirect, and induced person-years of employment during the temporary construction period, and 160 direct and 954 direct, indirect, and induced annual person-years across BC. Similar estimations could be made using estimates of total ROE capacity.

Summary of Employment Impacts

ROE development has the potential for generating significant employment benefits for the BC coast. There is currently little employment because the industry is in the early phases of development. However, as the industry develops, employment impacts will rise. The nature and benefits of employment will depend on many factors. Construction impacts will likely be significant for the BC coast's communities, especially given the small populations and high unemployment rates in most of the rural areas. Over the long term as these projects move into operation, total jobs will decline but the jobs that do exist will be long-term and stable. This employment will diversify the rural economies of the BC coast.

In all phases, many of the jobs will go to skilled labour. Many of the skills needed by ROE developers are those which are demanded by other industries, i.e., engineering, communications, and electrical, and are possessed by British Columbians, but in general these skills are not possessed by many rural residents. There are also likely to be appreciable demand for skills that are specifically related to ROE. If the NaiKun offshore wind project is indicative of most ROE projects in BC, then many jobs will go to outsiders. NaiKun Wind Energy Group has contracts with German-based Germanischer Lloyd Wind Energy to assist in design, engineering, and construction of the offshore wind project and German-based Siemens Power Transmission & Distribution to assist in transmission work.

Job leakage to non-locals because of skill gaps is compounded by a lack of domestic manufacturing capability. At present very little manufacturing capability exists on the BC coast. If nothing changes in the near future, ROE development in BC will support manufacturing jobs in other regions in Canada as well as in Europe and the US. Strengthening the BC supply chain – which is certainly possible as wave and tidal stream technologies are developed – would expand the employment impact of the ROE industry on the BC coast. In doing so, the BC ROE industry would shift from being foreign-supplied to domestic-supplied in the coming decades.

An important point regarding employment benefits flowing to First Nations but also relevant to other rural residents is that traditional activities may interfere. First Nations in particular are attached to hunting, fishing, and other traditional activities that do not mix well with the work schedules typical of project development (Wouters 2008).

Overall it is difficult to tell how much rural residents will benefit from ROE employment impacts. As just mentioned, there are many factors leading to substantial employment to non-locals. However at the same time, available evidence suggests that appreciable numbers of direct jobs in the early phases as well as in operations will flow to rural residents. Further, many indirect and induced jobs will also flow to the rural economies where ROE development takes place.

Mitigation Measures

The international and BC literature points towards numerous strategies and measures that can be employed to maximize employment benefits.

1. Involve planners, government agencies, labour groups, unions, and community representatives early in the ROE planning and impact assessment processes to identify opportunities for employment impacts and strategize ways to maximize these impacts.

2. Establish programs to educate local residents, unions, labour, chambers of commerce, and other business associations about the ROE development process and the needs of developers so that they can take steps to maximize their roles in projects. ROE developers can contribute to this effort by holding job fairs, open houses, or other events to inform people about employment opportunities. (Costanti 2004; Griffiths et al. 2008)
3. Encourage or mandate developers to hire, spend, and work locally. Project labour can be hired from the local area or region, and might include requirements regarding hiring from socially disadvantaged groups. As well, equipment can be assembled or even manufactured in the local area or region under the right conditions. (ADAS 2003; Wittholz and Pan 2004; Pedden 2006; Campbell 2008; Griffiths et al. 2008; Turner 2008)
4. Provide incentives for developers to train and hire key target groups such as unemployed workers or socially disadvantaged groups. (Kammen et al. 2004)
5. Establish training programs. These programs could either be relationships between developers and existing educational and training institutions, or could be new institutions and programs established specifically to support those wishing to work in ROE. Training will be maximized if programs are accessible and low-cost. Funding or other support for training programs could be required of developers as part of project approvals, or could be funded by different levels of government through the diversion of taxes. Training could be on-the-job, or could be programs linked to educational facilities as co-operative job opportunities. Governments or developers could also provide scholarships and grants to local institutions. (ADAS 2003; Kammen et al. 2004; Pedden 2006; Campbell 2008; Wouters 2008)
6. Encourage developers to provide flexible work schedules to allow those with atypical schedules, such as First Nations fishers and hunters, to participate both in their traditional economies and in the project. (Wouters 2008)
7. Encourage the growth of firms specialized in ROE design, development, research and development and manufacturing. Measures include increasing ROE development (thus growing the demand for each of these types of firms), introducing policies that encourage firms to locate in the region (i.e., tax incentives), and research and development support. (ADAS 2003)
8. Encourage developers to cluster projects geographically to maximize the scale of activity and to encourage the establishment of firms who provide goods and/or services to ROE developers. However, it is important to pace projects to provide longer-term employment benefits to those working in the construction phase and so not to stimulate boom-and-bust cycles (see below).

7.3.3 Revenue

The second major type of economic impact of ROE development is revenue generation. Governments can earn revenues from ROE development in the forms of property, income, corporate, and sales taxes, administrative and application fees, and royalty and rent fees. In a recent study of wind power development in Alberta, in which 1,650 MW of capacity is planned over the next few years, researchers found that during the five year construction phase, $22.5 million in taxes would accrue to the municipal governments, $72.7 million to the provincial government, and $292.4 million would accrue to the federal government (CTRI 2006). During operations, $56.2 million in taxes are expected to accrue to the municipal governments, $14.1 million to the province, and $29.7 million to the federal government. Many researchers have noted that the tax earnings of local governments from ROE development diversifies and stabilizes the tax base and assists rural areas struggling with supplying adequate infrastructure to residents (Campbell and Pape 1999; Hoffer 2002; Ouderkirk and Pedden 2004; US GAO 2004; USDOE 2004; Horne and Campbell 2006; Pedden 2006).

In the US, several researchers have catalogued the revenues that residents and other landowners have earned through land leases and sales (Hoffer 2002; Heavner et al. 2003; NWCC 2004; Ouderkirk and Pedden 2004; US GAO 2004; Pedden 2006). A study of the effect of meeting 10% of Vermont's electricity with wind found that the building of 150 1.5 MW turbines would result in $2.7 million USD to landowners in the form of lease fees (Hoffer 2002). In the US, wind farms typically pay landowners annual fees of between $2,000 and $5,000 per turbine per year (US GAO 2004). This revenue diversifies and stabilizes landowners' – typically farmers' – annual incomes (Campbell and Pape 1999; Ouderkirk and Pedden 2004; Pedden 2006).

Residents, communities, and First Nations can also earn revenue through partnerships with energy developers. Local ownership and/or local revenue sharing maximizes local economic impacts by increasing local retention of earnings (Costanti 2004). The Makah Tribe in Washington State, for example, is pursuing a wave energy pilot project and will bring in annual earnings to the tribe through its land leasing agreement with the developer partner in the project (FERC 2006). In southern Alberta the Piikani First Nation partnered with EPCOR, a utility company owned by the City of Edmonton, and developed a 900 kW wind project in 2001 (Windfall Ecology Centre Undated). The First Nation owns about 50% of the project, which sells the electricity to the grid but also earns green power credits (see below). Another approach popular in Europe is the energy co-operative. At the end of 2000, about 80% of wind power in Germany, Denmark, Sweden and UK was from co-operative facilities (Bolinger et al. 2004). In Denmark, the Middelgrunden project – twenty 2 MW turbines – is half owned by the local utility and the other half by around 8,500 residents and is the world's largest wind co-operative (ETNWE 2003). In the US, one tribe in California is considering a co-operative approach for a wind farm (USDOE 2005). There are also co-operatives in operation or being planned in Minnesota (Tennis et al. 1998) and Oregon (Bolinger et al. 2004).

Another source of income is from the sale of green power credits. As a result of climate change policy, there are many parties that wish to support renewable power generation to earn greenhouse gas credits to reduce their greenhouse gas emission liability. In Canada in 2003, green power sold for between $20 and $91 more per MWh than conventional power (Whitmore and Bramley 2004) – a substantial premium. Additionally, green power projects have access to special opportunities, such as improved terms of financing, access to the electricity grid, and tax deductions (Campbell and Pape 1999; Windfall Ecology Centre Undated).

Overall ROE development can provide greater revenues to landowners and local governments than conventional energy. Researchers in Washington State compared the impacts of wind energy with natural gas-generated electricity and found land owners accrued greater revenues through leases, royalties or land sales with wind power than with natural gas-fired energy projects, and much of this revenue goes to rural landowners (Washington 2003). Wind has a stronger tax generation impact than natural gas power plants because wind energy is more capital intensive (Heavner et al. 2003) –four to eight times greater according to the State of Washington (Washington 2003).

Revenues from ROE Development on the BC Coast

ROE development on the BC coast is expected to contribute revenues to all levels of governments, as well as to communities and First Nations if partnerships or benefit agreements are established. The federal government will receive earnings in the form of corporate, income, and sales taxes. The provincial government will receive earnings from developers in the form of administrative and application fees from the issuing of investigative permits, licenses of occupation, works permits, and other permits, as well as earnings from land rentals, participation rents, bonus bids, and corporate, income and sales taxes (BC MAL and BC MEMPR 2007b; BC MAL and BC MEMPR 2007a). Sea Breeze (2004) has estimated that their Knob Hill Wind Farm will pay out corporate income taxes averaging $16 million per year and land rental payments of approximately $150,000 per year.

While they have fewer powers to do so, local and regional governments can earn revenue from ROE projects through property taxes and permitting fees. Any revenue earned could be used to address infrastructure gaps or other financial needs.

Earnings will also flow to any communities or First Nations that partner with ROE developers, develop their own projects, or establish co-operatives. The proliferation of independent power producer (IPP) projects across BC, and on the coast in terms of wind, wave, and tidal energy, signifies the potential for profit in ROE development. In turn, significant profits from sales of green energy credits to BC or extra-provincial parties are possible (Campbell 2008). The relatively small 58.5 MW Holberg Wind Energy Project is estimated to earn between $1.1 and $1.7 million annually in green credits (BC EAO 2004a). The Haida Nation has partnered with NaiKun Wind Development on the NaiKun offshore wind energy project and the Tlatlasikwala First Nation is pursuing their own wind energy installation.

First Nations can improve benefits by earning revenues stemming from benefits agreements and compensation packages. In many cases, planned ROE developments are taking place or crossing through First Nations territories. Recently, for example, NaiKun Wind Development Inc. and the Lax Kw'alaams Nation came to a commercial agreement regarding the transmission routing for the project (NaiKun 2008). Similarly, both the Quatsino and Tlatlasikwala Nations are expected to see financial compensation for Sea Breeze's Knob Hill Wind Farm as the project occurs in the traditional claimed territories of both nations (Sea Breeze 2006). While such compensation is now a regular occurrence in Canada in the context of mining and other resource development, it is too early to tell what typical arrangements are and the potential compensation for ROE projects.

Mitigation Measures

To maximize revenue earnings, the following strategies can be considered.

1. Involve communities, chambers of commerce, and relevant government and other non-government groups to strategize regarding revenue maximization.

2. Establish tax and tenure regimes that strike an optimum balance between promoting ROE development and the gathering of benefits for communities, governments, and First Nations. (Costanti 2004)
3. Encourage and/or establish local ownership, partnerships, or co-operatives to maximize revenue retention in local areas. One option along these lines is to encourage or require developers to offer local ownership shares. (Costanti 2004)
4. Establish benefit agreements between ROE developers and communities, governments, and First Nations that fairly compensate these parties for the use of infrastructure, territories, and other provisions.
5. Communities and First Nations should actively seek ROE opportunities and recruit developers. (Costanti 2004)
6. Take steps to enhance community support for renewable energy development so that more projects occur in the future. One approach might be encouraging local landowners to lease to renewable energy developers, perhaps through incentives, education, etc. (ADAS 2003; Costanti 2004)
7. Market the green energy credit revenue potential of ROE projects and establish programs that facilitate the sale of green energy credits.

7.3.4 Boom and Bust Phenomena

A common concern with economic development in rural regions is that of boom and bust cycles where project development generates a boom in a rural economy only to be followed by a sharp drop-off in activity as the development phase ends. Boom and bust cycles are commonly associated with large project development where communities undergo large changes as a result of an influx in economic activity and people. The main impacts associated with boom and bust cycles include:

- overburdening of communities’ infrastructure by an influx of employees, employees’ families, and support workers and their families;
- rises in unemployment rates due to an influx of workers who could not find jobs;
- wage inflation due to higher pay rates on the project, leading to competition for labour, high turnover of staff, and closures of local businesses that cannot compete;
- disruption to the regional economy as people leave their occupations in search of work on the project;
- price inflation of goods and services, including housing;
- funding and service shortfalls of local governments due to time-lags between when services are needed and taxes are collected, and then oversupplies in bust period;
- modification of a local area’s culture(s) due to the influx of newcomers;
- social tensions due to mix of cultures, opinions on project, etc., including degradation of religious and traditional cultures; and
- stress in both long-time residents and newcomers in adapting, often contributing to increases in crime, mental disorders, and social tension (Dixon 1978; Yamaguchi and Kuczek 1984; Hua 1985; Cocklin and Kelly 1992).

While boom and bust phenomena are usually associated with major project development such as the construction of large hydroelectric dams, similar can occur with smaller-scale ROE projects.

Boom and Bust Phenomena from ROE Development on the BC Coast

None of the ROE literature directly discusses the potential for boom-and-bust phenomena. However, it is possible that some boom-and-bust phenomena could occur such as wage inflation, service shortfalls, cultural modification, social tensions, and the downturns associated with drops in activity. Many of the ROE projects slated for the BC coast will be staged from small, isolated communities with limited capacity to buffer negative effects. The proponent for the Banks Island North Wind Energy Project, for example, anticipates employing 250 workers during the construction phase (Golder 2007). Depending upon where these workers are based, this number of workers could induce some boom-and-bust effects. As well, it is possible that there could be negative financial, employment, or other impacts in cases where developers cancel or terminate projects (Turner 2008).

There is also the potential that ROE development will provide some economic stabilization to rural regions traditionally dependent upon resource development (and thus with a history of boom-and-bust cycles). The routine in BC is for IPPs to only follow through on their project plans if they can secure a power purchase agreement with BC Hydro. These agreements are typically for long periods of time, i.e., 20 years. While the construction of projects might initiate some boom-and-bust phenomena, the stability of a power purchase agreement at least ensures that operations phase jobs are secure for lengthy periods of time (Griffiths et al. 2008).

Mitigation Measures

To address potential boom-and-bust phenomena in coastal BC with ROE development, a variety of measures can be taken.

1. Conduct early planning involving community, government, and business stakeholders as well as ROE developers to address boom-and-bust phenomena. (Yamaguchi and Kuczek 1984; Cocklin and Kelly 1992)
2. Ensure that ROE development occurs at a slower pace instead of all at once. In areas where multiple projects are planned, the construction of projects should be sequenced to achieve greater stability.
3. Use mitigation measures presented in section 7.3.1 to maximize the employment of locals.
4. Encourage developers to plan projects to maximize the extent that workers can maintain employment as projects pass from one phase to the next.
5. Encourage or require developers to contribute to infrastructure funding and/or service.
6. In cases of large employee populations, encourage or require developers to provide housing or otherwise plan for worker housing before the project begins.
7. Encourage or require developers to address goods or services shortfalls with either temporary fixes that can be deconstructed following construction phase or permanent fixes that can find alternative uses following construction.

8. Provide non-resident workers with education or training with respect to local culture(s).
9. Ensure that different levels of government and their agencies are coordinated with respect to project needs. Local governments often have to provide services but often also receive few taxes or other revenue.

7.4 Economic Impacts on Existing Industries

An important economic impact consideration is how ROE development may affect other industries. In the sections below we review impacts from ROE development on a variety of marine and land-based industries, discuss how these industries on the BC coast may be affected, and discuss mitigation measures.

7.4.1 Air Travel

Offshore wind farms pose a hazard to low-flying aircraft, such as military and civilian helicopters and planes (METOC 2000; Ball 2002; WEDCAIWG 2002). For example, in bad weather helicopters sometimes fly without visual reference and in these situations wind turbines pose hazards (METOC 2000). For the protection of all, regulators may prohibit air traffic in the vicinity of offshore wind farms, thus withdrawing space for flying (OWE 2002). These concerns are in part due to the potential of ROE installations to interfere with communications technology such as radar. We discuss this topic further in section 7.4.3 below.

Impacts of ROE Development on Aviation on the BC Coast

There is some possibility that the wind energy projects planned for the BC coast will have a negative effect on the area's aviation community. If offshore oil and gas development ever takes place along the BC coast, helicopters used for travelling to and from drilling rigs and production platforms may be flying in the vicinity of onshore and offshore wind projects. These possibilities have been recognized by the proponents of the NaiKun offshore wind project (Pottinger Gaherty 2007) and regulators in terms of the Knob Hill (BC EAO 2004b) and Holberg wind projects (BC EAO 2004a). While standard lighting appears to be sufficient for aviation regulators for the two onshore wind energy projects that have passed through the environmental assessment process, it remains to be seen what the degree of concern is for offshore projects like NaiKun.

Mitigation Measures

To address the hazard posed by ROE development on the aviation community, the following measures should be considered:

1. Involve the aviation industry, recreational flying community, and associated regulatory agencies early in ROE planning and impact assessment processes, especially regarding siting decisions. (METOC 2000; Ball 2002; WEDCAIWG 2002)
2. Light and otherwise mark wind energy installations according to standard practices for tall objects.
3. Encourage or require developers to establish designated routes for helicopters and other aircraft to cross the area as well as flight rules around ROE installations regarding altitude and other flight details. Developers might

design farm configurations in concert with flight patterns. (Ball 2002; WEDCAIWG 2002)

7.4.2 Aquaculture

The international literature does not specifically describe impacts of ROE development on aquaculture. However, impacts of ROE on aquaculture may occur. Both the ROE and aquaculture industries involve placing installations in marine waters and using boats and other equipment in the areas, thus creating the potential for conflict.

Impacts of ROE Development on Aquaculture on the BC Coast

In recent years the aquaculture industry on the BC coast has grown to become a significant contributor to coastal community economies. As of December 2006, there were 127 salmon farm sites, many of which are on the east coast of Vancouver Island. BC is the fourth largest producer of cultured salmon in the world – in 2006, the farmgate value of the aquaculture harvest was $429 million, up 177% from 2004 (BC MOE 2007). There are also hundreds of shellfish aquaculture sites on the BC coast, mostly in the Port Alberni on the west coast of Vancouver Island, around Comox on the central eastern side of Vancouver Island, and around Cortes Island and Bliss Landing north of Powell River (Figure 8).

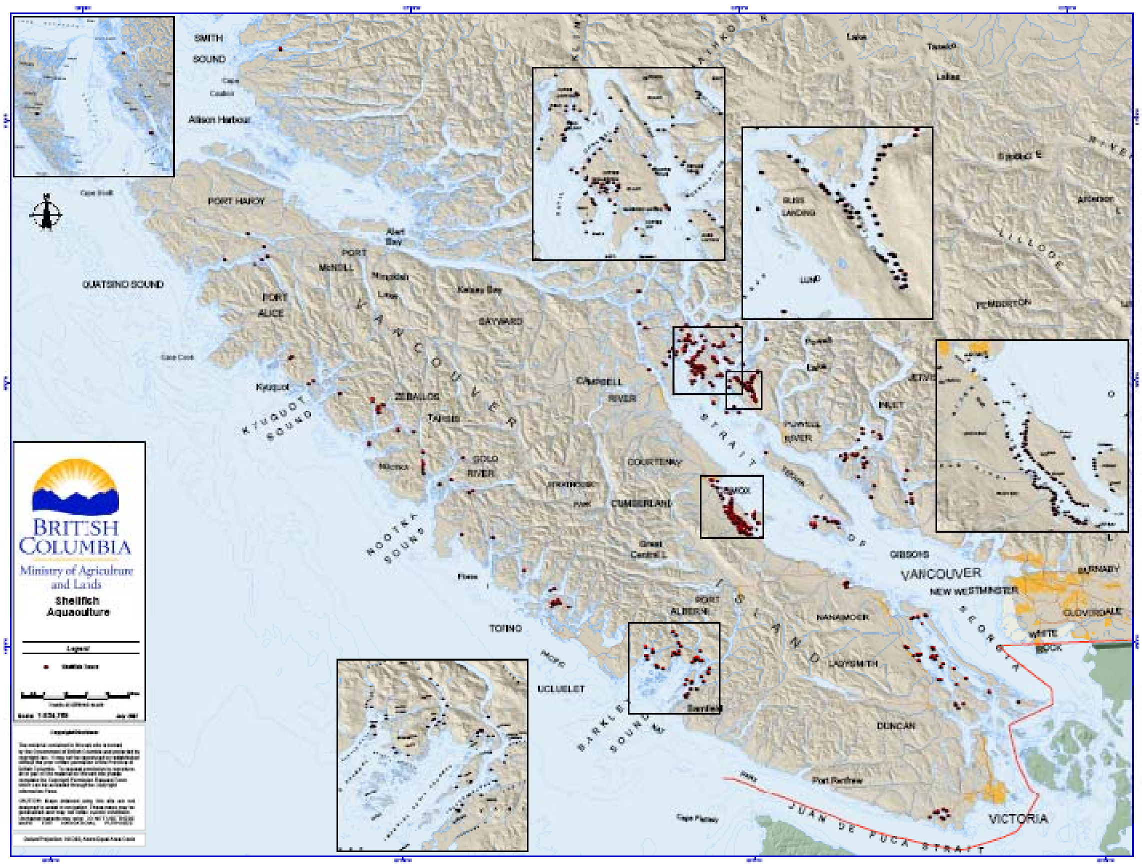

Figure 8. Map of shellfish aquaculture sites on the BC coast (BC MAL 2007).

There is clearly some overlap in the spatial interests of both the aquaculture and ROE industries, and conflict over space could result as the ROE industry expands. We expect, though, that little conflict will ensue as aquaculture firms already have tenure and

ROE developers will be forced to find other locations for ROE installations. We presume that all Investigative Permits that ROE developers hold are for sites without aquaculture. We expect that any future desire on the ROE industry's part to locate where aquaculture is currently practiced would be resolved through tenure transfer. There is some possibility that ROE development would create physical obstacles for aquaculture operators, i.e., obstructions to marine travel from installations and transmission lines, but given the relatively small number of ROE projects planned for marine waters in the main areas of concentration for aquaculture these effects would likely be minimal. It is also possible that spills caused or associated with ROE activity affect aquaculture, i.e., contamination of fish contained in pens.

There is a possibility that the broader aquaculture industry would benefit from ROE development. The ROE industry may support manufacturing firms that are involved with aquaculture as well as demand the services or goods of the aquaculture industry that have cross-over applications in ROE.

Mitigation Measures

To ensure conflicts and any other negative impacts are minimized and to maximize cross-over benefits between the ROE and aquaculture industries, several measures should be considered.

1. Involve the aquaculture and supporting industries and associated government agencies and non-governmental groups early in ROE planning and impact assessment activities. Such involvement can address both positive and negative impacts and should also examine the emerging geographical demands of these two growing industries. (Campbell 2008)
2. Encourage ROE developers to avoid areas popular with aquaculture.
3. Encourage the ROE and aquaculture industries to collaborate on how positive cross-over economic impacts can be maximized.

7.4.3 Communication

A rising concern among the marine navigation industry, aviation, and military stakeholders is the effect of ROE development, particularly offshore wind energy development, on communication technology. Large moving structures, especially those that are metallic, produce electromagnetic interference (EMI) (Ball 2002). Wind turbines can cause EMI by reflecting radio and radar signals and can also interfere with television, VHF radio, microwave (including cellular phone networks), and emergency communications (METOC 2000; Ball 2002; OWE 2002; WEDCAIWG 2002; Maritime and Coastguard Agency 2004; World Energy Council 2007; BWEA Undated). According to the UK Ministry of Defence, for example, if wind farms are in the direct line of sight of radar they can have an extremely detrimental effect on radar performance (METOC 2000).

To address this issue, a recent study was conducted into the effects of offshore wind farms on communications systems in the UK. Howard and Brown (2004) examined the effects of offshore wind farms on "all practical communication systems used at sea" and found that the effects on most of these systems were "not significant enough to affect navigational efficiency or safety" (3). No significant effects were found on GPS, magnetic compasses, Loran C, VHF and other voice communications, the Automatic Identification System of a particular ship, and small vessel radar. These results support assertions by Ball (2002) who noted that numerous UK offshore wind farms operate alongside telecommunication systems without interference, and the British Wind Energy Association (BWEA Undated) which noted that interference with cell phones has not been an issue with onshore wind – cell phone companies have sometimes used wind turbines to mount transmission or signal reinforcement equipment – and that TV interference is usually only an issue if broadcasting across bodies of water. Howard and Brown (2004) concluded that the only significant concern was the effect of wind energy structures on ship-borne and shore-based radar systems as impairment of these systems affects vessels' abilities to prevent collisions with other vessels (or the wind farms themselves or even offshore oil and gas installations) and impairs vessel mark and detection. Howard and Brown recommended risk assessment for particular wind energy projects to further investigate the potential for problems.

Howard and Brown's study has filled important gaps in knowledge regarding the effects of ROE installations on communications, but uncertainty remains. Notably, the study did not test the effects of offshore wind installations on helicopter radar and communication systems, short-range radio systems, and non type-tested systems, or the effects of bad weather conditions on all systems. The British Wind Energy Association (BWEA Undated) has also noted uncertainty regarding effects on military radar.

Impacts of ROE Development on Communications on the BC Coast

Given the concerns raised in the international literature of the effect of ROE installations on communications, it is perhaps surprising to see the light attention that the topic has been given in the BC ROE-related literature. Impact assessments for both the Knob Hill and Holberg wind projects on northern Vancouver Island note the potential for interference with NORAD radar installations, but found in both cases that the military is not concerned (BC EAO 2004b; BC EAO 2004a). To our knowledge there has been no other investigation of whether other forms of communication will be affected by ROE development on the BC coast. This appears to be a significant uncertainty that should be addressed considering the proliferation of ROE and particularly wind energy development along the BC coast, the existence of major shipping routes, the popularity of recreational boating and sailing, and the importance of communications to the many small communities along the BC coast.

Mitigation Measures

To address potential mishaps caused by interference in communication by ROE developments, several measures are recommended.

1. Involve the shipping industry, the military, the Canadian Coast Guard, the communications industry (broadcasters, telephone companies, etc.), the aviation community, as well as recreational boaters early in ROE planning and impact assessment processes. (METOC 2000; WEDCAIWG 2002; DT&A 2006)
2. Site projects away from shipping routes, boating areas, in areas with communications equipment, or within communications routes. (METOC 2000; Ball 2002; Howard and Brown 2004; World Energy Council 2007; BWEA Undated)

3. Site future radar scanners and other communications technology in relation to the location of ROE installations to minimize disruption. (Howard and Brown 2004)
4. Ensure that the marine and aviation communities as well as the military are aware of the exact location of energy installations. These notifications could also include suggestions on how to distinguish the installations from other signal sources, how to compensate, etc. (Ball 2002)
5. Require developers to install radar reflectors/intensifiers, directional transmitters or receivers, and other technical fixes to reduce interference and minimize problems. (METOC 2000; Ball 2002; World Energy Council 2007)
6. Establish exclusion zones to keep marine traffic away from ROE installations. (Howard and Brown 2004)
7. Assess the effect of projects on communications in the area of development. Potentially require risk analyses be conducted with respect to collisions or other mishaps that could be caused by ROE projects' interference with communication.

7.4.4 Fisheries

ROE projects are can have negative and positive effects on the fishing industry. The effects on the fishing industry from the ROE industry are of two forms: effects on the fish, and effects on fishers themselves.

Most studies on ROE acknowledge the potential for fish to be affected by the noise of construction and operations, vibrations caused by turbines in operation, electromagnetic fields emitted by cables carrying electricity, activity during construction and maintenance, the physical presence of energy devices, increased turbidity and lowered water quality at ROE construction sites, and the risks of pollution from collisions of ships with ROE devices (METOC 2000; BC Hydro 2002; OWE 2002; ETNWE 2003; Soerenson et al. 2003; Hagerman and Bedard 2004; Scottish Natural Heritage 2004; DT&A 2006; FERC 2006; ENTec 2007; FM&M 2007; SDC 2007; USDOI MMS 2007; Dacre et al. Undated). A strategic environmental assessment of ROE development in Scotland noted, for example, that shellfish were highly sensitive to smothering and contamination, cod and herring were sensitive to underground noise, and all of the species in the region of the proposed development were sensitive to loss of habitat (FM&M 2007). An environmental assessment scoping exercise for a demonstration project with the Wave Dragon device in the UK concluded that the project might displace fish stocks and harm spawning and nursery areas (PMSS 2005). Some impacts on fish are short-term, such as the noise and activity during construction, and some are or can be longer-term, such as the noise and vibrations from turbines during operations and the effects of spills of hydrocarbons. The longer-term effects may lead to long-term abandonment of fish from the area (METOC 2000).

The literature appears to consistently conclude that the effects of ROE development on fish are low. In reviews of the effects of wave energy development on fish, the Centre for Renewable Energy Sources (CRES 2002) and the European Thematic Network on Wave Energy (ETNWE 2003) concluded that the effects and risks on fish would be "low" and "small," respectively. A review of the effects of ROE developments in Wales found that such developments are likely to have mostly "small" effects on fish, that tidal fence-type installations would have a “small-medium” effect on fish (due to collision risk), that noise and vibration from some wave and tidal technologies would have a “small-medium” effect, and that electromagnetic fields from underwater cables would have a “small-medium” effect (ABP 2005). An often-referenced Swedish study of an offshore wind farm near Nogersund, Blekinge found that there were no negative impacts on fish from the 220 kW turbines (Larsson 2000 in Ball 2002). The study found that the fish population had increased within 400m of turbines, though fewer fish were caught when turbines were in operation. Test fishing near the Vindeby wind farm concluded that operational turbines did not affect fish, though there were questions about the quality of the data in the study (Ball 2002). A more recent study by Dong Energy et al. (2006) on the effects of offshore wind farms on fish in Denmark used a before-and-after-control study design and found no statistical evidence that fish were attracted to the artificial reef, no strong evidence of an effect of electromagnetic fields, and no change in the marine community in the area. However, the researchers did note that the research was carried out early after the installation of the farm and thus more research was necessary to rule out effects.

The effects on fishing of pollution from ship collisions with energy devices are not of a major concern. While there is a large body of evidence from the oil spill literature that indicates that fish and fishing can be severely impacted from spills, most analysts conclude that in the event of a collision it will be the energy device that is damaged, not the ship (OWE 2002; ETNWE 2003). Therefore there is little concern that collisions will result in release of hazardous cargo into the marine environment.

Nonetheless, numerous writers have noted the uncertainties that exist in terms of predicting the effects of ROE development on fish. There is substantial uncertainty regarding the degree to which noise and vibration from ROE devices affect fish, and many authors note uncertainties regarding the effect of the physical presence of the structures on the behaviour of fish, the effect of electromagnetic fields, and the effect on marine biota of taking energy out of the marine environment (METOC 2000; Ball 2002; ETNWE 2003; Soerenson et al. 2003; Scottish Natural Heritage 2004; ABP 2005; Dong Energy et al. 2006; DT&A 2006; OSPAR 2006; FM&M 2007; BWEA Undated; Dacre et al. Undated).

What is clear is that in most if not all cases fishers themselves are affected by ROE projects. The major impact on fishers is a long-term loss of access to fishing grounds designated as exclusion zones around the ROE projects in order to ensure the safety of the ROE installation (Ball 2002; OWE 2002; PMSS 2005; DT&A 2006; ENTec 2007; FM&M 2007; Pottinger Gaherty 2007; USDOI MMS 2007). Typically, trawlers, seiners, longliners and other mobile fishers are excluded from areas around ROE developments because their equipment could damage and/or get entangled in ROE devices, transmission cables, and other equipment (Soerenson et al. 2003; PMSS 2005; FM&M 2007; Pottinger Gaherty 2007). As a consequence of a loss of access, fisher displacement to other areas puts greater pressure on other fishing grounds (Halcrow Group 2006b; USDOI MMS 2007). Additional impacts on fishers include: increased damage to and/or obstruction of fishing gear from increased levels of seabed debris dug up during construction activities; altered anchoring mounds; and effects on catches (PMSS 2005; FM&M 2007).

There are also potential positive impacts on fish and fishers. ROE projects are associated with benefits to the fishing industry by way of two effects. Building a subsea structure in an offshore area and establishing a substrate for marine biota to develop a community around enhances aquatic populations (Thorpe 1999; OWE 2002; ETNWE 2003; Soerenson et al. 2003). The degree of this artificial reef effect is dependent upon the physical complexity of the structure(s) installed. Observers have noted that artificial reefs may change the species mix of the area for better or worse (Thorpe 1999; Ball 2002). The apparent benefits of the artificial reef effect have also led researchers to ask whether ROE installations should be removed or not once the project's useful life is over. Leaving some of a ROE structure may provide a lasting benefit to fish stocks, though it would continue to obstruct fishing (Thorpe 1999; Ball 2002).

The second positive effect results from the creation of fishing exclusions zones around ROE installations and cabling to protect the energy installations. This zone ends up being a protected zone for fish that can boost fish stocks (OWE 2002; ETNWE 2003; Soerenson et al. 2003; Halcrow Group 2006b).

Not surprisingly, there is uncertainty over the magnitude of these positive effects. One study into the effects of offshore wind installations on fisheries attributed the greater fish catches near the installations to the artificial reef effect (Ball 2002), but other studies have questioned the degree to which the artificial reef effect and exclusion zones enhance fisheries (e.g., Scottish Natural Heritage 2004; ABP 2005). An important point is that very little original research is referenced in the ROE literature. Furthermore, research regarding the artificial reef effect of offshore oil and gas installations has not been conclusive. Debate remains regarding whether or not artificial reefs increase fish populations, or simply attract fish from elsewhere and shift regional fish distributions (Manago and Williamson 1998; Patin 1999).

Notwithstanding the above, the common sentiment in the literature is that even with the negative effects of developing and operating energy projects from noise, activity, risk of pollution, etc., the overall effect on the fishing industry given the benefits of a no-take zone and the artificial reef effect is positive. An environmental impact assessment for a wave energy pilot project in Washington State, for example, recently concluded that though there might be some adverse impacts on fish and fish habitat, and that there would be a loss of area to fishers, the artificial reef created by the submerged turbines might tip the scale towards an overall positive effect on the local tribal fishery (FERC 2006). As has been pointed out, relatively little original research backs up these assertions, and thus substantial uncertainty remains as to the strength of both the positive and negative impacts of ROE development on the fishing industry (METOC 2000).

Impacts of ROE Development on Fish and Fishing on the BC Coast

Based on the literature, it is possible that ROE development along the BC coast could impact the region's fishing industry. The BC commercial fishery is a significant contributor to the region's economy and a relatively large employer. In 2004, the landed value of the salmon, groundfish, shellfish, and herring commercial fisheries was $390 million (BC MAL Undated). The commercial fishery also employs a substantial portion of First Nations people – a 2003 study found that roughly 31% of all jobs in the commercial fishing industry were held by First Nations (James 2003).

In impact assessments of the Knob Hill and Holberg onshore wind energy projects under development for north Vancouver Island it was noted that both will involve some impacts on fish and fish habitat, mostly from sedimentation from stream crossings and construction. However, regulators were satisfied with mitigation measures proposed by proponents and concluded that there would be no serious impacts on fish (BC EAO 2004a; BC EAO 2004b). Proponents for the Banks Island North Wind Energy Project also noted that the project will be constructed in the vicinity of the habitat of fish and may lead to sedimentation and other habitat damage (Golder 2007).

Likely the most important impact that ROE development will have on the fishing industry in BC will be fishers' loss of access to fishing grounds because exclusion zones are established around ROE installations. The NaiKun offshore wind farm is a good example of this conflict of interests. The NaiKun offshore wind farm will be located in shallow waters in the northwest portion of Hecate Strait, an area called Dogfish Banks (Pottinger Gaherty 2007). The Wind Farm Grid Area – the area where the turbines will be erected – is expected to be 30-60 km^2, and there will be two submarine cables – one going to the mainland and one to Haida Gwaii. Several fish species of economic importance may be affected by the project, including groundfish, migratory juvenile salmon, Dungeness crab, halibut, geoduck, abalone, herring, and rockfish. The proposed Wind Farm Grid Area is located within an important Dungeness crab fishing area, and there is an active groundfish trawl fishery targeting Pacific cod, skate, and sole in the proposed cable corridor area. Hook-and-line fishers also use the area. As well, the area of the project may be an important rearing area for groundfish, though there is insufficient data to confirm this. The cable routing will cross other commercial fishing areas and may also need to traverse herring spawning areas, salmon spawning streams, commercial geoduck beds, and roe-on-kelp operations upon landfall. The project may also affect benthic and pelagic flora and fauna, as well as marine mammals and birds, all potentially having an effect on fish species with economic value. Clearly, commercial fishers including First Nations fishers are likely to be affected by the NaiKun offshore wind project. If we consider that there are at least two more offshore wind projects planned for the North Coast area and one more planned for the north Vancouver Island area, and there are numerous tidal and wave energy projects planned for both the east and west coast of Vancouver Island and surrounding area, there is potential for substantial disruption of the fishing industry in BC via loss of access to fishing grounds and obstruction of travel. Fishers using adjacent areas are also likely to encounter greater seabed debris damaging their gear. Consequently, fishing is likely to be affected by ROE development and provincial ambitions to boost ROE development may lead to conflicts over the future of the ROE and fishing industries (Campbell 2008; Turner 2008).

There may also be some positive impacts from ROE development on fishing on the BC coast. The international literature on ROE development and the experience around the world with the emplacement of structures in the marine environment has indicated that the combined effects of the artificial reef effect and exclusion zones can strengthen fish populations. While the evidence is unclear as to the strength of these effects and as to the overall effects of ROE development on fish and the fishing industry, the positive effects of artificial reefs and exclusion zones should somewhat buffer the negative effects of ROE development and the losses to access that ROE development will bring about. Therefore, the BC fishing industry may only experience moderate effects from having to share the marine environment with the ROE industry.

Mitigation Measures

To address the negative impacts of ROE development on the BC fishing industry and to maximize the positive impacts, a variety of strategies can be employed.

1. Ensure that the fishing industry, non-commercial fishing interests, and associated scientific, government, and other communities are involved early in planning activities and impact assessments. (METOC 2000; Ball 2002; Scottish Natural Heritage 2004; DT&A 2006; FM&M 2007; Campbell 2008)
2. Encourage ROE developers to avoid activity in fish habitat, particularly spawning areas, migratory routes, etc. (METOC 2000; Ball 2002; BC Hydro 2002; Soerenson et al. 2003; Scottish Natural Heritage 2004; FM&M 2007; USDOI MMS 2007). Where unavoidable, minimize alterations, damages to, and losses of fish habitat. Overall, ensure no net loss of fish habitat. ROE projects should be planned to minimize the space that they occupy or cross.
3. Encourage or require ROE developers to conduct offshore and onshore activities around fish habitat using technologies and techniques that minimize impacts, e.g., buffer zones, sediment and erosion control, contamination, stormwater and water quality management, instream work practices, maintenance of fish passages, stream crossings, shore stabilization, spill response, timing of activity in concert with fish activity and sensitivity schedules, etc. (METOC 2000; Ball 2002; NRCan 2003; DT&A 2006; FM&M 2007; SDC 2007; USDOI MMS 2007; Dacre et al. Undated)
4. Encourage or require ROE developers to conduct baseline monitoring of fish stocks and fish habitat (e.g., water quality) before development and monitoring of changes after development. (Dillon 2006; SDC 2007; Dacre et al. Undated)
5. Encourage or require ROE developers to conduct construction activities using technologies and techniques that minimize pollution, noise, vibration, electromagnetic emissions, activity (i.e., requirements for maintenance), sediment disturbance, etc. using technologies that minimize noise, vibration, electromagnetic emissions, and maintenance. Cabling activities should be minimized and conducted using techniques and technologies that minimize impacts. Minimize cabling through smart routing and siting. (METOC 2000; Ball 2002; ETNWE 2003; NRCan 2003; Soerenson et al. 2003; Scottish Natural Heritage 2004; DT&A 2006; USDOI MMS 2007; Dacre et al. Undated)
6. Minimize exclusion zones and where necessary, design exclusion zones in terms of the risk level that fishing poses to ROE installations. Some users may be compatible with ROE while others may not. (FERC 2006)
7. Encourage ROE developers to design ROE installations to minimize exclusion zones and fishing gear entanglement and to maximize the artificial reef effect. Certain designs may allow for compatibility with fishing and may provide a substantial artificial reef effect. ROE developers could also be encouraged to construct artificial reefs in areas other than their installations to boost local fish habitat productivity. (Scottish Natural Heritage 2004; SDC 2007)

8. Ensure fishers are compensated for loss of fishing opportunities and that claims programs are established to address ongoing losses of gear, anchors, etc. (ETNWE 2003; BWEA 2004)
9. Establish routine communication avenues between ROE developers and fishers to address issues, monitoring results, impacts, etc. Communications can be maintained through liaison groups, hotlines, etc. (ETNWE 2003; BWEA 2004; Pottinger Gaherty 2007).
10. Require ROE proponents to perform risk analyses of collisions with ROE installations with a focus on spills and by making spill response plans for ROE developers to assist in the event of spills. (Dillon 2006; USDOI MMS 2007; Dacre et al. Undated)
11. Require ROE developers to notify fishers of ROE activities through communication avenues used by fishers such as 'notices to mariners,' the internet, etc. Notices should be given regarding planning processes, ROE development plans, locations of installations, cables, and other items, construction periods, other times and activities that may be disruptive to fishers, exclusion zones and activities permitted in them, etc. (BWEA 2004; Halcrow Group 2006a)
12. If goal is full resumption of fishing, require ROE operators to completely decommission installations at projects' ends. (Ball 2002; ETNWE 2003)

7.4.5 Forestry

A topic not raised in the international ROE literature but nonetheless important in BC is the possibility of conflict between the ROE and forest industries. The possibility of conflict is referenced by ROE developers and regulators, but overall it appears the impacts of ROE development on the forest industry will be minimal. On Banks Island where North Coast Wind Energy is planning on constructing their 700 MW wind farm, logging as well as gathering activities are common (Golder 2007). The Banks Island project represents a potential loss or at least obstruction to forestry activities. The Knob Hill Wind Farm will also infringe somewhat on forestry activities in the area (BC EAO 2004b). Impacts of the Knob Hill project on forestry include: a short term increase in annual allowable cut; a small reduction of harvestable forestry land for one company operating in the area; constraints of heavy equipment operation due to transmission lines; and potential for obstruction of forest companies' use of logging roads. Overall, however, regulators concluded there would be no significant effects (BC EAO 2004b). Similarly, the Holberg Wind Energy Project lies mostly in a forest company's tree farm license and the project will entail a minor loss in the total harvestable land base and potential obstruction of logging activities during turbine installation. Regulators concluded that the overall impact would be negligible (BC EAO 2004a).

These examples demonstrate the potential for impacts to the forest sector. To date ROE developers and regulators appear to have accommodated the forest industry to ensure that there are no significant impacts and thus it is likely that ROE development on the BC coast will have minimal impact on the forest industry.

Mitigation Measures

While no significant impacts are expected, a variety of practices are recommended to manage potential impacts on the forest sector.

1. Involve all facets of the forest industry, non-commercial forest users, and associated scientific, government, and other communities early in ROE planning activities and impact assessments.
2. Avoid or minimize ROE development in productive forest lands, mindful that productive logging areas are may be different than productive areas for other forest products. When unavoidable, ensure all losses to the forest industry are compensated or otherwise mitigated.
3. Ensure that ROE developers notify and coordinate road and other potentially disrupting activities with forest companies.

7.4.6 Marine Navigation and Ports

A potential impact of ROE development on the marine sector is the risk of collision between marine traffic and ROE (Thorpe 1999; METOC 2000; Ball 2002; Scottish Natural Heritage 2004; PMSS 2005; FM&M 2007; Dacre et al. Undated). The degree of navigational hazard posed by ROE developments depends upon the design and scale of development, where projects are located in relation to marine water use, the degree of marking and lighting, and the extent of restrictions that are established around ROE installations with respect to marine travel (Ball 2002; OWE 2002). Some designs are surface-piercing, whereas others are completely submerged. Submerged installations are hard to detect visually or by radar (ETNWE 2003). Nonetheless, the consensus view in the literature is that the navigational hazard posed by ROE installations is low (Salter, 2001 in Ball 2002; CRES 2002; ETNWE 2003).

It is common for exclusion zones to be established around ROE installations to protect them from collisions and damage. A negative impact on marine navigation, thus, is a loss of space. ROE installations block, restrict, alter and otherwise impede marine travel in open waters and near ports (METOC 2000; Ball 2002; BC Hydro 2002; OWE 2002; ETNWE 2003; Hagerman and Bedard 2004; Maritime and Coastguard Agency 2004; Scottish Natural Heritage 2004; DT&A 2006; ENTec 2007; SDC 2007). All marine traffic can be impacted including commercial vessels, fishing boats, sailing and pleasure craft, and emergency services. Ball (2002), for example, noted that recreational craft might be affected by the small wake vortexes created by submerged tidal stream devices. There is variation on the degree of blockage and obstruction to marine traffic depending on the type of ROE installation – tidal lagoons and barrages are obviously large obstructions, offshore wind installations require re-routing of marine traffic, while tidal stream and wave devices may allow traffic if they are deeply submerged below the water's surface.

The loss of marine space may create a cumulative negative effect or create a variety of side-effects. A review of the potential impacts of a wave energy demonstration project in the UK found that the project would directly obstruct shipping and increase vessel density in surrounding waters (PMSS 2005). This was echoed in a study of the effects of a proposed tidal project in Scotland that noted a loss of "already limited" navigational space (Dacre et al. Undated). The result can be 'choke points' in areas of high traffic density (Maritime and Coastguard Agency 2004). Another Scottish study observed that the displacement of vessel traffic would constrain key areas such as port entrances, harbours, inter-island channels, firths and sounds (FM&M 2007). The same study noted that island ports and harbours are highly sensitive to reductions in access as these are often only lines of communication for locals. Further, ROE projects withdraw space for anchoring, fishing, safe haven, pilot boarding, landing areas, and navy activities (Maritime and Coastguard Agency 2004).

Two benefits are noted in the literature regarding the effect of the ROE industry on marine navigation. First, several studies note that ROE development can enhance marine safety. ROE projects are often in shallow waters and generally are required to be well-marked and/or lit. The exclusion zones that typically surround the energy projects and the marking and lighting serve to minimize shipping traffic and may reduce accident rates (Ball 2002; ETNWE 2003; Soerenson et al. 2003). The navigational risk assessment conducted for the environmental assessment of the Wave Hub project in the UK concluded that slight changes of course of vessels around the project would lower the risk of vessel collision (Halcrow Group 2006b).

A second benefit is related to the synergies between the ROE industry and ports and existing shipbuilding and offshore industries. The existence and growth of a ROE industry may have spin-off benefits for ports and related industries. A review of a proposed tidal project in Scotland, for example, concluded that the project would support the same industries associated with the existing offshore oil and gas and shipping industries and thus provide an opportunity for those firms to diversify their businesses (Dacre et al. Undated). ENTec (2007) concluded that ports might also benefit through infrastructure improvements, e.g., dredging, roads, etc. Similar conclusions were reached by other reviews from the UK (Ball 2002; SDC 2007).

There is uncertainty with many of these findings. The main source of uncertainty has to do with the novelty and diversity of ROE designs, especially of wave and tidal stream technology that makes it challenging to estimate the level of hazard posed to marine vessels and the restriction on marine traffic (ABP 2005; SDC 2007).

Impacts of ROE Development on Marine Navigation and Ports on the BC Coast

The many tidal, wave, and wind projects that are planned for the BC coast are likely to have impacts on the shipping industry, the ports that service it, and other marine users. Throughout the BC coast there is marine traffic that is likely to run into conflict with ROE development. Most marine traffic in the BC coast is in the Lower Mainland and Victoria areas, throughout the inside of Vancouver Island, and around the Kitimat and Prince Rupert areas. However, local traffic occurs throughout the BC coast, and commercial shipping and BC Ferries regularly travel along the BC coast to and from ports and communities.

Commercial shipping routes cross planned seabed cable routes for offshore wind projects (Pottinger Gaherty 2007) and may be close to planned sites for ROE installations. BC Ferries crosses from Prince Rupert to Skidegate on Haida Gwaii near the proposed NaiKun offshore wind farm (Pottinger Gaherty 2007), and BC Ferries' routes along the Inside Passage in the North Coast and through the Gulf Islands and around Quadra Island are likely to cross near planned ROE installations or over or under seabed or overhead transmission lines. Alaska Marine Highway Ferries and other ferries may also be affected. Cruise ships travel the length of the BC coast. Golder (2007) noted that the transmission routing for the Banks Island North Wind Energy Project crosses Grenville Channel, which is an important passage for cruise ships. Recreational boats and sailing vessels travel throughout the BC coast, especially on the inside of Vancouver Island and along the Inside Passage on the North Coast and thus are likely to travel near ROE installations and across transmission routes. Furthermore, there may be places along the coast of BC where ROE installations are planned and where there is little space for exclusion of marine traffic, for example in Active Pass between Mayne and Galiano Islands and where one developer is considering tidal stream generation.[9] In such places, compromises will have to be made. However, without greater information on the size, extent, and applicability of exclusion zones for planned ROE installations to marine traffic, it is difficult to estimate the impacts on marine users.

ROE development could benefit BC ports by increasing activity and demanding services. The projects in the northern part of the coast, such as the NaiKun offshore wind project, the Banks Island North Wind Energy Project, and others slated for Aristazabal, Banks, and Porcher islands will be staging their activities from Prince Rupert and Kitimat and are also likely to use facilities in smaller communities in the area. Second, as discussed in the employment impacts section, the ROE industry often requires similar manufacturing and other services that are already provided by shipbuilding and offshore industries. BC's shipbuilding and related industries are thus likely to benefit.

Mitigation Measures

To ensure that negative impacts are minimized and positive impacts are maximized, a variety of measures are recommended.

1. Ensure that the Coast Guard, the shipping industry, ferry companies, recreational boating associations, port authorities, and associated scientific, government, and non-governmental groups are involved early in ROE planning and impact assessment processes. (METOC 2000; Maritime and Coastguard Agency 2004; DT&A 2006; Campbell 2008; Dacre et al. Undated)
2. Encourage or require ROE developers to locate projects in areas not used for shipping and boating, such as navigational channels, or in areas not spatially constrained or with low vessel density. (METOC 2000; Ball 2002; BC Hydro 2002; Scottish Natural Heritage 2004; DT&A 2006; FM&M 2007; USDOI MMS 2007; Dacre et al. Undated)
3. Ensure exclusion zones are established around ROE installations, seabed cables, and any other equipment or infrastructure, though these restrictions should be reflective of the level of risk that different types of vessels pose. (Maritime and Coastguard Agency 2004; Scottish Natural Heritage 2004; DT&A 2006; Halcrow Group 2006b)
4. Require ROE developers to install lighting, marking, or other equipment or features to ensure marine users can see or otherwise know they are near ROE installations. Other equipment and features might include reflective painting, foghorns, radar transponders, intensifiers, and reflectors. (Ball 2002; Scottish Natural Heritage 2004; Halcrow Group 2006b) (Thorpe 1999; ETNWE 2003; DT&A 2006; FM&M 2007; USDOI MMS 2007; Dacre et al. Undated)
5. If possible, use submerged devices as opposed to floating designs, and place submerged structures and equipment at depths that minimize or do not necessitate exclusion. (Scottish Natural Heritage 2004; FM&M 2007)

[9] See entry 1 in Appendix 2.

6. For ROE farms, arrange devices in orientations that minimize collision risk and establish and clearly mark navigational channels for vessels to pass through. (Thorpe 1999; Ball 2002; ETNWE 2003; DT&A 2006)
7. Inform marine users of ROE locations and activities through notices, navigational charts, and other appropriate media. Marine users can also be informed of recommended routing in the vicinity of ROE installations. (Thorpe 1999; Ball 2002; ETNWE 2003; Maritime and Coastguard Agency 2004; Scottish Natural Heritage 2004; DT&A 2006; FERC 2006; Halcrow Group 2006b; FM&M 2007)
8. Conduct risk assessments for collision and integrating findings into development plans. (Ball 2002; Dacre et al. Undated). Information on conducting navigational risk assessments can be found in *Guidance on the Assessment of the Impact of Offshore Wind Farms: Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms* (UKDTI 2005).
9. Develop emergency procedures to address collisions for both marine users and ROE operators, including spill response. (ETNWE 2003; Dillon 2006)
10. Conduct ROE construction in concert with marine user patterns to minimize conflict. (METOC 2000)
11. Monitor area around ROE installations using radar, AIS, CCTV, or other appropriate technologies to ensure that exclusion zones are respected and to help prevent collisions. (Maritime and Coastguard Agency 2004)
12. Establish liaison groups with marine user groups to address issues, monitor impacts, etc. (Dacre et al. Undated)

7.4.7 Mining

Two industries that could be affected by ROE development are onshore and offshore mining. There is limited literature on this topic, but two European studies caution that the presence of ROE installations can interfere and/or restrict the activities of aggregate mining companies (Maritime and Coastguard Agency 2004; ENTec 2007).

Overall little conflict between ROE developers and mining interests are expected on the BC coast. Developers of the Knob Hill Wind Farm on north Vancouver Island had to buy out a holder of mineral claims in the area as it was determined that mining would not be compatible with the planned wind farm (BC EAO 2004b). Other developers may be forced to make similar arrangements with claim holders in the future. With respect to aggregate mining, only the Sunshine Coast area is important as it supplies the south western BC market (BC MEMPR Undated-b; BC MEMPR Undated-a).

Mitigation Measures

To mitigate impacts of ROE development on the mining industry in coastal BC, several measures are recommended.

1. Engage the mining industry and associated scientific, government, and associated communities early in ROE planning activities and impact assessments.
2. Avoid or minimize ROE development in productive or high-potential mining areas.

3. Ensure mining interests with prior rights are compensated fairly when ROE developments infringe upon those rights.

7.4.8 Offshore Oil and Gas

ROE development can have both positive and negative impacts on the offshore oil and gas industry. One benefit to the oil and gas industry is that ROE developers can provide physical, meteorological, or other data that can assist offshore oil and gas developers. A second benefit is that ROE developers can support expansion of shipping and marine industries that in turn can support the offshore oil and gas industry (OWE 2002). ROE development may also hinder existing or future offshore oil and gas industry by creating physical constraints to exploration, development, or other activities (Maritime and Coastguard Agency 2004; SDC 2007).

Impacts of ROE Development on Offshore Oil and Gas in BC

At present there is no offshore oil and gas industry in BC. However, the Geological Survey of Canada estimates that there may be 9.8 billion barrels of oil and 25.9 trillion cubic feet of natural gas in the sea bed of the BC coast, mainly in Hecate Strait and Queen Charlotte Sound. Several oil companies hold leases on offshore areas of the BC coast (Figure 9). There is currently a moratorium on offshore oil and gas activity on the BC coast due to concerns over environmental impacts, but there is ongoing consideration of lifting the moratorium to allow for further exploration and development.

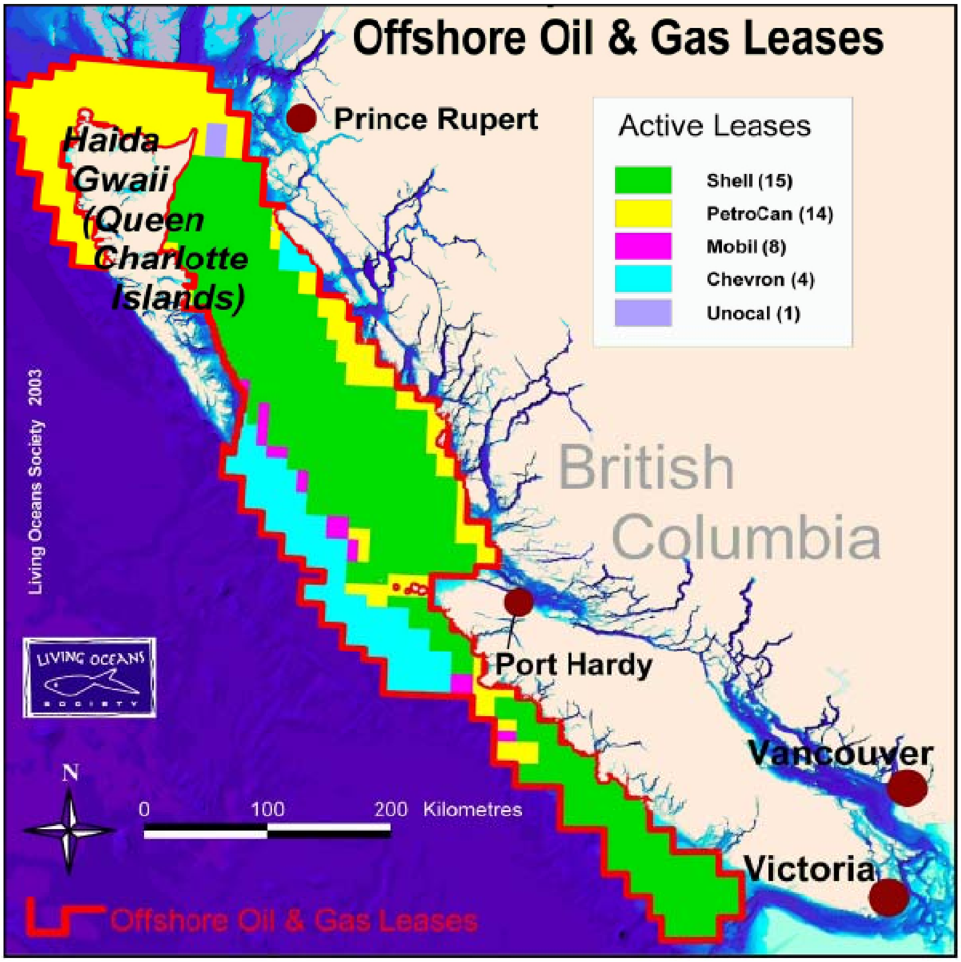

Figure 9. Offshore oil and gas leases on the BC coast (Living Oceans Society).

ROE developers, particularly offshore wind farm developers, will likely have to address a potential conflict over the use of marine space given that oil companies already hold leases to the seabed. ROE installations generally require exclusive use of the marine space for the protection of the installations, offshore substations, and seabed cabling. Consequently, proposed projects such as the NaiKun offshore wind project may have to compensate leaseholders as the project is sited within prime offshore oil and gas territory (Turner 2008).

Assuming ROE developers proceed, future offshore oil and gas developers may then have to contend with the ROE industry's presence if the offshore oil and gas industry ever commences activities on the coast. While seismic testing and other offshore oil and gas exploratory activities can possibly co-exist with ROE (providing appropriate care is taken to prevent collisions between vessels and ROE installations), it is questionable how compatible offshore oil and gas development and production – involving the use of drilling rigs and ships, the emplacement of production platforms and possibly seabed pipelines, maintenance vessels and helicopters, etc. will be with ROE installations and their offshore infrastructure.

Mitigation Measures

No mitigation measures or suggested practices have been suggested in the literature with respect to ROE development and the offshore oil and gas industry. Nonetheless, it is reasonable to suggest that government should proactively engage oil and gas lease holders and the ROE industry to develop a strategy for resolving potential conflict between the two industries.

7.4.9 Property Values

Some concerns have been expressed regarding the impact of ROE projects on the value of real estate. However, studies in the US and Australia have found that wind energy development has had no impact on property value and even an increase in value in some locales (Sterzinger et al. 2003; AMEC 2006; Pedden 2006). ENTec (2007) suggested it was not clear how tidal projects would affect property values, though they noted the possibility of a reduction in value. Given that most ROE development in BC will be on public land in remote locations, few impacts on property owners are anticipated.[10]

Mitigation Measures

To minimize impacts on property owners, two measures should be taken.

1. Encourage developers to avoid private property when locating their projects.
2. Require developers to assess the impacts of ROE projects on property owners in the approvals and permitting process. If impacts are determined to exist, developers should be required to compensate or otherwise mitigate the impacts.

7.4.10 Tourism

ROE development has aesthetic impacts that can affect tourism negatively, such as visual changes and noise (Thorpe 1999; METOC 2000; ETNWE 2003; ENTec 2007; SDC 2007). Wind farms, for example, are tall, have visible moving blades, are lit at night for navigational safety, and emit noise (Ball 2002; OWE 2002). Nearshore and onshore projects, particularly tidal barrages and lagoons, involve structures, marking, and lighting. Offshore submerged devices are obviously less visually intrusive, but because of lighting, marker buoys, and the activities and noises of maintenance vessels, there are still some aesthetic impacts (OSPAR 2006). Furthermore, all projects have onshore infrastructure – transmission lines, small buildings, etc. – that can be visually offensive (Thorpe 1999; Ball 2002; ETNWE 2003).

Aesthetic impacts are largely subjective, but factors thought to affect the degree of visual and noise impacts include:

- the location of ROE installations and transmission lines/corridors;
- the distance that installations are offshore or away from sensitive receptors;
- the shapes of ROE structures (i.e., pointy is worse than linear which is worse than submerged);
- the height of installations on land or above sea level;
- the location of viewpoints;

[10] Impacts on First Nations are discussed in section 8.12.

- the scale of the installation (i.e., individual devices vs. farms);
- the technology used (e.g., two blade wind turbines are more visible than three blade designs; different wind turbine and blade designs have different noise characteristics)
- the colours that visible structures are painted;
- the presence of shiny surfaces;
- the degree of lighting and marking;
- the use of logos and advertising signs;
- current and prevailing weather conditions;
- existing landscape values;
- whether there are other visual foci present in the land or seascape;
- the nature of local topography and/or adjacent coastline (i.e., intervening topography to block sound or views, land use, visual quality, vegetation cover);
- background noise levels; and
- real and perceived effects on wildlife that have tourism value (METOC 2000; Ball 2002; ETNWE 2003; AMEC 2006; FM&M 2007).

The impact assessment literature illustrates that ROE projects' designs are among the most important factors affecting visual impacts. A review in Wales found that there would be impacts ranging from "small" to "large" with the most serious impacts associated with shoreline wave projects, tidal barrage and lagoon projects, and offshore wind projects (ABP 2005). One study in Scotland concluded that concrete structures at the coastal edge – such as for shoreline wave energy – and transmission lines may have "high" landscape/visual impact, depending upon the coastline (Scottish Natural Heritage 2004), while a second study concluded that sounds and narrows are more sensitive, and that linearly-shaped devices zero to five kilometres from the coast would have "moderate to major" effects in all seascape types but less beyond this distance, and that pointy devices would have "major or moderate" effects if located within ten kilometres of the coast and "moderate" effects past ten kilometres (FM&M 2007). A Europe-wide study concluded that wave energy devices would have little visual impact relative to wind energy installations due to the limited height of wave energy devices, but still could have impacts depending on the area in which they were located (ETNWE 2003). Environmental impact statements for both a Newfoundland wind project and for ROE development in the US noted the potential for cumulative visual effects of multiple energy projects in close proximity (Dillon 2006; USDOI MMS 2007). Denmark has banned onshore wind in favour of offshore wind due to public complaints over aesthetic impacts (OWE 2002).

Notwithstanding the above, in numerous studies limited or no visual impacts are noted. A review of tidal stream devices in North America concluded that the TISEC tidal stream device would have little effect on the seascape during the operational phase as it would be submerged (DT&A 2006). An impact assessment in Washington State concluded that a wave pilot project in Washington State would have an insignificant effect on the seascape (FERC 2006). A European study also concluded that submerged wave energy devices should have little visual impact (ETNWE 2003). OWE (2001 in Ball 2002) reported that offshore wind is generally not visible from shore at sea-level when farms are more than 8 kilometres offshore. Greenpeace (2000 in Ball 2002) and

OWE (2001 in Ball 2002) reported that wind turbines are invisible beyond about 45 km from shore due to the Earth's curvature.

Similarly, few impacts from the noise of ROE are documented in the literature. Early wind energy installations generated a bad reputation for wind energy and noise impacts during operation, but more recent studies have found that the noise levels of modern wind and other ROE installations during operation are often no louder than the natural sounds of waves, winds, or other background noise (Thorpe 1999; Ball 2002; ETNWE 2003; Anemos 2004; CBCL 2006; Top Pond 2006). A study by National Wind Power, for example, estimated that the sound from 50 1.5 MW turbines located five kilometres offshore would transmit sound equivalent to or less than the ambient noise at shore (METOC).

The evidence suggests that ROE development has minimal negative impacts on tourism. Data from the Netherlands and Germany indicate that marking of offshore wind farms (i.e., lighting, painting, etc.) did not reduce tourist visits (Ball 2002). A German study found no negative effects on tourism as long as wind farms were at least 15 km offshore (OWE 2002). A BWEA study of the effects of onshore wind on tourists found that 91% of tourists felt the farm made no difference (ETNWE 2003). Anemos (2004) reported that studies in Vermont, USA, and Australia also found similar results.

A variety of literature suggests that ROE development may enhance tourism by attracting visitors interested in green technology and renewables. According to AMEC (2006) visitors to the Atlantic Wind Test Site in PEI increased from 1,200 in 1998 to 65,000 after new wind turbines were installed in 2001, not including school bus tours. AMEC also noted that 150,000 people per year go to a scenic tourist drive in Australia to view a wind energy installation. Anemos (2004) reported that rural areas in the US and Denmark have found increases in tourism after wind power development, and that local governments frequently post signs for tourists and advertise their local wind developments. In England, boat trips are available out to the North Hoyle offshore wind farm, and visitor centres exist at the La Rance Barrage in France and the Annapolis Tidal project in New Brunswick (ABP 2005). In the Netherlands, a mayor insisted that an offshore wind farm be named after their town because of perceived tourism potential (OWE 2002). For a wave energy pilot project in Washington State, an interpretative centre is planned to facilitate tourism (FERC 2006).

Additionally, ROE projects can create opportunities for recreation that can have direct spill-over effects on tourism. The European Thematic Network on Wave Energy (ETNWE 2003), for example, suggested that the artificial reef effect of offshore installations may boost tourism by improving fishing. See section 4.9 below regarding how ROE development affects recreation. Other studies that have noted that ROE development can have positive tourism spin-offs include Ball (2002), Dacre et al. (Undated), and ADAS (2003).

Overall, there is uncertainty regarding the impacts of ROE development on tourism (Scottish Natural Heritage 2004; OSPAR 2006). This uncertainty exists because of lack of scientific studies and the lack of experience around the world with ROE.

Impact of ROE Development on Tourism on the BC Coast

One of BC's most important industries is tourism, and among the many contributing factors is the scenic quality of the BC coast. Therefore, the potential impact of ROE development on aesthetics is a concern. This concern is further justified considering that many of the ROE projects are planned for areas known for their aesthetic quality that already have substantial tourist traffic:

- There are a number of tidal projects planned in the Gulf Islands and Quadra Island area where there are BC Ferry routes and where fishing and kayaking are popular.
- Several onshore wind farms are planned for the north of Vancouver Island where there are numerous recreation and tourist draws such as Cape Scott Provincial Park.
- Wave projects are being investigated near Tofino and Ucluelet on the west coast of Vancouver Island. This area is very popular due to its beaches and seascape and is also home to Pacific Rim National Park Reserve.
- On- and offshore wind farms are planned on islands and in waters where cruise ships and BC Ferries travel and where tourists come to experience wilderness and First Nations culture. Proponents of the proposed NaiKun offshore wind farm, for example, noted that the project may affect park visitation on Haida Gwaii, as well as the quality of wilderness experiences and activities such as sport fishing (Pottinger Gaherty 2007). Under certain weather conditions, it is thought that people will be able to see the project from the beaches of Naikoon Provincial Park. The Haidalink transmission project to bring electricity from the NaiKun wind project to Haida Gwaii will further impose visual changes to the area. Proponents of the Banks Island North Wind Energy Project expect to span the cruise ship routes through Grenville Channel with an overhead transmission line (Golder 2007).

Clearly the potential for negative impacts on the tourism industry is possible given the spatial coincidence of both tourism and ROE development. ROE installations as well as the necessary transmission lines create substantial potential for reductions in the tourism experience.

Notably, the projects that have passed through the environmental assessment process– the Knob Hill and Holberg wind projects slated for northern Vancouver Island – are forecast to have little effect on tourism. In its environmental assessment report on the Knob Hill project, the British Columbia Environmental Assessment Office (BC EAO 2004b) stated that there are few locales where the wind turbines would be visible and tall trees will block the views of the only locations within direct line of sight. The report further states that there will be no noise impacts. In its environmental assessment report for the Holberg project, the Environmental Assessment Office (BC EAO 2004a) stated that the visual impacts of the wind project would be minor compared to the incursions already present due to logging, and though the lighting would be visible at night, there would be no significant effects. The report also indicated that that the noise levels from the Holberg project would be below background levels. The north of Vancouver Island is not one of the most important tourist sites on the BC coast and thus the impact assessment findings may not be indicative of the threat that ROE development poses to the tourism industry, but these studies do provide some evidence that tourism impacts can be mitigated. It is also likely that any upcoming tidal and wave installations would use submerged designs and thus would have little or no visual impact.

It is certainly possible, given the evidence from around the world, that ROE development on the BC coast would draw tourists and expand the tourism industry. The co-location of planned ROE developments and tourist sites and travel routes might thus benefit tourism (e.g., BC EAO 2004b; Holberg Wind Energy 2004; Sea Breeze 2004; Campbell 2008; Griffiths et al. 2008; Turner 2008). Sea Breeze has suggested it may provide escorted tours at the Knob Hill Wind Farm (Sea Breeze 2004).

It is likely that the mixed reactions of tourists and the uncertainty of the effects of ROE development on tourism will only be resolved on a case-by-case basis. As such, it is difficult to tell how planned ROE development on the BC coast will affect the region's tourism industry.

Mitigation Measures

To ensure that negative impacts on tourism are minimized and positive impacts are enhanced, several measures are recommended.

1. Involve the tourism industry and associated scientific, government, and related communities early in ROE planning activities and impact assessments. (Ball 2002; ADAS 2003; DT&A 2006; Campbell 2008)
2. Encourage or require ROE developers to locate projects (including transmission corridors) in areas not valued for their visual or aesthetic quality and not used for tourism. (METOC 2000; Ball 2002; BC Hydro 2002; Helimax 2002; NRCan 2003; Scottish Natural Heritage 2004; FM&M 2007; USDOI MMS 2007; World Energy Council 2007)
3. In cases where ROE projects are placed in or near tourist sites, encourage or require developers to design projects so that they minimize their aesthetic impact. To the extent possible, use installation and transmission corridor designs that are submerged vs. surface-piercing and tall, minimally lit and marked, not shiny, painted natural colours, and quiet. Lighting should have directional shielding. Transmission components of projects should minimize landfalls and onshore equipment. When constructing "farms," developers should use designs and arrangements that are the most visually pleasing, such as short lines or clusters. (METOC 2000; Ball 2002; Soerenson et al. 2003; Scottish Natural Heritage 2004; AMEC 2006; DT&A 2006; FM&M 2007; Dacre et al. Undated)
4. Use visualization techniques and noise impact assessment to gauge the impact of ROE development and integrate findings into project design. (METOC 2000; AMEC 2006; Dillon 2006; SDC 2007)
5. Encourage or require ROE developers to conduct noisy and visually unappealing activities such as construction in locations out of sight and during times of low tourist activity. If activities must take place during tourist season, develop a traffic management plan to minimize traffic disruption. (AMEC 2006)
6. Ensure developers maintain clean facilities and sites. (AMEC 2006)
7. Encourage or require ROE developers to avoid signage unless for the purpose of attracting tourists. (AMEC 2006)
8. Encourage developers to develop a tourism marketing plan for their projects. Components could include marketing of the project, construction and

operation of visitor interpretive centres, tours, etc. (Ball 2002; ADAS 2003; ETNWE 2003; FERC 2006)

7.5 Energy Supply in Rural Areas

ROE development in rural areas can improve the local electricity supply. The result, according to numerous reports, is often a reduction and/or stabilization of energy costs, an improvement in reliability, and greater independence (Yamaguchi and Kuczek 1984; Campbell and Pape 1999; Ecotec 2002; Helimax 2002; Hoffer 2002; Washington 2003; Aeolis 2005). The energy development can also induce improvements in the local infrastructure, such as to the electrical grid and roadways. All told, the area may become more attractive to other developers and industries leading to spin-off economic development benefits (ADAS 2003; AMEC 2006; ENTec 2007). These benefits can be considered forward linkages of ROE development (see section 7.3).

Impact of Improved Energy Supply on Rural Areas of the BC Coast

A key concern of energy providers in BC is the quality of energy supply for remote and off-grid communities. Parts of the Central Coast and Haida Gwaii, as well as many small communities throughout the BC coast, are not part of the BC Hydro electrical grid and are mostly using diesel electricity generation. In general, diesel generation is more expensive, less reliable, and more polluting than electricity from the provincial power grid (BC Hydro Undated). Communities off the grid also have poorer access to community services, and their economic opportunities are more limited that those on the grid (BC Hydro Undated). Many of the communities using diesel generation along the BC coast are First Nations communities or are locations with tourist lodges (BC Hydro 2007).

BC Hydro has initiated its Remote Community Electrification Program to address these issues and has noted the potential role that ROE development can play (BC Hydro Undated). This theme has been picked up by industry, government, and First Nations. NaiKun Wind Development Inc. recently established an agreement with the Haida Nation to send power from its planned offshore wind farm to Haida Gwaii through the Haidalink transmission project (NaiKun 2007a). Haidalink will be financed and majority-owned by the Haida Nation, and will replace diesel generation (NaiKun 2007a; Pottinger Gaherty 2007). The provision of electricity through ROE instead of diesel generation on Haida Gwaii is also being investigated by the provincial government (Turner 2008). The BC Environmental Assessment Office (BC EAO 2004a) noted that the transmission upgrades that will come with the planned Holberg Wind Energy project on north Vancouver Island will enhance energy security and price stability on Vancouver Island.

Davidson (2007) conducted a feasibility study of the extent to which tidal stream generation could address the electricity needs of a remote, off-grid community on Stuart Island. The island has a small number of year-round residents as well as resorts catering to fishing tourism. Electricity is generated using diesel generators. Davidson estimated the cost of their electricity is 29 cents/kWh – almost five times higher than the standard rate in BC. Stuart Island receives deliveries of 80,000 litres of diesel by boat from Campbell River.

Davidson listed several arguments why remote off-grid communities are prime targets for ROE development. First, he observed that much of the BC coast's tidal energy resources are close to remote off-grid communities. Indeed, many of the exploratory efforts of tidal proponents has occurred in the area, and Stuart Island in particular has some of BC's best tidal resources (Cornett 2006). Second, he argued that the economic interests of remote off-grid communities are often limited by their energy supply. Stuart Island's tourism-based economy could grow with improved energy supply. Third, remote off-grid communities tend to require small amounts of electricity, even with the growth that could occur given an improved energy supply. Fourth, he noted that in many cases it would be very expensive to run the electrical grid to these spatially-distributed communities. Lastly, he argued that conversions of remote off-grid communities from diesel to ROE generation would eliminate the risk of spills and consequent damages to fisheries posed by routine shipments of large quantities of diesel.

There are many other communities on the BC coast in similar positions to the community of Stuart Island. Each could benefit from ROE development in the ways that Davidson suggested Stuart Island could, and many of these communities also have suitable ROE resources nearby. Further study is necessary to explore the extent to which ROE development could benefit remote off-grid communities, especially in terms of economic development.

Mitigation Measures

To maximize the benefits to remote, off-grid communities, two measures are recommended.

1. Involve remote, off-grid communities and energy providers early in ROE planning and impact assessment processes.
2. Fund or otherwise leverage support for the improvement of local electricity transmission lines to improve the energy reliability of areas on the grid that currently have poor service.

7.6 Health Benefits

One of the most obvious benefits of pursuing renewable energy projects is the environmental benefits over alternative sources of electricity. Fossil fuel-based electricity generation releases emissions of nitrogen oxide (NO_x), sulphur oxides (SO_x), and particulate matter (PM), among other pollutants, each of which are known to cause health problems. According to the BC Lung Association (2007), these air pollutants can cause eye and throat irritation, breathing difficulties, aggravation of existing respiratory and cardiac conditions, increased need for medication, increases in doctor and emergency room visits, and premature death. Renewable energy provides electricity without the air pollution side-effects of diesel or other fossil fuel combustion (Campbell and Pape 1999; ADAS 2003; ETNWE 2003; Aeolis 2005; Jamison et al. 2007; Dacre et al. Undated).

Renewable energy can also generate an emotional or psychological health benefit. In Ontario, First Nations pursuing renewable energy projects have found that the experience generates community pride and a sense of independence (Windfall Ecology Centre Undated). ADAS suggests that the pursuit of renewable energy is also associated with a sense of hope, enhanced self-respect, and satisfaction due to the association with "green power" (2003).

7.7 Recreation

ROE projects have the potential to degrade the recreational experience by withdrawing space and restricting access to areas. Tidal barrage and lagoon projects, for example, restrict where boaters and other water and coastline users can go, alter amenity beaches, and are likely to change how wildlife use the area thus affecting bird watching and similar activities (ETNWE 2003; PMSS 2005; ENTec 2007; FM&M 2007; SDC 2007). ROE projects can also restrict divers' access to key sites (Soerenson et al. 2003), and impact surfers by reducing wave energy (Hagerman and Bedard 2004). Onshore projects can also affect recreation. Transmission lines, for example, can interfere with shoreline hiking and beach walking.

ROE development may also provide recreational benefits. Tidal barrage and lagoon projects provide calm water that can enhance opportunities for marine activities (Ball 2002; Scottish Natural Heritage 2004; ABP 2005). The Severn Tidal Barrage, proposed for the UK, is anticipated to have recreation and leisure benefits by creating a large area of water with a more stable tidal range and reduced currents (Ball 2002). The area of calmed water behind the tidal barrage will be conducive to sailing, canoeing, windsurfing, and waterskiing, and this might lead to new marinas and watersports facilities (Ball 2002). Additionally, Soerenson et al. (2003) found that ROE projects might improve access to the shore and coastline if new roads are built. Hoffer (2002) noted that roads built for wind energy development can improve access for tourists and recreationists.

Impacts of ROE Development on Recreation on the BC Coast

A recent study of non-commercial recreation on the Central and North Coasts and Haida Gwaii (EPG 2003) provides some data on the significance of recreation on the BC coast. The study found that about 30,000 locals and 40,000 non-locals recreate in these areas every year and spend about $39 million annually.

Environmental assessments for the two onshore wind farms being developed on Vancouver Island are also illustrative. The impacted areas accommodate recreational activities including camping, boating, canoeing, caving, fishing (freshwater and saltwater), hiking, hunting, kayaking, mountain biking, off-road driving, photography, swimming, and exploring of First Nations culture (BC EAO 2004a; BC EAO 2004b).

There are also numerous parks and other recreational sites in the area. In the Campbell River area where tidal projects are being considered, fishing, boating, sailing, and kayaking are very popular. On the west coast of Vancouver Island in the Tofino and Ucluelet areas where wave energy projects are being considered, surfing, windsurfing, and beach walking are very popular activities.

Available information suggests that the impact of planned onshore wind projects on recreation will be minimal. The impact assessment for the Knob Hill Wind Farm noted that the new access roads built for the project will improve access to the backcountry for 4x4 drivers, bird watchers, and other users (BC EAO 2004b). The study also concluded that recreationists may be able to see the project from particular sites, though a survey of recreationists found that most did not feel that an occasional view would alter their experience negatively. The impact assessment for the Holberg Wind Energy Project concluded the impacts on recreationalists would be less than that of the normal annual logging operations (BC EAO 2004a).

It is possible that the other ROE projects under development and in consideration will have more substantial impacts on recreationists. These impacts can only be assessed with further information on project design, layout, and assessments of the recreation use of the individual areas.

Mitigation Measures

In addition to the measures suggested in section 7.4.10 with respect to mitigating impacts of ROE development on tourism, a variety of additional measures can mitigate impacts on recreation.

1. Involve recreational groups – both groups representing particular activities but also broader overarching groups – early in ROE planning and impact assessment processes.
2. Encourage ROE developers to locate projects in areas not popular for recreation.
3. Encourage ROE developers to minimize installation and transmission footprints and recreation exclusion zones. Developers can choose designs and technologies that facilitate rather than block recreation, such as submerged tidal stream devices instead of surface-piercing designs.
4. Encourage or require developers to provide compensation in cases where recreational areas are altered by ROE projects.
5. Notify recreation groups when construction or other activities might disrupt access are to occur through signage, direct communications to user groups, and other appropriate media.
6. Encourage or require developers to address increased access of user groups that may be damaging to the area. Measures could include education, blocking access, road de-activation, and on-site security.

7.8 Rural Demographics and Migration

The international literature has not explored the effect of ROE development on rural demographics and migration trends. However, the topic seems worth exploring in the context of the BC coast.

Available data suggests that population is declining in the central and northern portions of the BC coast and it is growing in the southern (and largely urban) portion. Studies by BC Statistics (2000) and Statistics Canada (2000) found that between 1991 and 1996 many rural youth left for urban centres The same studies also found return migration of older individuals, but concluded that this was not making up for the out-migration. An increase in ROE development in rural areas, especially the clusters of development planned for northern Vancouver Island, the Kitimat and Prince Rupert area, and Haida Gwaii will help counter out-migration by expanding employment opportunities. Without more specific information on the timing and magnitude of ROE projects, it is not possible to forecast specific migration impacts.

7.9 Traditional Activities and Interests

While we have located no literature that specifically describes how ROE development can affect First Nations traditional activities and interests, the potential for negative impacts exists. First Nations have interests and cultural traditions that involve the use of resources, lands, and waters on the BC coast. If left unchecked, ROE development could lead to the exclusion of First Nations from lands or waters important to them, obstruction and interference of cultural activities, and alteration of important "cultural landscapes" through aesthetic and/or perceived changes. Key sensitivities include fisheries obstructed by ROE installations, and cultural sites, trails, and activities affected by transmission lines (Wouters 2008).

The proponent of the NaiKun offshore wind project in the traditional territory of the Haida and Tsimshian Nations noted that the project could impact upon traditional activities, such as the gathering of marine resources (Pottinger Gaherty 2007). The Banks Island North Wind Energy Project is located within the traditional territories of the Gitxaala, Gitga'at, and Haisla Nations and may impact fish species important to First Nations such as eulachon and smelt (Golder 2007). The Knob Hill Wind Farm is primarily in the traditional territories of the Quatsino, Tlatlasikwala, and Kwakiutl First Nations (BC EAO 2004b). The impact assessment for the Knob Hill project noted that First Nations are concerned over impacts on hunting, archaeological resources, and the environment. As an expression of their interests, First Nations in the vicinity of the Knob Hill project requested revenue sharing agreements and compensation for infringement, employment opportunities, training of community members, and advice on installing wind energy in one of their own communities (BC EAO 2004b).

Given the many land claims that remain unresolved in BC (BCTC 2007b), the pervasiveness of asserted traditional territories on the BC coast, and the many ROE projects that are under development and being investigated, we should expect that impacts upon First Nations' traditional activities and interests to be a persistent theme in the years to come. And while these factors contribute to uncertainty over the extent of impacts on First Nations from ROE development, it is possible that the powers provided to First Nations from case law and federal legislation will address the majority of the issues that arise.

Mitigation Measures

Several measures are recommended to address the impacts of ROE development on First Nations and their interests:

1. Involve First Nations and related government agencies and advisory groups early on in ROE planning and impact assessment processes.
2. Avoid or minimize disturbance to sensitive First Nations cultural resources including fishing grounds, hunting areas, ceremonial sites, etc.
3. Engage First Nations regarding how ROE development could further their interests and address their needs. To do so, educational opportunities for First Nations should be provided to enhance their understanding of the impacts and opportunities present in ROE development.
4. Fund First Nations to participate in planning and impact assessment processes. Funding could come from government or from developers.
5. Encourage developers and consultants to develop impact assessment methods and perform assessment with First Nations.
6. Encourage or require developers to develop benefit agreements with First Nations to ensure tangible benefits. Such agreements might include compensation packages as well as agreements on hiring and spending policies, operations practices, ownership participation, revenue sharing and other facets of ROE projects.

7.10 Additional Mitigation Measures

In addition to the many mitigation measures that we have already described, there are two other measures that deserve special emphasis.

7.10.1 Planning

In earlier descriptions of mitigation measures we have repeatedly mentioned planning with stakeholders as an important measure to employ. Here we expand on what can and should be carried out in planning ROE development.

The first point is that all stakeholders should be involved early in the planning process. There are many ways to engage stakeholders and care should be taken in selecting the technique. Methods include information provision (e.g., brochures, documents, open houses, public exhibitions, internet sites, tours, etc.) and involvement in planning and decision making (i.e., though meetings, workshops, liaison groups, collaborative decision-making tables, etc.) (BWEA 2002; ETNWE 2003).

There is a large literature expounding the virtues of collaborative involvement of stakeholders in planning. This literature suggests that the more complex and controversial the planning situation, the greater level of stakeholder involvement is required. In concert with this movement towards greater involvement, the British Wind Energy Association (BWEA 2002) has suggested that the more complicated and controversial the situation, the more consultation necessary. The association does note, though, that if key decisions have already been made or there is not enough time or resources, then ROE proponents should focus on information provision or other forms of less extensive involvement. The association has developed best practice guidelines for consultation for offshore wind development. The guidelines suggest that consultation should be:

- genuine in that there is a real intention on the part of the developer to involve stakeholders in the planning process;
- comprehensive in that all aspects of the project are covered and stakeholders are involved from the start of the project to the end;
- interactive in that stakeholders have the opportunity to learn from each other, develop solutions together, and develop relationships;
- responsive in that the end product reflects stakeholders' contributions and concerns;
- inclusive in that all stakeholders are treated equally and have equal levels of influence;
- fair in terms of procedures and outcomes; and
- transparent in that the process, the information, and the outcomes are clearly comprehensible by both those involved and outsiders (BWEA 2002).

According to the European Thematic Network on Wave Energy (ETNWE 2003), the Kalmarsund offshore wind energy project in Sweden was delayed because it did not involve early and genuine public involvement. For this reason, developers of the Karlskrona Offshore project involved locals early in the planning process and incorporated their recommendations into decision making (ETNWE 2003). The European Thematic Network on Wave Energy (ETNWE 2003) further suggested that the Middelgrunden project – the largest wind energy co-operative in the world – came into existence due to genuine public planning where public and stakeholder concerns were incorporated into the project design. They noted:

> … if the channels for a dialogue are kept open and looked after, potential threats can be mitigated before a more general disruptive protest is formed. There will be a sense of control over the development of the project and the dialogue with the concerned public will not be handed over to misinformation by media. If a sense of public control is created through an open and dynamic dialogue, the confidence of the public can be achieved. (ETNWE 2003, 309)

A second point regards spatial planning and zoning. While we have already discussed how ROE projects will often close off the area around installations to fishing and perhaps other marine users in order to protect installations, it is important to note that there may be room for shared marine uses and thus planning should focus on finding cohabitation solutions (ETNWE 2003; Scottish Natural Heritage 2004). Interactive and inclusive stakeholder involvement techniques usually facilitate finding compatibilities and creative solutions.

The third point is that planning for individual projects is best integrated within a broader "strategic" coastal planning process looking at all of the activities and uses of the coastal and marine area (BWEA 2002; ENTec 2007). The British Wind Energy Association attributed problems in offshore wind energy development with a lack of strategic planning in the UK (BWEA 2002). British Columbia has demonstrated global leadership with its strategic land use planning processes – the Commission on Resources and Environment (CORE) and Land and Resource Management Planning (LRMP) processes – and the principles that have guided these processes can and should be used in planning processes addressing ROE development. Through both strategic, high-level planning and localized project-focused planning, the many issues and opportunities that ROE development presents should be resolvable and turned into win-win situations for all involved.

7.10.2 Impact Benefit Agreements

In earlier sections we have alluded to a strategy that stakeholders and governments might employ to address socio-economic impacts of ROE development called impact benefit planning. More specifically, this strategy involves the establishing of formal, comprehensive agreements between project developers and local entities (governments, communities, and/or First Nations) over how the project will be developed, how benefits will be shared, and what remedial measures are to be taken if there are negative impacts. The objective is to ensure that local communities and regions benefit from development projects (Kennett 1999; Sosa and Keenan 2001). These agreements are typically called impact benefits agreements (IBAs) but are also called community benefits agreements and supraregulatory agreements. Early IBAs were established between governments and private developers, but today in Canada IBAs are regularly established between First Nations and developers due to the rising legal prominence of First Nations (Sosa and Keenan 2001; Wouters 2008). IBAs are commonly used in mining, oil and gas, and other resource development contexts (Wolfe 2001).

IBAs typically address issues and details regarding revenue sharing, planning processes (e.g., assurances of participation), recognition of rights (e.g., Aboriginal Rights), hiring and spending practices, training opportunities, compensation packages, impact monitoring, dispute resolution mechanisms, assurances regarding environmental practices, local support for the project, liaison committees, contingency procedures, etc. (Kennett 1999; Sosa and Keenan 2001; Wolfe 2001). IBAs can also cover funding for community infrastructure or other local needs (ADAS 2003), agreements regarding business participation in the project, and agreements regarding rights of the developer (Wolfe 2001).

Sosa and Keenan (2001) reviewed the IBA experience in Canada and identified several key lessons:

- IBAs can be used to gain assurances by local parties, but also as beneficial tools by developers;
- IBAs should be based upon a process of learning and capacity building;
- the language used in agreements should be specific to enhance enforceability;
- provisions should be set out regarding actions to be taken in the event of change in project conditions, e.g., expansion, early closure, etc.;
- funding for the negotiating of IBAs should be determined early on;
- negotiating IBAs has large social costs, especially in First Nations where limited resources are stretched over numerous processes; and
- there remains uncertainty over the effectiveness of IBAs.

Another key element in IBAs are descriptions of implementation strategies. Often IBAs specify goals but lack plans for attaining them (Wouters 2008).

The Haida, Tsimshian Lax Kw'alaams, Quatsino, and Tlatlasikwala Nations have already or are in the process of concluding IBAs with ROE developers. Developers should be encouraged or even required to establish IBAs with the local communities and First Nations to better ensure positive impacts and to specify how negative impacts will be addressed. IBAs can be the tool to codify many of the best practices discussed in this document. IBAs should be based upon learning opportunities for the parties involved, and developers should provide funding assistance to communities and First Nations with limited negotiating capacity. Furthermore, these agreements should be specific to maximize enforceability, and should include provisions to address changes in the projects or other foreseeable conditions and strategies for implementation.

7.11 Key Uncertainties

Understanding the socio-economic impacts of ROE development on the BC coast requires a good understanding of the likely impacts of such development in general, a good understanding of the sensitivities and socio-economic dynamics of the BC coast, and an appreciation of the degree to which mitigation efforts will address these impacts. There are uncertainties concerning each of these three components.

Our understanding of the socio-economic impacts of ROE development is limited by two key factors. First, while global experience with offshore wind energy is growing, the limited experience with ROE precludes a clear understanding of impacts. There is very little experience with many of the ROE technologies, particularly tidal and wave technology, and the wide variety of designs that exist further blurs predictions of the economic, environmental, and social impacts of these technologies (Ball 2002; RGU 2002; ETNWE 2003; Soerenson et al. 2003; Hagerman and Bedard 2004; Scottish Natural Heritage 2004; DT&A 2006; ENTec 2007; FM&M 2007; USDOI MMS 2007).

Consequently, the effects of wave and tidal energy projects are often estimated based upon the experiences of offshore wind and offshore oil and gas development (ETNWE 2003; Soerenson et al. 2003; DT&A 2006). A second factor is that the majority of the literature characterizing the impacts of ROE is "grey literature." The majority of reports are written by consultants, industry, and government agencies and are based on environmental assessments that identify potential impacts. There has been very little scientific research on the actual post-project impacts (Dong Energy et al. 2006).

More specifically, there are numerous knowledge gaps that must be filled to gain a better appreciation of the impacts of ROE development on the BC coast. Key uncertainties or ROE development impacts include:

- the extent of employment and revenue impacts – there are many projects planned for the BC coast but very little concrete data exists, at least in the public domain, on capital costs, employment needs, technology, and economic linkages;
- the distribution of economic impacts among governments, communities, First Nations, across areas of the BC coast, and across industries;
- the degree to which particular communications technologies are affected, as well as how communications on the BC coast will be affected;
- the overall impacts of ROE development on fish and the fishing industry of the BC coast, including how ROE development will supplant fishing in the long term;
- how existing offshore oil and gas leases on the BC coast will affect ROE development and how ROE development will affect any future offshore oil and gas development;
- the overall impacts on the shipping industry and other marine traffic;
- the risk posed by ROE development in terms of marine collision hazard, including the risks of hydrocarbon spills;
- the overall impacts on tourism;
- the degree to which improved energy supply would enhance the economies of the rural coast, specifically of remote off-grid communities;
- how ROE development might affect population and migration rates;
- the overall effect of ROE development on recreation on the BC coast;
- the degree to which First Nations' traditional activities and interests will be affected; and
- the timing of impacts (while there are many projects planned, and some in the development phase, it is difficult to tell if most projects will be in operation in five years or 15).

Additionally, there may be cumulative socio-economic effects of ROE development (ABP 2005; FM&M 2007). As with the more commonly considered cumulative environmental effects, a complete appraisal of the socio-economic impacts of ROE development on the BC coast must also consider past and foreseeable future economic and social activities and the combined and synergistic effects all may have on the economic and social well-being of the BC coast.

Finally, there is uncertainty as to the effectiveness of the many mitigation strategies that have been described throughout this section. While some measures are known to work quite well, e.g., involving stakeholders in ROE development siting decisions to reduce conflicts over space or other resources, the effectiveness of other measures are not proven. For example, the effectiveness and usefulness of IBAs in general and in a ROE context is not known.

8. Permitting and Approval Process for ROE Projects in British Columbia

Developing ROE projects in BC involves a variety of permitting, approval, and assessment processes. All projects will require various permits under the BC *Land Act*, and many projects will also require permits under other provincial legislation as well as from other levels of government. In most cases of ROE development in coastal BC, there will also be a requirement for consultation with and accommodation of First Nations. We describe all of the relevant processes separately below.

8.1 Provincial Permitting

Ninety four percent of the land base in BC is Crown land. To evaluate sites, construct and operate projects, ROE developers are required to get permits and tenures under the *Land Act*. The BC Ministry of Energy, Mines, and Petroleum Resources (MEMPR) is responsible for Crown land tenuring policies for power projects. The BC Ministry of Agriculture and Land (MAL) makes land use allocation decisions and provides tenure rights to Crown land under the *Land Act* through its agency the Integrated Land Management Bureau (ILMB). The underlying principles behind government policy is an interest in optimizing access to Crown resources for development, ensuring that the most suitable uses are made of Crown land, ensuring that only the minimum amount of land necessary is used, ensuring a fair return for use of the land to the Crown, and ensuring maximum compatibility with other uses (Vold and Sranko 2006). While the BC MEMPR and MAL have further articulated policy for ROE projects in *Land Use Operational Policy: Wind Power Projects* (BC MAL and BC MEMPR 2007a) and *Ocean Energy Project Application Directive: Land Use Policy - Ocean Energy* (BC MAL and BC MEMPR 2007b), gaps remain in terms of how offshore wind, tidal, and wave projects will be permitted.

The first step for ROE developers is to acquire an Investigate Permit (IP) to begin site evaluation. IPs have maximum area limits and are typically for a two year period. There is an application fee and an annual rental fee, and developers must hold insurance and post a security bond. Applications for IPs are advertised but are generally only reviewed by the BC MAL. There may be site visits by government staff to ensure that IPs are being actively used.

If developers decide to install investigative equipment within their IP area, such as a meteorological tower, they must apply for and receive a License of Occupation (LO). LOs are for sites within developers' IP areas and are typically for a period of two years. There is an application fee and an annual rental fee, and developers must hold insurance and post a security bond. Applications for LOs may be referred to the DFO, Transport Canada, First Nations, local government, upland owners, or other agencies or groups as deemed appropriate by the BC MAL. Applications are also typically advertised. There may be site visits by government staff to ensure that LOs are being actively used.

If developers require roads, trails, bridges, airstrips, or other modifications during these initial phases, then Works Permits (WPs) are required. WPs are granted for between two and ten years and involve an application fee and an annual rent fee.

When projects reach the construction and operations phases, developers require general area LOs or leases, depending on their needs. Leases are generally less restrictive than general area LOs in terms of time limits and exclusivity. Typically, ten year LOs are taken for the purposes of construction, and then longer term (e.g., 30 years) leases are taken for operations. The re-application for the operations phase allows for adjustment of boundaries and other terms as design specifications change. For wind projects, both types of tenure require assessment and addressing of the effect of noise on nearby residents. These tenures can also be taken away if developers are not demonstrating active use of the area. Developers are also likely to require WPs and/or Statutory Rights of Way for roads, transmission lines, and similar works, and possibly LOs for communication sites. Each of these forms of tenure entail annual rental fees, and proponents also must hold insurance and post a security bond. Upon operations, wind power producers must pay an annual Wind Power Land Participation Rent based upon gross revenue; however there is a ten year grace period. There will likely be a similar participation rent charged to offshore wind and tidal and wave projects, but it appears that this has not yet been resolved. See Vold and Sranko (2006) for a discussion on this topic.

Tenure applications require that applicants develop a plan and may involve a variety of stakeholders in decision making. All tenure applications require a Development Plan specifying details on modifications to the site, design details on the generating device, public access, environmental management, reclamation, mitigation measures, etc. The plan must be approved by the BC MAL. Applications for tenure may be advertised and the public and stakeholder groups may comment and register their opinions on whether tenure should be offered, and a Project Review Team may be formed of stakeholder groups and government agencies (BC 2007). Objections may be made under section 63 of the *Land Act*, and hearings may be conducted to review the application. Finally, a decision is made and posted on the Integrated Land Management Bureau website at http://www2.lwbc.bc.ca/ApplicationPosting/index.jsp.

ROE developers may also be required to get permits under the *Wildlife Act*, 1996, *Environmental Management Act*, 2003, *Heritage Conservation Act*, 1996, and other provincial legislation.

8.2 Local and Regional Government Permitting

Local and regional governments may require ROE developers to apply for Building Permits and Temporary Use Permits when projects are sited in their boundaries. These powers are provided for in the *Local Government Act*, 1996 and *Community Charter*, 2003. ROE projects may also require municipal or regional rezoning which may entail hearings or other processes. In the past, local and regional governments had greater powers relevant to independent power production but these have been removed with recent provincial legislation (see below).

8.3 BC Environmental Assessment Process

In BC, many ROE projects will be subject to an environmental assessment (EA) under the *Environmental Assessment Act*, 2002 (BCEAA). Provincial EA is administered by the BC Environmental Assessment Office (BC EAO). The BC EAO reports to the Minister of Sustainable Resource Management and "is a neutral provincial agency that coordinates assessment of the impacts of major development proposals in British Columbia" (Government of British Columbia 2004). The intent of the BC EA process is to identify potential adverse impacts as a result of project development and operations and to determine appropriate measures to minimize or mitigate such impacts (Government of British Columbia 2004). The environmental assessment has four essential elements:

1. opportunities for all interested parties to identify issues and provide input, including First Nations and neighbouring jurisdictions;
2. technical studies of the relevant environmental, social, economic, heritage and health effects of the proposed project;
3. identification of ways to prevent or minimize undesirable effects and enhance desirable effects; and
4. consideration of the input of all interested parties in compiling the assessment findings and making recommendations about project acceptability (BC EAO 2003).

The BC EA process involves eight steps (Table 12). The application of the *BCEAA* begins with a determination of whether a project is deemed to be "reviewable." A project is reviewable if it is listed in the *Reviewable Projects Regulation*, if the Minister of Sustainable Resource Management determines a project is reviewable, or if a proponent asks the BC EAO to consider the project reviewable (BC EAO 2003). According to the *Reviewable Projects Regulation*, all energy projects with a nameplate capacity of or greater than 50 MW is reviewable.[11] Interested parties, such as local governments or stakeholder groups, may request that the Minister conduct an EA as per section 6 of the BCEAA.

Table 12. Eight steps of the BC Environmental Assessment process (BC EAO 2003).

Step 1: Determining if the *Environmental Assessment Act* applies
Step 2: Determining the review path
Step 3: Determining how the assessment will be conducted (scope and procedures)
Step 4: Developing and approving terms of reference for the application
Step 5: Preparing and submitting the application
Step 6: Reviewing the application
Step 7: Preparing the assessment report and referring the application to the ministers responsible for the project
Step 8: Deciding whether or not to issue an environmental assessment certificate

Note that it is possible that projects can be approved without an EA. Under section 10(1), the executive director of the BC EAO may exclude projects from the provincial EA process even if projects are included in the *Reviewable Projects Regulation*. In addition, the *Significant Project Streamlining Act*, 2003 gives the BC Cabinet and individual ministers the power to prevent provincial or local government laws, regulations or bylaws from constraining development projects if the provincial government decides that the project is "provincially significant."

[11] Many wind projects are likely to be of capacity ratings above 50 MW. Few or none of tidal and wave energy projects will have 50 MW or more of capacity.

If it is determined that an EA will be conducted, a review path is determined. Usually the BC EAO manages the assessment, but the review may be referred to the Minister of Sustainable Resource Management. A Procedural Order is first issued to the proponent by the BC EAO describing the process, the scope of the assessment, how stakeholders will be consulted, and other details. Next the proponent develops their application including terms of reference for the EA. The terms of reference are typically developed with the BC EAO as well as other provincial and federal agencies, First Nations, and possibly other parties. Once the terms of reference are finalized, the proponent conducts studies on environmental, cultural, archaeological, and socio-economic impacts, and conducts consultation with the public and First Nations, local and regional governments, and other stakeholders as appropriate. Next, the proponent reports on the EA results in an environmental impact statement (EIS) and submits this to the BC EAO. The BC EAO then publishes the EIS, reviews and comments on the EIS, and gathers comments from other relevant provincial and federal agencies, First Nations, other stakeholders and the general public. Next, the BC EAO prepares an assessment report that contains conclusions on the nature of the impacts and how stakeholders will be affected, and then refers the report to the appropriate ministers for a decision. The ministers then have 45 days to decide whether to issue an environmental assessment certificate, which usually contains project-specific conditions such as requirements for ongoing environmental monitoring (BC EAO 2003).

Note that local and regional governments have little capacity to stop energy projects. The *Significant Projects Streamlining Act* prevents such levels of government from influencing decision making on “significant projects” as already mentioned. In addition, section 53 of the *Miscellaneous Statutes Amendment Act (No.2), 2006* amends section 121 of the *Utilities Commission Act* and specifies that local governments’ powers under the *Local Government Act* and the *Community Charter* may not “supersede or impair” authorizations granted by the provincial government under the *Utilities Commission Act*, such as certifications to proceed with IPPs. This amendment countered section 2 (2a) of the *Community Charter* which specifies that the provincial government will “respect municipal authority” and mandate consultation “on matters of mutual interest,” as well as the 2004 Memorandum of Understanding between the Government of BC and the Union of BC Municipalities which stated that the two levels of government will work together in developing IPP projects and in ensuring “that local, regional, and provincial interests are appropriately considered”(BC and UBCM 2004, 2).

8.4 Federal Environmental Assessment

ROE projects may also be reviewable under the federal environmental assessment process as per the *Canadian Environmental Assessment Act*, 1992 (CEAA). The CEAA is coordinated by the Canadian Environmental Assessment Agency and reports to the Minister of the Environment. The CEAA is founded on four guiding principles:

1. to achieve sustainable development by promoting high quality environmental assessment;
2. to integrate environmental factors into planning and decision-making processes;
3. to anticipate and prevent degradation of environmental quality; and

4. to facilitate public participation in the environmental assessment of projects where the federal government is involved.

The CEAA process has five to eight steps depending upon the extent of assessment required. The first step is to determine whether the act applies. Section 5 of the CEAA specifies that a physical work is reviewable if the developer (in part or as a partner) is the federal government, if the federal government funds the project (in whole or in part), has jurisdiction over the lands or waters used by the project, or if federal approvals or permits are required (CEAA 2003). Furthermore, physical activities may require EA if they are listed in the *Inclusion List Regulation* or are beyond that which is excluded from EA as directed by the *Exclusion List Regulation.*

It is likely that many ROE projects will trigger an EA under CEAA. Many projects will likely receive federal funding or support, such as through the ecoENERGY for Renewable Power program. Many ROE projects will occur in federal lands or waters. Under the *Constitution Act*, 1982, the *Geneva Convention*, 1958, and due to the *B.C. Offshore Mineral Rights Reference* case, the federal government has jurisdiction over international and navigable waters, shipping, fish and fisheries, marine mammals, birds, First Nations territory, international trade, and the seabed. Activities associated with ROE development such as manipulation of an ecosystem function in a national park, harmful alteration of fish habitat requiring authorization under section 35 of the *Fisheries Act*, and harmful activities to migratory birds would all trigger an EA under the CEAA. Finally, many ROE projects are likely to require approvals from Transport Canada or other federal agencies (see below in section 8.5).

In the second step, Responsible Authorities (RAs) – federal ministries or agencies selected based upon the nature of the project – determine whether or not a screening or comprehensive study EA is required. Comprehensive studies are required when the project is listed in the *Comprehensive Study List Regulation.* Project types listed in the regulation include physical works in national parks, electrical generation stations or transmission lines in wildlife areas or migratory bird sanctuaries, tidal power electrical generating stations with nameplate capacities of 5 MW or more, and electricity transmission lines with voltages of 345 kV or more that are 75 km or more in length, among others. If the project is not listed in the regulation, then a screening is conducted. In its *Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the Canadian Environmental Assessment Act*, Natural Resources Canada indicated that there is some uncertainty at present regarding the level of federal EA that offshore wind farms will undergo (NRCan 2003).

In the third step, the RA determines the scope of the comprehensive study or screening. The scope of the EA will be reflective of the nature of the project and the potential environmental and socio-economic impacts that it might affect, and it will also cover mitigation measures, alternatives to the project, and cumulative effects. Comprehensive studies are more intensive assessments and may involve follow-up programs, the consideration of the sustainability of renewable resources, or other matters that the RAs or Minister requires.

Next, the proponent carries out its EA studies, consults stakeholders, and prepares its EIS. Natural Resources Canada (NRCan 2003) describes the typical contents of EISs. If the project is undergoing a screening, the proponent's EIS is submitted to the RA, there is a stakeholder review process, and a determination is made regarding whether or not to certify the project with the current level of assessment, or whether further EA is required. If no further EA is required, monitoring procedures are typically prescribed and the developer moves to construction. If further EA is required, then the RA asks the Minister of Environment to refer the project to mediation or a panel review.

If the proponent is performing a comprehensive review, then early on in the process the Minister of Environment decides if this level of EA is sufficient or if a panel review or mitigation process should be initiated. If no further EA is necessary, then the proponent submits its EIS, there is a stakeholder review process, and a determination is made regarding whether to certify the project. Monitoring procedures are typically prescribed when projects are certified. The developer then proceeds with construction.

If further EA is required, then either a mediation process or a panel review ensues. Mediation is chosen when the project raises issues of conflict between stakeholders. Review panels are established for projects with uncertain or likely to be significant effects and it is unclear if these effects are justifiable, or when stakeholders have major concerns. In the case of mediation, the Minister of Environment appoints an impartial and independent mediator who brings together stakeholders, reviews the project, and attempts to resolve differences among stakeholders. At the conclusion of the mediation process, the mediator prepares a report for the RA. In the case of a panel review, the Minister of Environment appoints an independent panel that determines guidelines (i.e., scope) for the EA, and then the developer conducts further studies and possibly consultation, and submits it's EIS. Next, a stakeholder review process is carried out, and finally the panel prepares its report for the RA.

In the final step, the RA makes a decision over whether to certify the project. If projects are certified, monitoring of impacts is typically prescribed.

8.5 Federal Permitting

In addition to the CEAA, many ROE projects will require additional permits as per federal legislation. The *Navigable Waters Protection Act*, 2005, for example, requires that projects that affect navigable waters get approval from the Minister of Transport. Wind energy projects also require an Aeronautical Obstruction Clearance from Transport Canada because of the height of wind energy installations and how this may affect aviation and are typically given requirements for lighting. There may also be other approvals or permits required.

8.6 Harmonized Environmental Assessment

In the event of a trigger of a federal EA, the EA process will likely be harmonized through the *Canada-British Columbia Agreement on Environmental Assessment Cooperation* (Canada and BC 2004). This agreement integrates federal and provincial processes and streamlines the EA process due to their wide overlap. However, the CEAA and BCEAA differ in several ways – for example, CEAA requires assessment of cumulative effects whereas the BCEAA does not – and thus harmonized EAs may end up being a mix of the two processes. The many triggers of the CEAA for EA means that in many cases ROE projects will trigger harmonized EA.

8.7 First Nations Consultation

A key issue for EA in the context of ROE is First Nations jurisdiction over lands, waters, and resources that ROE projects may use or impact. First Nations in British Columbia have unextinguished treaty and Aboriginal rights that may include Aboriginal title and a right in the land itself (Donavan and Griffith 2003). Actions of the government such as legislation, regulation, and permitting resource use and development may infringe upon treaty and Aboriginal rights (Donavan and Griffith 2003). Aboriginal rights are defined as "rights to engage in certain activities that are held by Aboriginal people as a communal group, pursuant to the integral role these activities play in the culture of the group holding the right," and "Aboriginal title includes the right to exclusive use and occupation of the land, the right to choose the use to which the land is put, and an economic component" (Donavan and Griffith 2003, 3 and 5).

Aboriginal and treaty rights receive constitutional protection under section 35 of the *Constitution Act*, 1982. To be considered an Aboriginal right, First Nations activities:

> …must be an element of a practice, custom or tradition integral to the distinctive culture of the aboriginal group claiming the right. To be integral, a practice, custom or tradition must be of central significance to the aboriginal society in question – one of the things which made the culture of the society distinctive. The practices or customs and traditions which constitute aboriginal rights are those which have continuity with the practices, customs and traditions that existed prior to contact with European society (*R. v. Van der Peet,* 1996.

Furthermore, in *R. v. Van der Peet,* the Supreme Court of Canada concluded that even if activities are interrupted temporarily, they may still be considered continuous. A practice, custom or tradition existing prior to European contact, and resumed after an interval, may still form the basis for an Aboriginal right. *R. v. Van der Peet* provided guidelines in determining the scope of Aboriginal rights:

a) the practice must have been integral to the culture prior to contact with European society;
b) incidental or occasional activities do not qualify, nor do aspects of an Aboriginal society that are true to everyday society; and
c) the scope and content of the Aboriginal right must be determined on a case by case basis (Donavan and Griffith 2003).

Aboriginal title relates solely to Aboriginal interests in the land itself and confers an exclusive right to use and occupy such lands. In *Delgamuukw v. British Columbia*, 1997 the court concluded that Aboriginal groups must have been exclusive occupants of the territory prior to 1846, the time at which the Crown asserted sovereignty in BC. Furthermore, the group claiming title to the land must have the capacity and intention to retain exclusive control of the land (Rankin 2004).

Currently, 31 Aboriginal title claims exist with respect to land and marine areas along the BC coast (BCTC 2007b). There are four First Nations in stage 5 of the treaty process, 23 in stage 4, two in stage 3, and two in stage 2.

The Haida Nation's position complicates the jurisdictional picture further. The Haida have claimed title over all of Haida Gwaii including the seabed resources of over half of Hecate Strait and 320 kilometres out into the Pacific Ocean and have filed a lawsuit to address its Aboriginal title claim. *Haida et al. v. Minister of Forests et al.*, 2000 indicated that the Haida Nation may be able to resolve its claim, since "there is reasonable probability that the Haida will be able to establish Aboriginal title to at least some parts of the coastal and inland areas of Haida Gwaii" (para. 47). This case is interesting because the federal and provincial governments have not recognized or acknowledged Aboriginal title claims to ocean territory (Rankin 2004). First Nations with an interest in ocean resources appear to have only one option for asserting title: seeking court intervention similar to the Haida lawsuit. Thus, ROE activity may lead to new court cases.

If ROE projects located in waters held under Aboriginal title, or if fish and other resources used by First Nations are negatively impacted, an infringement of section 35 of the *Constitution Act*, 1982 may occur. The government can justify an infringement of section 35 if it satisfies the test outlined in the Supreme Court of Canada case *R. v. Sparrow*, 1990 whereby the infringement would be allowed if it were the result of government pursuing a legitimate objective. In *R. v. Gladstone*, 1996 Chief Justice Lamer argued that attaining economic objectives might justify the infringement of an Aboriginal right or title, particularly in a region suffering from high unemployment:

> As distinctive aboriginal societies exist within, and are a part of, a broader social, political, and economic community, over which the Crown is sovereign, there are circumstances in which, in order to pursue objectives of compelling and substantial importance to that community as a whole (taking into account the fact that aboriginal societies are a part of that community), some limitation of those rights will be justifiable (para. 73).

In *Delgamuukw v. British Columbia*, 1997 Chief Justice Lamer expanded on the justification for infringement:

> In my opinion, the development of agriculture, forestry, mining, and hydroelectric power, the general economic development of the interior of British Columbia, protection of the environment or endangered species, the building of infrastructure, and the settlement of foreign populations to support those aims, are the kinds of objectives that are consistent with this purpose and, in principle, can justify the infringement of aboriginal title (para. 165).

In other words, a justification to breach section 35 can hold if a valid economic objective is pursued, giving rise to the conclusion that First Nations' Aboriginal title rights may be impinged. However, if the government proceeds with such impinging development projects, it still has a fiduciary obligation to First Nations, as provided for by *Delgamuukw v. British Columbia*, 1997 (at para. 203) to pay fair compensation.

To justify a section 35 violation resulting from ROE project approvals, case law requires the province and third parties to undertake meaningful consultation with affected First Nations, conducted in good faith. The duty to consult includes an obligation for gathering adequate information to ascertain the extent to which a proposed project jeopardizes Aboriginal rights. In *Taku River Tlingit First Nation v. Ringstad et al.*, 2002 the BC Supreme Court ruled that the existence of Aboriginal title does not have to be first proved in court by BC First Nations before the duty to consult applies. Thus the BC Supreme Court found in favour of the Taku River Tlingit First Nation (TRTFN) and prevented the Tulsequah Chief mine project in northern BC from proceeding. The province appealed the decision, maintaining that until the TRTFN had rights or title proven in court, the government did not have a legal or fiduciary duty to consult with TRTFN. However, the Court of Appeal ruled that Aboriginal rights would be subject to a constitutional violation if the provincial government were allowed to proceed. If the government were permitted to disregard the existence of Aboriginal title and rights, the effect would rob "s. 35 (1) of much of its constitutional significance, effectively ending any prospect of meaningful negotiation or settlement of aboriginal land claims" (Dolha 2002).

In response to these court rulings, the BC government announced revised consultation guidelines relating to First Nations interests for all applicable provincial ministries, agencies, and Crown corporations. The *Provincial Consultation Policy* (BC 2002) describes the BC government's approach to consultation with First Nations regarding Aboriginal rights and title. In essence, the province "must consider and attempt to address and/or accommodate Aboriginal interests prior to making decisions that may affect those interests" and "consultation efforts should be made diligently and meaningfully, and with the intention of fully considering aboriginal interests" (BC EAO 2003, 8, 40). The policy suggests five stages in the consultation process:

1. pre-consultation assessment;
2. initiation of consultation;
3. consideration of the impact of the decision on Aboriginal interests;
4. consideration of whether any likely infringement of Aboriginal interests could be justified; and
5. examination for opportunities to address and/or reach workable accommodations of Aboriginal interests and/or negotiate resolution (BC 2002).

The policy closes with the following statement:

> If resolution cannot be gained through negotiation, attempted accommodation, or other methods, it will be advisable to reevaluate the project or decision and seek legal advice before proceeding further (BC 2002, 36).

Case law dealing with the duty to consult and accommodate First Nations people has continued to evolve. In *Heiltsuk Tribal Council v. B.C. Minister of Sustainable Resource Management*, 2003 the Supreme Court of British Columbia ruled that the duty to consult is also a reciprocal responsibility of First Nations to consult in good faith. The duty to consult and accommodate First Nations people was considered in *Taku River Tlinglit First Nation v. British Columbia (Project Assessment Director),* 2004. The TRTFN objected to construction of a road through part of its traditional territory that was needed in order to facilitate reopening of an old mine. The TRTFN had participated extensively in the provincial EA process but still contended that their interests in the project were not accommodated and that provincial consultation was inadequate. While lower courts found that the province had failed to meet its duty to consult and accommodate the TRTFN, the Supreme Court of Canada concluded that the Crown's obligation to consult and accommodate was fulfilled in the case:

> The TRTFN's role in the environmental assessment was, however, sufficient to uphold the Province's honour and meet the requirements of its duty. Where consultation is meaningful, there is no ultimate duty to reach agreement. Rather, accommodation requires that Aboriginal concerns be balanced reasonably with the potential impact of the particular decision on those concerns and with competing societal concerns. Compromise is inherent to the reconciliation process. In this case, the Province accommodated TRTFN concerns by adapting the environmental assessment process and the requirements made of Redfern in order to gain project approval (*Taku River Tlinglit First Nation v. British Columbia (Project Assessment Director)*, 2004, para. 2).

However, while there is a clear duty to consult and accommodate First Nations people prior to making decisions that might negatively impact lands subject to rights and title claims, the Supreme Court of Canada concluded that consultation activities are dependent on the context of proposed projects. Indeed, since each EA project is different, the Supreme Court of Canada found that “it is impossible, however, to provide a prospective checklist of the level of consultation required” (*Taku River Tlinglit First Nation v. British Columbia (Project Assessment Director*, 2004, 2).

In *Haida Nation v. British Columbia (Ministry of Forests)*, 2004 replacement and transfer of a timber forest license on Haida Gwaii were allegedly approved despite repeated objections from the Haida Nation. The Supreme Court of Canada concluded that the provincial government has a duty to consult and accommodate First Nations people even when asserted Aboriginal rights and title claims have yet to be proven. Furthermore, the Supreme Court of Canada found that the duty to consult and accommodate First Nations people cannot be transferred to a third party:

> The effect of good faith consultation may be to reveal a duty to accommodate. Where accommodation is required in making decisions that may adversely affect as yet unproven Aboriginal rights and title claims, the Crown must balance Aboriginal concerns reasonably with the potential impact of the decision on the asserted right or title with other societal interests. Third parties cannot be held liable for failing to discharge the Crown’s duty to consult and accommodate. The honour of the Crown cannot be delegated, and the legal responsibility for consultation and accommodation rests with the Crown. This does not mean that third parties can never be liable to Aboriginal people (*Haida Nation v. British Columbia (Minister of Forests),* 2004, 2).

In summary, governments have an obligation to meaningful consult with First Nations in cases where ROE projects are proposed in areas or in ways that may affect First Nations rights and title, even where those claims have not yet been settled through the treaty process or otherwise. Second, First Nations may have decision making power over lands and resources, and potentially waters, within their traditional territories. Third, there is an onus on government to ensure that First Nations are accommodated whenever their interests are compromised. The consequence for ROE development and EA processes is that First Nations must be meaningfully consulted early in the process and accommodated where there are infringements. There may also be approvals required of ROE developers issued by First Nations.

9. Conclusion

This report shows that the ROE industry is likely to undergo substantial expansion in BC and can make an important contribution to the economic and social well-being of the BC coast. However, there will be significant and diverse impacts associated with this expansion. Given the relative newness of the ROE industry there is also considerable uncertainty regarding impacts. The regulatory process is also complex due to legal and jurisdictional uncertainties between First Nations and the federal and provincial governments. Consequently, the proposed expansion of the ROE industry needs to be carefully planned and managed.

Of the many mitigation strategies identified in this report, several deserve emphasis. First, development of the ROE industry requires extensive stakeholder collaboration to ensure benefits are maximized and impacts are mitigated. Consultation should include the completion of comprehensive Impact Benefit Agreements with First

Nations. Second, a marine and coastal planning process based on the successful BC LRMP model should be completed to ensure that development occurs in a coordinated fashion that protects other economic and environmental interests. Third, mitigation measures contained in this report need to be incorporated in the plans for ROE development. Fourth, extensive research needs to be undertaken on the potential impacts of ROE development in a BC context to reduce the current uncertainty and address the substantial knowledge gaps.

Appendix 1: Interviews

List of Questions for Interviews

1. What do you think the key
    a. positive economic impacts are of renewable/ocean energy development for the BC coast?
    b. negative economic impacts are of renewable/ocean energy development for the BC coast?
    c. positive social impacts are of renewable/ocean energy development for the BC coast?
    d. negative social impacts are of renewable/ocean energy development for the BC coast?
2. Confirm employment literature observations:
    a. Few jobs to locals?
    b. Low O&M requirements?
3. Extent of supply chain in BC for ROE?
4. What are the key means to mitigate
    a. negative economic impacts?
    b. negative social impacts?
5. What are the key means to enhance
    a. positive economic impacts?
    b. positive social impacts?
6. What is your sense of the scale and opportunities for the BC coast to develop
    a. tidal energy?
    b. wave energy?
    c. wind energy?
7. What are your greatest concerns with renewable/ocean energy development on the BC coast?

List of Interviewees

1. Chris Campbell, Executive Director, Ocean Renewable Energy Group
2. James Griffiths, Manager; Monique Stevenson, Senior Manager, Marketing & Communications; and Suzanne Mondoux, Manager, Aboriginal & Community Relations. Sea Breeze Power Corp.
3. Geoff Turner, Policy Advisor, Bioenergy &Renewables Branch, Electricity & Alternative Energy Division, BC Ministry of Energy, Mines, and Petroleum Resources.
4. Gary Wouters, Policy Coordinator, Turning Point Initiative.

Appendix 2: ROE Development on the BC Coast

Table 13. Detailed list of ROE projects on the BC coast.

Energy Type	ID	Site Name / Project Name	Location	Proponent	Phase	IP/ILMB file #	Estimated Capacity (MW)[1]	Reference
Tidal	1		Active Pass, near Matthews Point, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412947		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7541
Tidal	2		Baynes Channel, near Channel Point, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412937		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7549
Tidal	3	Campbell River tidal project	Campbell River, Vancouver Island	BC Tidal Energy Corp. and Marine Current Technologies Ltd.	Project Development (Aiming to be in operation by 2009)		3.6 (At least three 1.2 MW turbines)	http://www.marineturbines.com/mct_text_files/131107_MCT_to_develop_tidal_power_on_west%20_coast_of_Canada.pdf
Tidal	4		Canoe Pass between Quadra and Maud Islands, Vancouver Island	Canoe Pass Tidal Energy Corp. (sister company to BC Tidal Energy Corp.)	Project Development (Awaiting ILMB approval for tenure)	1413074		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8942
Tidal	5		Cape Mudge in Discovery Passage, Campbell River, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412939		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7559
Tidal	6		Discovery Passage at Race Point, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412938		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7555
Tidal	7		Discovery Passage near Campbell River and Grouse Island, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412940		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7532
Tidal	8		Discovery Passage near Orange Point in the Sayward District, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412935		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7544
Tidal	9		Discovery Passage near Yaculta Bank, Campbell	0778992 BC Ltd./ Fred	Site Evaluation (Assessing	1412933		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7551

			River, Vancouver Island	Olsen Renewables [2]	resource under permit)			
Tidal	10		Discovery Passage near Yaculta Bank, Campbell River, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412934		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7552
Tidal	11		Enterprise Channel near Trail Islands, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412932		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7538
Tidal	12		Innes Passage, east coast of Sonora Island, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412918		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7464
Tidal	13		Johnstone Strait and Current Passage, near Helmcken Island, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412941		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7545
Tidal	14		Johnstone Strait near Chancellor Passage, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412945		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7539
Tidal	15		Johnstone Strait near Race Passage and Chancellor Channel, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412944		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7556
Tidal	16		Johnstone Strait, near Helmcken Island, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412942		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7537
Tidal	17		Near Parson Island, Blackney Passage, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412946		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7533
Tidal	18		Pearse Passage near Alert Bay, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412930		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7553
Tidal	19		Plumper Passage, Victoria District, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412943		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7540
Tidal	20	Pearson College – EnCana – Clean	Race Rocks Ecological Reserve, near Victoria, Vancouver Island	Pearson College, EnCana Corp., and	Operations (testing of demonstration project)		0.065	http://www.racerocks.com/racerock/energy/tidalenergy/tidalenergy2.htm http://www.cleancurrent.com/technology/rrproject.htm

		Current Tidal Power Demonstration Project at Race Rocks		Clean Current Power Systems Inc.				
Tidal	21		Trincomali Channel, in Porlier Pass, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412931		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7536
Tidal	22		Weynton Passage, near Hanson Island, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource under permit)	1412948		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7547
Wave	23		Ucluelet, Vancouver Island	Finavera Renewables	Site Evaluation (Examining feasibility under Investigative Use Permit)	1412960	5	http://finavera.com/en/wave/ucluelet; http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7635
Wave	24		Off the coast from Tofino, Vancouver Island	Syncwave Energy Inc.	Site Evaluation (Assessing resource)	1412971		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7722
Wave	25		near Ucluelet, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource)	1412962		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7656
Wave	26		near Ucluelet, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource)	1412963		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7662
Wave	27		near Ucluelet, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource)	1412965		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7664
Wave	28		near Ucluelet, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource)	1412964		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7665
Wave	29		near Ucluelet, Vancouver Island	0778992 BC Ltd./ Fred	Site Evaluation (Assessing	1412961		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7650

				Olsen Renewables [2]	resource)			
Wave	30		near Ucluelet, Vancouver Island	0778992 BC Ltd./ Fred Olsen Renewables [2]	Site Evaluation (Assessing resource)	1412936		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7653
Wind	31	Aristazabal Island Wind Farm	Eastern Hecate Strait, North Coast (offshore)	Sea Breeze Power	Site Evaluation			Information from Coastal First Nations internal document
Wind		Aristazabal Island -10	Eastern Hecate Strait, North Coast (offshore)			6407575	110	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Aristazabal Island -11	Eastern Hecate Strait, North Coast (offshore)			6407576	110	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Aristazabal Island -3	Eastern Hecate Strait, North Coast (offshore)			6407568	110	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Aristazabal Island -4	Eastern Hecate Strait, North Coast (offshore)			6407569	110	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Aristazabal Island -5	Eastern Hecate Strait, North Coast (offshore)			6407570	110	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Aristazabal Island -6	Eastern Hecate Strait, North Coast (offshore)			6407571	110	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Aristazabal Island -7	Eastern Hecate Strait, North Coast (offshore)			6407572	110	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Aristazabal Island -8	Eastern Hecate Strait, North Coast (offshore)			6407573	110	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Aristazabal Island -9	Eastern Hecate Strait, North Coast (offshore)			6407574	110	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	32	Banks Island	Eastern Hecate Strait, North Coast			6407676	350	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Banks Island	Eastern Hecate Strait, North Coast			6407677	350	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Banks Island -1	Eastern Hecate Strait, North Coast	Banks Island Wind Farm Ltd.	Site Evaluation	6407779	90	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8584; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Banks Island -2	Eastern Hecate Strait, North Coast	Banks Island Wind Farm Ltd.	Site Evaluation	6407891	90	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8583; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Banks Island -3	Eastern Hecate Strait, North Coast	Banks Island Wind Farm Ltd.	Site Evaluation	6407892	90	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8582; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)

Wind		Banks Island -4	Eastern Hecate Strait, North Coast	Banks Island Wind Farm Ltd.	Site Evaluation	6407893	100	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8581; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Banks Island -5	Eastern Hecate Strait, North Coast	Banks Island Wind Farm Ltd.	Site Evaluation	6407894	90	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8580; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Banks Island -6	Eastern Hecate Strait, North Coast	Banks Island Wind Farm Ltd.	Site Evaluation	6407895	90	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8579; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Banks Island -7	Eastern Hecate Strait, North Coast	Banks Island Wind Farm Ltd.	Site Evaluation (Assessing resource under Investigate Permit)	6407896	90	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8578; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	33	Banks Island Wind Farm	Eastern Hecate Strait, North Coast	North Coast Wind Energy Corp. (Katabatic Power, Deutsche Bank)	Project Development (Proposal Developed; in EA Pre-application process; Also applying to assess resource further)	6407866	Initially 700 MW; expansion to 3000 MW	http://www.katabaticpower.com/banks.html http://www.eao.gov.bc.ca/epic/output/html/deploy/epic_project_home_292.html http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8394
Wind	34	Dome Mountain	Dome Mtn, North Coast			6407754	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	35	Hirsch Creek	Hirsch Creek, near Kitimat, North Coast	073354 BC Ltd.	Site Evaluation (Assessing resource under permit)	6407808	100	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7527; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	36	Humphrys Creek	Humphreys Creek, near Kitimat, North Coast	073354 BC Ltd.	Site Evaluation (Assessing resource under permit)	6407809	120	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7526; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	37	Kennedy Island	North Coast			6407816	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	38	Klo Creek	North Coast			6407752	200	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Klo Creek	North Coast	Chinook Power Corp.	Site Evaluation	6407758		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8044
Wind		Klo Creek	North Coast	Chinook Power Corp.	Site Evaluation	6407877		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8043
Wind	39	Matzehtzel Mountain	North Coast			6407753	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)

Wind	40	McCauley Island	North Coast			6407411	250	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	41	Mount Hays	Prince Rupert, North Coast			6407359	30	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Mount Hays Wind Farm	Prince Rupert, North Coast	Katabatic Power	Project Development (Applying for amendment to power production licence; Permitted for development by ILMB)	6407822	25.2	http://www.katabaticpower.com/mthays.html http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8516 http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7364
Wind	42	NaiKun Wind Farm	Western Hecate Strait off Haida Gwaii, North Coast	NaiKun Wind Energy Group Inc.	Project Development (They hold an IU and a Permit to Conduct Research from Haida Power Authority; in EA Pre-application process; expecting to begin construction in 2009)	6407436	Initially 320 MW; expansion to 1750 MW	http://www.naikun.ca/ http://www.eao.gov.bc.ca/epic/output/html/deploy/epic_project_home_230.html http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8147 http://www.naikun.ca/the_project/exploration_permitting.php http://www.naikun.ca/wind_links/20070925%20NKW%20Wind%20Energy%20Fact%20Sheet.pdf
Wind		NaiKun	Western Hecate Strait off Haida Gwaii, North Coast			6407371	4540	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	43	Porcher Island	North Coast			6407372	980	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	44	Porcher Island	North Coast (offshore)			6407489	9040	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	45	Price Island -1	Eastern Queen Charlotte Sound, North Coast			6407562	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Price Island -2	Eastern Queen Charlotte Sound, North Coast			6407563	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Price Island -3	Eastern Queen Charlotte Sound, North Coast			6407564	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Price Island -4	Eastern Queen Charlotte Sound, North Coast			6407565	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	46	S of Port Edward	Port Edward, North Coast			6407688	150	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	47	Sinclair Creek	North Coast			6407751	200	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)

Wind	48	Telegraph y Passage /Ecstall River	Prince Rupert area, North Coast			6407846	150	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	49	Trutch and Barnard Islands	North Coast			6407416	90	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	50	Trutch and Ethelda Bays	North Coast	Earth First Energy Inc.	Site Evaluation (Assessing resources under License of Occupation)	6407815		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7337
Wind	51	Mount Dodge	North Coast	Rengen Power Corp.	Site Evaluation	6407938		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=9243
Wind	52	-	Near Port Alice, Vancouver Island	Unknown	Site Evaluation (Applying for Investigate Permit)	1409892		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8935
Wind	53	-	Near Port Hardy, Vancouver Island	Zero Emission Energy Developments Inc.	Site Evaluation (Applying for Investigate Permit)	1413064		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8889
Wind	54	Adam River	Vancouver Island			1412439	50	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Adam River	Vancouver Island	Aeolis wind Power Corp.	Site Evaluation (Applying to place Wind Monitoring Tower)	1413063		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8857
Wind	55	Ahaminqa s and Gold River	Vancouver Island			1412732	70	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	56	Amor de Cosmos Creek	Johnstone Strait area, Vancouver Island	Aeolis Wind Power Corp.	Site Evaluation (Applying to place Wind Monitoring Tower)	1413062		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8875
Wind	57	Bloedel	Gold River area, Vancouver Island	Brookfield Power Wind Corp.	Site Evaluation (Applying to assess resource)	1413939		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8691
Wind	58	Cape Caution	North Vancouver Island			5406982	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Cape Caution	North Vancouver Island			5406983	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Cape Caution	North Vancouver Island			5406986	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	59	Cape Palmersto	Cape Scott area, Vancouver Island			1412099	250	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)

		n						
Wind	60	Cape Sutil -1	North Vancouver Island (offshore)			1412348	310	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Cape Sutil -2	North Vancouver Island (offshore)			1412349	310	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Cape Sutil -3	North Vancouver Island (offshore)			1412350	320	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Cape Sutil -4	North Vancouver Island (offshore)			1412351	340	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Cape Sutil -5	North Vancouver Island (offshore)			1412352	340	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Cape Sutil -6	North Vancouver Island (offshore)			1412353	330	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	61	Comstock Mtn	Vancouver Island			1412075	50	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	62	Franklin Range	Port McNeill area, Vancouver Island			1412313	40	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Franklin Range wind project	Port McNeill area, Vancouver Island	Sea Breeze Power	Site Evaluation (Assessing resource under License of Occupation; applying for amendment to existing license)			http://www.seabreezepower.com/projects/franklin_range.php;
Wind		Franklyn Range	Port McNeill area, Vancouver Island	Sea Breeze Power		1412314		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8202
Wind	63	God's Pocket Wind Farm	Near Shushartie Lake, Port Hardy area, Northeast Vancouver Island.	Sea Breeze Power	Site Evaluation (Early in process)	1402023	80 (Up to 180 MW)	http://www.seabreezepower.com/projects/gods_pocket.php http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7783
Wind	64	Gold River	Gold River area, Vancouver Island	Brookfield Power Wind Corp.	Site Evaluation (Assessing resource under permit)	1413925	70	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8207; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	65	Gold River/Crumble Mtn	Gold River area, Vancouver Island			1412730	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	66	Gold River/Upana River	Gold River area, Vancouver Island			1412731	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	67	Goodspeed	Vancouver Island			1412467	40	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	68	Great Bear	Vancouver Island			1412469	40	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)

Wind	69	Hardy Bay	Hardy Bay, Port Hardy area, Vancouver Island	Zero Emission Energy Developments Inc.	Site Evaluation (Applying for Investigate Permit)	1413073		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8901
Wind	70	Holberg Wind Energy Project	Holberg area, north Vancouver Island	Holberg Wind Energy GP Inc.	Project Development (EA approved)		58.5	http://www.eao.gov.bc.ca/epic/output/html/deploy/epic_project_home_228.html; BC EAO (2004a)
Wind	71	Hushamu Creek	Port Hardy area, Vancouver Island			1412026	20	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Hushamu Wind Farm	Four locations on Vancouver Island between Port Hardy and Coal Harbour	Sea Breeze Power	Site Evaluation (Early in process)		43	http://www.seabreezepower.com/projects/hushamu.php
Wind	72	Jordan Ridge	Jordan Ridge, near Port Renfrew, Vancouver Island	Aeolis Wind Power Corp.	Site Evaluation (Assessing resource under permit)	1413914	150	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7947; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Jordan Ridge	Jordan Ridge, near Port Renfrew, Vancouver Island	Aeolis wind Power Corp.		1413917		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8005
Wind		Jordan Ridge -1	San Juan Ridge, near Port Renfrew, Vancouver Island	Aeolis Wind Power Corp.	Site Evaluation (Assessing resource under permit)	1413912	150	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7903; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Jordan Ridge -2	San Juan Ridge, near Port Renfrew, Vancouver Island	Aeolis Wind Power Corp.	Site Evaluation (Assessing resource under permit)	1413913	70	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7924; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	73	Kains Lake	Northwest of Kains Lake, Port Hardy area, Vancouver Island	Sea Breeze Power	Site Evaluation (Assessing resource under permit)	1413015		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8185
Wind	74	Knob Hill	Knob Hill, Port Hardy area, Vancouver Island	Sea Breeze Power		1412907		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7325
Wind		Knob Hill	Knob Hill, Port Hardy area, Vancouver Island	Sea Breeze Power		1412028		referred to in 1412028
Wind		Knob Hill Wind Farm	Knob Hill, Port Hardy area, Vancouver Island	Sea Breeze Power	Project Development (EA approved, awaiting PPA; also application for 2 new tower sites)	1412052	450	http://www.seabreezepower.com/projects/knobhill/; http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8717; Sea Breeze (, 2004 #1430}; BC EAO (2004b)
Wind	75	Malaspina Peninsula	Malaspina Peninsula, Powell River area, Sunshine Coast	Unknown	Site Evaluation (Applying to assess resource)	2409686		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8987

Wind	76	Malcolm Island - East	Port McNeill area, Vancouver Island			1412499	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Malcolm Island - North	Port McNeill area, Vancouver Island			1412442	280	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Malcolm Island - West	Port McNeill area, Vancouver Island			1412441	90	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	77	Mount Brandes	Holberg area, north Vancouver Island			1412104	60	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	78	Nahwitti Lake	Near Nahwitti River, Port Hardy area, Vancouver Island	Sea Breeze Power		1412053		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8135
Wind		Nahwitti Lake (NW of)	Near Nahwitti River, Port Hardy area, Vancouver Island			1412361	150	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Nahwitti River	Near Nahwitti River, Port Hardy area, Vancouver Island	Sea Breeze Power	Project Development (Development with License of Occupation)	1413012		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8201
Wind		Nahwitti River	Near Nahwitti River, Port Hardy area, Vancouver Island	Sea Breeze Power	Project Development	1413053		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8135
Wind	79	Nahwitti Wind Farm Project	Near Nahwitti River, Port Hardy area, Vancouver Island	Nomis Power Corp.	Project Development (In EA Pre-application process)		200	http://www.eao.gov.bc.ca/epic/output/html/deploy/epic_project_home_249.html
Wind	80	Newcastle Ridge (wind)	Sayward area, Vancouver Island	Sea Breeze Power	Site Evaluation (In proposal stage)		Initially 45 MW, expansion to 90 MW	http://www.seabreezepower.com/projects/newcastle_ridge.php
Wind	81	Nimpkish Block (wind)	Port McNeill area, Vancouver Island	Sea Breeze Power	Project Development (EA not yet started)		71	http://www.seabreezepower.com/projects/nimpkish_block.php. According to James Griffiths of Sea Breeze Power Corp., the company is only pursuing one portion of this project called Nimpkish 2 (2008).
Wind		Nimpkish Lake	Port McNeill area, Vancouver Island			1412027	36	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Nimpkish Lake Block 2	Port McNeill area, Vancouver Island			1412494	30	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	82	O'Connell Lake	Quatsino Sound area, Vancouver Island	Earth First Energy Inc.	Site Evaluation (Assessing	1412914		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7411

					resource under permit)			
Wind		O'Connell Lake	Quatsino Sound area, Vancouver Island	Earth First Energy Inc.	Site Evaluation (Assessing resource under permit)	1412925		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7474
Wind		O'Connell Lake North	Quatsino Sound area, Vancouver Island			1412315	200	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	83	Pemberton Hills	Fraser Valley, Lower Mainland			1412459	30	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	84	Pinch Creek	North Vancouver Island			1412461	200	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	85	Point Grey	West of Point Grey, City of Vancouver	Finavera Renewables Inc.	Site Evaluation (Assessing resource)	2409585		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8496
Wind	86	Roberts Creek	Sunshine Coast	6740103 Canada Corp.	Site Evaluation (Site Evaluation (Assessing resource under permit)	2409501	50	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8286; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	87	Sechelt	Sunshine Coast			2408993	130	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	88	Shushartie	Cape Scott area, Vancouver Island	Sea Breeze Power		1413009		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8162
Wind		Shushartie Mountain Project	Cape Scott area, Vancouver Island	Sea Breeze Power	Project Development (EA not yet started, awaiting PPA; applying for amendment to current permits)	1412534	450	http://www.seabreezepower.com/projects/shushartie_mountain.php; http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8182
Wind		Shushartie North	Cape Scott area, Vancouver Island			1412024	50	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Shushartie River	Cape Scott area, Vancouver Island	Sea Breeze Power	Project Development	1412979		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7781
Wind		Shushartie South	Cape Scott area, Vancouver Island			1412466	100	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	89	Texada Island	Comox area, Vancouver Island	Katabatic Power Corp.	Site Evaluation (Applying to assess resources)	2409296		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7388
Wind		Texada Island	Comox area, Vancouver Island	Katabatic Power Corp.	Site Evaluation (Applying to assess resources)	2409297	70	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7384; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)

Wind	90	Texada Island	Comox area, Vancouver Island	Bowark Energy Ltd.	Site Evaluation (Assessing resource under permit)	2409453	150	http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=8191; Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	91	Three Isle Lake	Port McNeill area, Vancouver Island			1412130	50	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Three Isle Lake	Port McNeill area, Vancouver Island	Earth First Energy Inc.	Site Evaluation (Assessing resource under permit)	1412919		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=7395
Wind	92	Topknot Point	Port McNeill area, Vancouver Island			1412068	20	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	93	Twin Peaks	Port McNeill area, Vancouver Island	C-Free Power Corp.	Site Evaluation (Applying for Investigate Permit)	1413089		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=9045
Wind	94	Victoria Lake	Port Hardy area, Vancouver Island			1412070	50	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	95	Whistler/Blackcomb Mtn	Whistler area, South Coast			2409166	20	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	96	William Lake	Vancouver Island			1412069	150	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	97	Windy Ridge	Northwest Vancouver Island			1412133	30	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Windy Ridge (wind)	Northwest Vancouver Island	Sea Breeze Power	Site Evaluation (Early in process (taking wind data))			http://www.seabreezepower.com/projects/windy_ridge.php
Wind	98	Wolverine	Vancouver Island			1412129	120	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind		Wolverine	Vancouver Island			1412468	40	Holt and Eaton (2007) (based upon data from ILMB in Sept 2007)
Wind	99		Port Hardy area, Vancouver Island	4079647 Canada Inc.		1413104		http://www.arfd.bc.ca/ApplicationPosting/viewpost.jsp?PostID=9226

Notes: 1. Estimated capacity is either the estimate for the project provided by the project's proponent, or an estimate of theoretical energy potential as per work by Holt and Eaton (2007). 2. According to the Ministry of Energy, Mines, and Petroleum Resources, 0778992 BC Ltd. is an affiliated company of Fred Olsen Renewables of Norway (Turner 2008).

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