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Introduction

The Sunshine Coast shares characteristics with many rural BC communities but is unique in its proximity to the province’s major city – Vancouver. Inhabited almost entirely along its western and coastal margin, the Sunshine Coast relies almost entirely on energy imported from outside its borders. Spending over $106 million and emits over 355,000 tonnes of greenhouse gases annually (SCRD, 2010), the region faces both the need to meet growing demand for energy sustainably while finding means to reduce its reliance on imported energy.

The development of a Renewable Energy Atlas was identified in the Community Energy and Emissions Plan (CEEP) adopted in 2010 as a means to optimize use of local and regional renewable and alternative energy sources. One of the six goals in the CEEP was ‘Expanding Local Renewable Energy Opportunities’. In We Envision, the Regional Sustainability Plan, renewable energy is identified as a fundamental component to supporting an 80% reduction in greenhouse gas emissions by 2050 (p.54) (SCRD, 2011). Specific actions include supporting 5 to 10 projects by 2020, as well as supporting renewable energy technology requirements for buildings, home based renewable energy systems, and local opportunities for professional skills development.

The purpose of this Atlas is to serve as a preliminary review of Renewable Energy on the Coast, an invitation to the residents, businesses and the communities of the Sunshine Coast to learn more and consider the powerful potential of more integrated Renewable Energy resources. This document serves as a first step to better understanding what types of Renewable Energy technology are viable on the coast. Some technologies are already in operation on people’s homes on smaller scales or out of view in more remote corners of our communities. Ensuring future projects also meet the community’s social and environmental goals will be an essential component of advancing Renewable Energy on the coast.

This atlas helps determine and identify for each of eight key renewable energy types:

- a brief overview of suitability on the Coast and basic requirements
- opportunities for residential, community, commercial and local government applications
- working examples, costs and benefits, potential impacts and risks

In addition this atlas touches on key approval and permitting processes, serving as a useful starting point for residential, community, local government and commercial applications to create more renewable energy opportunities on the Sunshine Coast. While this document does not describe how each technology works it does provide helpful links for readers interested in learning more. More detailed assessments of Renewable Energy that include primary data collection (e.g. Strait-Highlands Energy Asset Map in Cape Breton) (Strait-Highlands Regional Development Agency, 2008) could be conducted in the future to provide detailed assessment of potential.

Every year for the past five, global wind power supply and capacity has shot up by 25% and solar by 50% (International Energy Agency, 2008). While Canada lags in development, Ontario and parts of BC and Alberta are taking steps in this direction. While Alberta currently generates only 2% of its electricity needs from wind, Denmark harnesses over 20% of theirs since 2004. Denmark has also provided a
compelling model of engaging communities to embrace renewable wind energy, as has Germany – a leader in solar PV technology. District Energy systems which often generate heat centrally for distribution to many buildings in city or town centers, are appearing in many large centers in Europe and North America (in cities of Vancouver and Burnaby’s size, to smaller centers like Revelstoke). In BC, communities like Dawson Creek, the City of Abbotsford, T’sou-ke First Nation and Cowichan Valley Regional District are pursuing renewable energy like solar, wind and biogas technology.

Renewable energy sources provide a major step towards local energy resilience. For the Sunshine Coast it would mean less dependence on all of its energy needs from expensive energy imports. As population is expected to rise slowly each year, renewable energy and heat sources provide a means to meet that demand, while simultaneously reducing our carbon emissions and the environmental and health impacts of fossil fuel extraction, transportation and consumption.

Renewable energy can serve to generated local economic opportunities through job creation in the green energy sector, green sector education and training. More locally distributed generation – at household, building and neighbourhood levels – reduces the impacts of power outages making our region resilient in the face of future energy demands and changing environmental conditions.

Acknowledgements
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Energy Supply and Distribution
The Sunshine Coast is served by BC’s two major energy utilities – BC Hydro and FortisBC. BC Hydro serves all developed areas of the coast. Power is brought from Squamish, with substations in Gibsons, Sechelt, and Pender Harbour. Several small micro-hydro generating stations supply power into the Sunshine Coast grid. The main transmission line to Vancouver Island also crosses the SCRD before crossing at Texada Island. FortisBC’s pipeline also comes from Squamish, and serves areas as far as Halfmoon Bay before crossing to Texada Island. Proximity to power lines or gas pipelines is critical for renewable energy technologies that propose to sell energy to the utilities.

Renewable electricity sources can be connected to the grid or used in an offgrid application where BC Hydro service is too far away for practical application or to serve as completely independent power sources. BC Hydro actively looks for alternative sources of power and has established a number of methods for selling power to the grid. The net metering tariff allows for customers to sell up to 50 kW of power to the grid through an existing connection. Power sold into the grid will be subtracted from the customer’s consumption on an annual basis. Excess power will be purchased by BC Hydro at a current price of $0.0813/kWh. BC Hydro publishes interconnection standards which must be followed for putting power into the grid, with simpler requirements for systems below 25 kW.

The Standing Offer Program provides certainty for larger projects up to 15 MW looking to sell power into the grid. Any project that meets the program requirements is eligible, with no tender calls. BC hydro currently purchases the power at a base rate of $0.102/kWh, with variations for time of day and year. An interconnection study is required as part of the application process, although for systems connecting to the distribution system this may be replaced by a screening study.

For larger projects, BC Hydro regularly puts out calls for competitive proposals. These are sometimes specific to certain technologies (e.g. biomass).

Biogas production can also be connected to the FortisBC pipeline system. Fortis has not been as active in sourcing energy as BC Hydro, but they are starting to look for alternative sources of gas, particularly that which can be sold as renewable. Landfills, agricultural facilities, and waste treatment plants are the most promising sources of biogas, which can be upgraded and injected into the FortisBC pipeline system.

Energy Demand
Homes and businesses on the Sunshine Coast consume about 1,939,000 GJ of building energy annually (excluding Howe Sound Pulp & Paper). About 60% of this is electricity and 20% natural gas. The remainder is propane, heating oil, and wood. Only a very small proportion of this energy is locally generated or comes from a renewable source.

The distribution of energy use is important when considering some types of renewable energy systems. Systems that generate heat, such as solar hot water or biomass, need to be located close to where the energy will be used. For larger systems, heat will need to be distributed to multiple buildings by means
of a district energy system. Energy density, or the amount of energy per hectare of land area, plays a role in determining the viability of distributing energy between buildings.

On the Sunshine Coast, energy density is relatively low compared to urban areas such as Vancouver. The most energy dense areas are, not surprisingly, upper Gibsons and downtown Sechelt. Major energy consumers include schools, shopping malls, recreation facilities, and the hospital. Any district energy system distributing heat to existing buildings would likely need to be located in one of these two areas.

Developments centered in other growth areas centered in Egmont, Madeira Park, Halfmoon Bay, Roberts Creek and Langdale may support district energy with potential for increased density also supporting efficient transportation infrastructure.

Some buildings are also potential sources of heat. Industry is often a good source of waste heat, but on the Coast the only significant source of industrial heat would be HSPP which is not close to any other development. Another potential source is ice arenas, which reject heat from refrigeration equipment throughout the year. The possibility of using waste heat from the Gibsons arena for the Town’s geothermal exchange district energy utility has been considered.

Map 1 (see the Appendix) provides a thumbnail sketch of energy demand on the Sunshine Coast.

The Maps
The written descriptions of the technologies found in the following pages are supported by maps. These maps are intended to provide a visual guide to the applicability of renewable energy on the Sunshine Coast. The maps were developed from a number of sources, including:

- BC Hydro’s Green Electricity Resources Map
- BC Hydro’s Green Energy Study for BC, Phase 2
- LiDAR topographic and solar radiation data
- BC Assessment data
- Local knowledge and input

The maps are developed at a fairly high level. They should not be used to definitively state whether a technology is viable for a certain site, but rather to indicate whether further investigation is likely to be worthwhile. The maps are located on pages 36 to 41 of the report.

Map 1. Energy Demand (GJ/hectare)
Map 2. Solar Radiation
Map 3. Biomass Power Potential
Map 4. Potential Wind Power
Map 5. Existing and Potential Hydro power
Map 6. Detailed Wind Energy Map (S-HRDA)
Forms of Renewable Energy and Renewable Heat

The advance of renewable energy technology in today’s market is being driven by many factors including increasing cost effectiveness of renewable energy, environmental and health benefits, growing interest and desire for green energy jobs and efforts to mitigate climate change.

A quick assessment of potential renewable energy resulted in a list of eight. Some technologies are more mature and also more cost effective. All of them are best suited to the local conditions and resources in coastal British Columbia. Each of these 8 renewable energy technologies are detailed below and some BC examples are provided along with cost and typical project size. Where precise values are not known, best estimates have been provided.

Table 1. An overview of 6 electricity generation technologies reviewed in this report

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Typical Scale (kW)</th>
<th>Installed Capital Cost (per kW)</th>
<th>BC example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Microhydro and Small hydro</td>
<td>1-25 kW; 25kW+</td>
<td>$1,300-$4,000</td>
<td>- Municipal water distribution infrastructure</td>
</tr>
<tr>
<td>2. Solid Waste and Landfill Gas</td>
<td>1 – 30 MW</td>
<td>$3,000-$8,000</td>
<td>- Hartland Landfill Gas Utilization Project, CRD</td>
</tr>
<tr>
<td>3. Biomass</td>
<td>(electricity: 500 to 2000 kW)</td>
<td>$2,500-5,000</td>
<td>- UBC District Energy system - Catalyst Power project, Abbotsford</td>
</tr>
<tr>
<td>4. Wind</td>
<td>1 to 1000 kW (5 to 20 kW on buildings)</td>
<td>$3,000 to $6,000</td>
<td>Bear Mountain (Dawson Creek) 103,000 kW</td>
</tr>
<tr>
<td>5. Solar PV</td>
<td>1-5 kW (per home)</td>
<td>$6,000 to $8,000</td>
<td>- T’sou-ke First Nation</td>
</tr>
<tr>
<td>6. Tidal</td>
<td>1,000 to 250,000 kW</td>
<td>~ $60,000</td>
<td>Race Rocks (no longer operating)</td>
</tr>
</tbody>
</table>

Table 2. Two renewable heat energy technologies reviewed in this report

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Coefficient of Performance</th>
<th>Installed Capital Cost</th>
<th>BC example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Geo-exchange/ Air to Air Heat pump</td>
<td>Geo-exchange 3-4 ; Air-to-Air 2.5-2.8</td>
<td>Geo-exchange $10,000 to $20,000 ; Air-to-Air $3,000 micro-unit to $10,000 large</td>
<td>- Gibsons District Energy Utility (Geo-exchange)</td>
</tr>
<tr>
<td>2. Solar Thermal</td>
<td>Site specific</td>
<td>$6,700 (house) to $10,000 (business)</td>
<td>- &gt;20 homeowners and local government on the Sunshine Coast</td>
</tr>
</tbody>
</table>
Multiple benefits - Reduced emissions, increased efficiency, less costly technology, and more

The International Energy Agency (IEA) states that Renewable Energy technology is a key part of mitigating CO₂ emissions (Muller, Brown, & Olz, 2011). As of 2008 they represent a CO₂ savings globally of 1,718,000,000 tonnes had this power been generated by fossil fuels instead. The life cycle emissions of renewable energy technologies are a fraction of fossil fuels (Figure 1).

Renewable energy provides multiple additional benefits including:

- Lower SO₂ and NOₓ life-cycle emission levels compared with fossil fuel energy¹
- Lower water consumption profiles for renewable compared with fossil fuel energy
- Renewable Energy supports increased energy security and availability while addressing energy price volatility and uncertainty
- Renewable Energy generates more jobs per unit energy than the fossil fuel industry (Muller, Brown, & Olz, 2011, p. 15)

Simultaneously, the energy efficiency and performance of all renewable energy technologies is rising as illustrated in the figure below for Solar PV cells in the past 35 years. Solar PV system prices have decreased steadily – falling 56% from 2006 to 2011, and costs of installed system costs the same during this period. The advent of new micro-inverter technology enables even small scale systems to convert DC input power from renewable sources to grid ready AC output electricity in tiny, affordable units. The combined small size and sophistication of these systems is one of a number of drivers that has raised global new investment in renewable energy from $22 billion in 2004 to over $211 billion in 2010. Increased efficiency, system improvements, manufacturing cost reductions and recent market shifts have made a targeted $1 per watt goal in reach. As these alternative energy sources approach grid parity (i.e. generating power from alternative sources will be equal in cost to purchasing from the grid),

¹ Biomass emission levels for NOx are higher but depend on biomass composition and conditions of harvesting, transport and conversion to energy (Muller, Brown, & Olz, 2011)
energy generation will shift from traditional sources to renewable energy types on a very large scale. These shifts may help enable a shift in energy generation from coal, oil and gas to solar PV, wind and wave/tidal power.

The Sunshine Coast can benefit from increased renewable on many of these fronts, as well as generating and increasing economic opportunities, job creation and new skill development.

Eight types of Renewable Energy on the Coast

Solar Energy

Solar Thermal
Solar thermal is the use of solar energy for hot water and space heating. Solar thermal is typically accomplished by passing a water/antifreeze solution through a panel mounted on the roof of a building. The water is heated by the sun and then stored in a storage tank until required. Solar thermal is a well-established technology, with millions of panels in use world-wide. In Spain solar thermal has been mandated for new and renovated buildings, while one in seven homes in Austria uses solar thermal (Solar BC, 2009). In BC, the SolarBC program resulted in over 500 installations between 2008 and 2010. 14 of these were on the Sunshine Coast. Although solar thermal has been used to serve multiple buildings in a district energy system, they are usually stand-alone systems intended to serve the building they are installed in.

![A simple residential hotwater system on the coast (left); and a solar hotwater installation at SCRD Field Road Office (right).](image)

The best applications for solar thermal are those that have a consistent year round heating requirement and relatively low temperature requirements. Heated swimming pools are ideal, while buildings with large, steady water heating loads (e.g. hotels or hospitals) are also potential candidates. In residential
applications solar thermal is usually used for water heating. Although it can be used for space heating, this is not an ideal application as the highest loads occur in the winter when there is the least solar energy available.

Payback periods for solar thermal can vary widely depending on the application, ranging from under 10 years to as long as 40 years, although government rebates may reduce that significantly (Community Energy Association, 2007). The cost of a typical residential water heating system is approximately $6,700 ($4,950 after current government incentives), with savings of $175 – 280 per year (9 – 13 GJ), reducing carbon emissions by 0.6 tonnes (based on displacing natural gas). A solar thermal system has a life expectancy of 20 to 30 years (NRCan, 2002).

**Application on the Sunshine Coast**

Solar thermal energy is broadly applicable on the Sunshine Coast. The viability of solar thermal is affected by a number of factors, including solar radiation, temperature, orientation, and shading. Most of the Sunshine Coast has a medium solar resource for BC, ranging from 3.0 – 4.0 kWh/m² per day (BC Hydro and Canadian Cartographics Ltd., 2002). This is lower than some areas of the province that have a high solar resource, such as the Okanagan and Peace (~4.5 kWh/m² per day), but the Sunshine Coast benefits from mild winter temperatures, which improve system efficiency. See Map 2 in the Appendix which profiles Annual Solar Radiation on the coast.

Areas closer to Georgia Straight have higher solar radiation than areas further inland, but most populated areas of the Sunshine Coast will have a similar solar resource, with the exception of Egmont and Langdale. A south facing orientation is ideal for solar panels, but an orientation from SE to SW is acceptable. Shading is probably the most significant limiting factor on the Sunshine Coast, whether from trees, buildings, or topography. In winter the sun’s altitude doesn’t exceed 30°, so a location with a clear view of the sun throughout the year is needed to maximize solar potential. Flat or south sloping areas such as Upper Gibsons and Sechelt are best suited to solar, while heavily treed areas such as Roberts Creek are less likely to be good candidates. Local topography and orientation will play an important role in determining specific site suitability.

**Requirements, Potential Impacts and Risks**

There are no environmental or health concerns with installing a solar water heating system. Systems should be installed by a certified installer. There is one CANSIA certified installer on the Sunshine Coast.
at the time of writing (Sechelt Plumbing). A building permit is required to install a solar thermal system, and a backflow prevention device is required in the Town of Gibsons, and the Sunshine Coast Regional District.

If constructing a new house, but not ready to install a solar thermal system, builders can reduce future costs by making the home solar ready. This means installing a pipe chase from the hot water tank to the roof so that pipes and wiring can be accommodated later. This is a requirement for new homes in the SCRD, District of Sechelt, District of North Vancouver, Dawson Creek and over two dozen other BC jurisdictions and the Provincial government is looking at incorporating it into the next building code revision.

**Solar Photovoltaics (PV)**

Solar photovoltaics (PV) are the use of solar energy to generate electricity using silica based panels, which convert sunlight into electric current. The power can be used immediately or stored in batteries until required. PV is a mature technology that is used in all kinds of applications, from calculators to satellites. World-wide, there has been a huge increase in the number of PV installations in recent years, with 17,000 MW (REN21) installed in 2010 (from 1,300 MW in 2001). Germany accounted for over a third of this and their PV industry generates 10,000 jobs in production, distribution and installation (Renewable Energy World, 2010) (Release Wire, 2009).

While the price of PV has been dropping, it is still an expensive technology and will not necessarily be cost effective versus electricity from BC Hydro. The best applications continue to be in off-grid situations such as cottages or remote work sites, or where the cost of distribution wiring (streetlights or remote signage) is substantial.

PV costs are typically in the range of $6,000 - $8,000 per kW (BC Hydro, 2011) installed (without batteries). Although a typical single family house would require approximately 8 kW to meet all electricity needs, in practise it would be essential to aggressively reduce energy consumption first in order to reduce the amount of PV required. Payback periods for PV are in the range of 50 to 100 years, at current BC Hydro rates. Off-grid, where electricity is generated from gasoline or diesel, payback periods will be much shorter. A PV system has a life expectancy of 25 - 30 years (BC Hydro, 2011).
Application on the Sunshine Coast

Like solar thermal, PV is broadly applicable on the Sunshine Coast and is impacted by the same factors of solar radiation, temperature, orientation, and shading. Unlike solar thermal, PV actually performs better in cool weather, but the overall impact of temperature is small. The lack of snow on the Sunshine Coast, compared to interior or Northern BC climates, is also an advantage, reducing the need to clear snow from the panels. Map 2 in the Appendix profiles Annual Solar Radiation on the coast.

Requirements, Potential Impacts and Risks

There are no environmental or health concerns with installing a PV system. Systems should be installed by a qualified electrician. A building and electrical permit are required to install a PV system, and BC Hydro approval is required if it is to be connected to the grid.

Geo-exchange and Heat Pumps

Geo-exchange is one of the most commonly used sources of renewable energy used in BC and on the Sunshine Coast. Geo-exchange is the use of the earth’s stable and relatively (compared to outdoor air) warm temperatures. It should not be confused with geothermal, which refers to extracting high temperature heat from deep in the earth. Geo-exchange requires heat pumps to raise the temperature of the ground to a useful temperature for heating. Although the heat pumps require electricity to operate, they use it very efficiently, extracting 2 – 4 times as much heat as the input electricity. Heat pumps can be used in many other similar situations, where a low temperature source of heat is available. This includes oceans, lakes, and wells, sewer systems, waste industrial heat, or outside air. The warmer the heat source, the more efficiently the heat pumps will operate.
There are many geo-exchange installations on the Sunshine Coast, as well as heat pump systems using ocean water and outside air. Most of these have been in residential homes. The Town of Gibsons has established a geo-exchange based district energy system that provides heat to an entire subdivision through the use of geo-exchange heat pumps.

The cost of geo-exchange and other heat pump systems varies according to the application, the heat source, ground conditions, and the alternatives available (such as natural gas). Typically paybacks will be in the 15 – 30 year range, but in some situations may be less than 10 years. Horizontal geo-exchange systems (where pipes are buried at shallow depths) are usually more cost effective than vertical systems (where holes are drilled into the ground), but require considerable land area.

**Application on the Sunshine Coast**

Suitability of ground conditions on the Sunshine Coast will depend on the site. Many sites are rocky, but can still be good for vertical systems. Horizontal systems require softer soils that can be excavated easily. Many areas also have groundwater available. Most installations will likely be vertical systems due to space constraints, but buildings with large land areas (such as schools) can install horizontal systems. The Town of Gibsons has initiated a geo-exchange district energy utility in Upper Gibsons using horizontal fields.

Due to the extensive coastline, the potential for ocean water as a heat source is good on the Sunshine Coast. These systems are generally cheaper than geo-exchange systems. Any building close to the water could potentially be viable.

Wastewater treatment plants can be a good heat source for larger systems. Unfortunately, the treatment plants in Gibsons and Sechelt are not located next to major buildings requiring heat. Potentially new buildings or industrial facilities could be located near the treatment plants in order to access this heat. Heat can also be extracted directly from sewer pipes. These would need to have high flows to be viable. The outflow pipe from the Dusty treatment plant in Sechelt is probably the best candidate for heat.
Air can be used as a heat source anywhere on the Sunshine Coast. The climate is very good for air-source heat pumps as temperatures are rarely below freezing. Air source heat pumps can be used in almost any kind of building or facility, new or retrofit. Air-source heat pumps are not as efficient as geo-exchange installations, but may still provide 2 – 3 times as much heat as the electricity input.

Because heat pumps use electricity, they are always more viable where a cheaper fuel (such as natural gas) is not available. Locations without gas service will be best suited to heat pump applications, whether geo-exchange or other.

**Requirements, Potential Impacts and Risks**

Few health or environmental concerns are tied to geo-exchange systems. Systems should be installed by qualified contractors (certified by the Canadian Geo-exchange Coalition) to ensure systems are well constructed and will not leak. Closed geo-exchange systems use anti-freeze solutions, which are non-toxic but should not be released. Open loop systems which use groundwater have to be carefully designed to ensure the aquifer is not depleted.

Geo-exchange systems and air-source heat pumps do not require any special permits other than building and electrical permits. Open loop systems and ocean/pond systems may need a permit from the Department of Fisheries and Oceans or the Province.

Air-source heat pumps can sometimes be noisy. Care should be taken to ensure noise is not a concern for neighbours or any noise bylaws are not being violated.

Figure 7. Heat source pumps, come in a variety of brands and shapes, and are increasingly visible on businesses and homes throughout the Sunshine Coast.
Wind

Wind is one of the fastest growing sources of new electricity generation, with 39,000 MW installed in 2010 (REN21). European countries in particular have embraced wind power, with wind accounting for 6% of electricity generation in Germany and 19% in Denmark (Wikipedia, 2012). BC’s first wind farm, Bear Mountain near Dawson Creek, opened in 2009 with thirty-four 3 MW turbines.

The cost effectiveness of wind power has benefited from economies of scale, with most wind farms now using dozens or even hundreds of very large turbines. These can be up to 200 metres tall and generate up to 7.5 MW each, enough to power a small community. But wind turbines are also available in much smaller sizes, from a few hundred watts (often used on sailboats) to 100 kW (suitable for a school, business, group of homes, etc). Wind farms need a significant amount of space and steady winds, which is why they are often located on open prairies, mountain ridges, or in the ocean off-shore. For smaller wind turbines, local geography and obstacles (natural or man-made) will determine the amount of wind.

Wind turbines operate best with steady strong winds. They generally require 7 – 10 km/h winds to begin generating power and reach their nameplate ratings at approximately 50 km/h. Average wind speeds of over 18 km/h (BC Hydro, 2011) are recommended for wind power to be viable. Several manufacturers (e.g. Siemens, Lagerwey) have developed wind turbines designed to operate most effectively in low to medium winds (3 – 9 km/h) (Appleyard, 2012), the economics may not yet make small scale installations at these wind speeds workable.

Wind power costs are typically in the range of $3,000 - $6,000 per kW installed (BC Hydro, 2011), with payback periods ranging from 10 – 40 years. Large wind farms will be at the lower end of that range, while small scale applications will be at the higher end. A wind system has a life expectancy of 25 - 30 years (BC Hydro, 2011).
Application on the Sunshine Coast

Generally speaking, the Sunshine Coast is not a good location for wind power, as Vancouver Island blocks winds off the Pacific Ocean and the terrain is not flat. The best locations would be exposed waterfront sites or ridges in the mountains. No detailed wind monitoring has been done on the Sunshine Coast, but BC Hydro has done computer modelling of wind resources. These indicate that most of the Sunshine Coast has a poor wind resource (under 4 m/s), but the Thormanby Islands and some mountain ridges are given a fair resource (4 – 6 m/s). See Map 4 in Appendices. A comprehensive and primary data based wind resource assessment project similar to the S-HRDA Cape Breton study would generate a detailed picture of wind and other renewable energy potential on the coast, at a cost of about $100,000 (see Appendix Map 6).

The Merry Island lighthouse station near South Thormanby has an average measured wind speed of 18 km/h. It is possible that other similarly exposed waterfront locations will have sufficient wind speeds to justify wind power, including Francis Point, Trail Islands, Mission point, and Keats Island. Merry Island and Keats Island are both connected to the BC Hydro grid, so would have potential for grid connection.

Mountain ridges are more difficult for developing wind projects due to the difficulty of access to roads and power lines. There is an extensive network of logging roads throughout the Sunshine Coast, which would make some locations more viable. Locations on Mount Elphinstone or along the ridge of the Sechelt Peninsula may be best suited due to logging road access and proximity to power lines. Dakota Ridge or near the Chapman Creek water treatment plant are two possible sites that may be worth exploring. A small turbine that produced power for the Dakota Ridge ski area might make an interesting community pilot project.

Requirements, Potential Impacts and Risks

Small scale wind systems do not pose significant health or environmental concerns (< 50 kW). Large scale wind systems will need to undergo rigorous planning, including environmental assessments for systems over 50 MW. Turbine noise can be an issue and large turbines should be located well away from residential areas. Impacts on birds, bats, and insects have also been reported, and there needs to be
careful consideration of wildlife impacts, particularly for migratory birds. Locating wind turbines out of major bird migration corridors is recommended. While bird deaths have largely been a concern in older systems with high speed turbines, two bird fatalities are caused per turbine annually in North America – a tiny fraction of other human causes like impacts with buildings, high tension lines, and vehicles (Pembina Institute, 2009).

The visual impact should be considered, as large turbines will be visible from a distance. All systems will need to meet any height, noise, or other restrictions in local bylaws.

**Hydro**

Hydro power provides the majority of BC’s power, most of it from large dams on the Peace and Columbia rivers. In recent years small hydro has come to the forefront as the primary source of new power generation in BC. BC Hydro defines small hydro as less than 50 MW, and estimates that small hydro could provide up to 20% of BC’s power (BC Hydro and Canadian Cartographics Ltd., 2002). There are six small hydro projects operating on the Sunshine Coast - McNair Creek, Clowhom, Upper and Lower Clowhom, and Tyson Creek. Clowhom was built by BC Hydro in 1957, while the others have been built or are under construction more recently by private developers. Two projects are undergoing agency review.

Most small hydro projects divert a portion of the water in a river using a weir, which is a small dam that allows the majority of water to continue over it. Recent projects and proposals on the Coast are incorporating high altitude lakes, enhanced by weirs, to provide storage that would allow for extended periods of energy production. The water is returned to the river lower down. The amount of power that can be generated depends on the water flow and the elevation drop. While most power projects are 5 MW or larger and sell power to BC Hydro, hydro turbines as small as 100 W (0.0001 MW) are available for residential applications. In addition to creeks and rivers, hydro power can also be generated from municipal water systems where pressure reducing valves (PRVs) are used to moderate system delivery pressures. This has been done in West Vancouver and Lake Country. High pressure (>30 psi) and consistent flow are criteria for viability.
Small hydro costs are typically in the range of $1,300 - $4,000 per kW installed for commercial systems (BC Hydro, 2011), with payback periods ranging from 2 – 7 years. Smaller systems will likely have higher costs and longer paybacks. Life expectancy of commercial systems is up to 100 years (BC Hydro, 2011).

Application on the Sunshine Coast

The Sunshine Coast has excellent hydro power potential, with lots of rivers and creeks, steep terrain, and high rainfall. BC Hydro has assessed the hydro potential of most sites in BC between 0.1 and 5 MW, and identified a number of additional potential sites on the Sunshine Coast (see Appendix). The study was completed in 2002 and while out of date, with respect to project scale and viability, it indicates the potential for hydro power for the Sunshine Coast.

The viability of these hydro systems will partly depend on their road access and distance to power lines. Those situated near existing logging roads and where the generating station will be reasonably close to power lines will have a better chance of being economically viable.

In addition to the sites identified by BC Hydro, there may be opportunities for smaller scale micro-hydro to serve homes or businesses in the immediate vicinity. Many Sunshine Coast homes are on larger acreages with streams passing through them. However, a considerable flow of water and/or elevation drop is necessary to generate meaningful quantities of electricity. A 2 kW turbine would generate enough power for a typical house, but would require 1500 litres/minute of flow (equivalent to 150 showerheads) and a 20 metre elevation drop.

The SCRD water supply has a number of PRVs throughout the water distribution system that may have potential for power generation. There may also be potential for generating power from existing water intakes at Gray Creek, Chapman Creek and McNeill Lake.

Figure 11. A microhydro installation like this award-winning independent energy project in District of West Vancouver generates 1.1 GWh annually, equal to the power use of about 90 single family homes and will provide $700,000 net revenue over 25 years for the District. This illustrates the small scale and low impact opportunity for small scaled hydro projects on the Sunshine Coast. Mounted turbine (left) and micro-inverter and control systems in small pump house (right). Photo courtesy: Paul Nash, Alpine Water & Energy. For more information visit: http://seatoskygreenguide.ca/infrastructure/eagle_lake_green_energy_project
See Map 5 in the Appendix.

Requirements, Potential Impacts and Risks

Hydro systems do not pose any health concerns. There may be environmental concerns, mostly relating to fish habitat, although roads and transmission lines may also impact other eco-systems and wildlife. There may also be an impact on recreation activities, including white water kayaking and fishing. Visual impacts will often be a concern in areas frequented by hikers, particularly if new roads or transmission lines are required.

Gen-Zed Construction completed a 3 kilowatt microhydro installation in Roberts Creek in June 2012. Using an existing small dam structure and penstock pipe, microturbine generators were installed into a pump house. The power generated feeds into an integrated control system completed with micro-inverter in the household. The sophisticated control system permits the direction of electric power into one or more parts of the system: the 2,000 square foot home; a set of lead-acid batteries capable of supplying the home with up to 3 days of off-grid power; heating for an in floor radiant and hotwater heating systems. In addition the system is designed to take advantage of BC Hydro’s updated and simplified net-metering program – feeding electricity back onto the grid when the other systems are not in use.

On average this microhydro installation will readily cover 75% of the home’s daily electric needs when in full use. With the addition of another turbine, 100% household energy use is anticipated. When fewer in-home systems are being used, and back-up batteries are fully charged, the system switches to net-metering – supplying the local grid with additional electric power and revenue for the owner.

A group of Local Businesses custom designed and installed this system including Gen-Zed, Coast Sheet Metal Works Ltd., and Olson Electric. The installation also incorporates Canadian Energy Systems Design microturbines (from Nova Scotia), electronics from Canadian based Tekmar and thermal buffer tanks from Eco King Heating Products (Langley).

There are opportunities to expand low impact renewable energy applications on the coast – to generate more clean energy locally, increase energy resilience for the region and expand green business opportunities on the coast. The list of suppliers and systems in the appendix can help get you started.
Larger scale hydro systems will need to undergo rigorous planning and consultation, including environmental assessments. Small residential systems will, at a minimum, require a water license and electrical permit.

Small hydro projects have been somewhat controversial in BC due in part to the Province’s decision to have private companies develop them, rather than BC Hydro. Private power companies are required to sell their power to BC Hydro.

**Tidal**

Tidal power is still an emerging technology, and its development has been limited by suitable locations and high cost. There are seven operating tidal power stations world-wide, ranging from 1.2 to 254 MW, including a 20 MW plant in Canada at the Bay of Fundy. For two years a small demonstration tidal power project ran at Race Rocks near Victoria. Most large scale tidal power plants have been of the barrage type, in which a dam is placed across the mouth of an inlet. Smaller plants can use tidal stream generators, similar to wind turbines in the water. Research continues into tidal power and some larger systems have been proposed at various sites around the world.

Tidal power has an advantage over some other renewable energy technologies in that the tide is completely reliable and predictable. Barrage systems can also be used for temporary energy storage, by pumping water when there is excess power available and releasing it later.

Barrage type systems require a large volume of water within the inlet and a large height between high and low tide. Current speed is not as important, since the dam will focus the water and increase the speed. Stream generators rely on existing currents, and current speed is the most important factor. A current speed of 2 m/s is desirable, although this may change with new technologies.

Because of the few installations, no data is available on the cost or cost effectiveness of tidal power. However, it is likely to be very expensive. The demonstration at Race Rocks cost approximately $60,000 per kW (Race Rocks and UWC Pearson College, 2012) (10 times the cost of wind), although pilot projects tend to be relatively expensive.

**Application on the Sunshine Coast**

Although the Sunshine Coast has some long inlets and fast currents, the tidal range is not particularly high compared to other parts of the world such as the Bay of Fundy. Therefore the potential for barrage type systems is likely limited. Stream generators may have more potential. BC Hydro’s renewable energy map shows two potential sites for tidal power, at Skookumchuk Narrows and Welcome Passage (Thormanby Island). Narrows Inlet may be another potential site. However, no detailed assessment of these sites has occurred. See Map 5 in the Appendix.
Requirements, Potential Impacts and Risks

Barrage systems have a large environmental impact. Existing systems have shown silting of the inlets, fish mortality, destruction of habitat, and changes in salinity. It is unlikely a barrage system enclosing a coastal inlet could pass an environmental assessment or withstand the public outcry.

Stream generators do not appear to have significant environmental impact. But there are too few systems installed for much research to have been done on this. Such systems would also have to consider the impact on marine transportation and visual impacts, as well as tourism and fishing.

Biomass

Biomass refers to the use of various types of organic matter to generate energy. Wood is the most commonly used form of biomass, and is used extensively as firewood in homes. But biomass can also include wood waste (such as sawdust or bark), food and green waste, construction waste, agricultural residues, or other sources. Biomass can be considered a mature technology, with many large mills in BC burn wood waste to generate power, including Howe Sound Pulp & Paper. But research continues into alternative sources of biomass and different means of generating energy from biomass.

The cost effectiveness of biomass as an energy source depends largely on the availability and cost of the biomass. The cost of collection and transportation is the most critical component of what have long been considered waste products. However, some sources of biomass, such as wood chips, are now considered a valuable commodity and the price of them has risen in recent years. Generally, the cost of the fuel must be very low for a biomass plant to be cost effective, since the capital and operating costs are quite high. Free biomass sources with minimal transportation costs are ideal. Moisture content of the biomass affects the energy value, and dryer feedstocks are preferred.

Biomass plants can produce energy in several ways – by producing heat for buildings or other uses, producing electricity for sale to BC Hydro, producing gas for sale to FortisBC, or producing liquid fuels for transportation. Producing heat, typically through direct burning of biomass, is the easiest and cheapest form of biomass energy. While a residential wood stove may cost as little as $100 per kW, larger wood waste systems may cost from $500 - $1,000 per kW (Ministry of Labour & Citizen Services, 2009).
However, there is also a requirement to distribute the heat to where it’s needed, perhaps through a district energy system, which can add significantly to the cost.

Electricity can be generated from biomass alone or can also produce heat as a by-product, known as co-generation or combined heat and power (CHP). Systems are more likely to be viable if there is a use for heat in the vicinity, particularly large facilities with year round heating requirements (e.g. hospitals, greenhouses, etc.). Costs range from $2,500 - $5,000 per kW electric (Community Energy Association, 2008) (BC Hydro, 2011).

Biomass can also be turned into biogas or liquid biofuels through pyrolysis/gasification. Biogas can be cleaned and upgraded and injected into the FortisBC distribution system. Costs are in the range of $1,500 per kW (BC Bioproducts Association, 2007). At this time the cost of producing biogas is more than it can be sold for, and is therefore not viable. Biofuels can be used as a replacement for gasoline or diesel in vehicles. The cost of a biofuels plant is $400,000 - $600,000 per million litres produced (WISE Energy Co-op, 2004). Biofuels are already being made available by small businesses and individuals on the Sunshine Coast, such as PlantOil Recovery in Roberts Creek.

The amount of biomass required varies based on the type and use, but a 1 MW biomass heating plant would require roughly 6,000 – 9,000 m³ of wood annually, while a 1 MW biomass electric plant would require 25,000 – 35,000 m³ annually (Biocap Canada, 2008).

In addition to the capital costs, biomass plants have significant operating and maintenance costs. These can quickly outweigh other costs for small systems, rendering them unviable. The life expectancy of biomass plants is 20 - 30 years (BC Hydro, 2011).

Application on the Sunshine Coast

Because it has so many forms, biomass is applicable throughout the Sunshine Coast. Most single family houses could (and many do) use wood stoves or pellet stoves for space heating. Other buildings, such as multi-family or commercial, could also use individual wood furnaces or boilers. There would need to be someone able and willing to feed and operate the furnace or boiler for it to be cost effective. Pellet stoves might be the most practical for these applications, but pellets are one of the most costly forms of biomass.

For larger systems, uses for the heat become important. There are few large heating loads on the Sunshine Coast (other than HSPP, which already uses biomass energy). The most likely location for a biomass plant that produces heat would be in Sechelt, with access to St. Mary’s hospital and other buildings in the vicinity. See the Energy Demands section below for more detail.

The most likely sources of biomass on the Sunshine Coast are forestry residues or construction waste. There is very little milling of wood on the Sunshine Coast, so mill waste is minimal. The same can be said for agricultural waste. Green waste is significant, but is already used extensively by Salish Soils. And the population is too small and spread out to justify an energy plant based on food waste. There is a
significant amount of construction waste, but it can be highly variable depending on the state of the construction industry. Construction waste may need to be used in conjunction with other sources.

There is a considerable volume of forestry residues available within the Sunshine Coast Forest District. This area encompasses Powell River and Texada Island in addition to the Sunshine Coast. The current allowable cut in the SCFD is 1,198,000 m³, with an average annual harvest of 1,018,000 m³. It is estimated that around 8% of the harvest remains as forest residues (Canadian Centre for Policy Alternatives, 2009), or about 80,000 m³ annually. This would be sufficient for a 2 – 3 MW electric power plant. There are also other sources of forest residues, such as private forest lands or powerline maintenance by BC Hydro.

The costs of transporting forest residues would be a critical factor in assessing viability. Transportation costs on forestry roads are $0.10 – $0.15/km per m³, but there may also be a requirement for barging from remote locations. It may also be possible to chip residues in place before transporting, which might reduce costs. See Map 3 in the Appendix.

Requirements, Potential Impacts and Risks

There are some health and environmental concerns with biomass. Combustion of biomass creates particulate emissions which impact local air quality. Modern high efficiency wood stoves have much lower particulate emissions than older stoves and fireplaces, but still cause emissions. Larger systems can almost completely eliminate emissions with sufficient pollution control devices, but these can be costly. Although the emissions are very low on larger systems, the large volumes of biomass being used means the total emissions can be significant if sufficient controls are not incorporated.

Depending on the size of the plant, an environmental assessment may be required, although that would probably not be the case for the size of plant that would be viable on the Sunshine Coast. An air emissions permit would be required, as well as any required permits from the SCRD or municipalities. Installing a wood burning appliance in homes or businesses requires a building permit and insurance companies often require a WETT certification.

If a plant is located in a residential area, traffic may be a concern for a very large plant. However, the availability of biomass on the Sunshine Coast will limit any plant to a modest size and traffic is not likely to be an issue.
Solid Waste and Landfill Gas

Solid waste can be a potential energy source in two ways – either by combusting it directly or through the collection of landfill gas. Combustion of solid waste to generate energy is common in many parts of the world. An existing waste-to-energy (WTE) plant in Burnaby has been operating since 1988 and generates both electricity and steam. WTE plants are generally very large, processing 150,000 – 300,000 tonnes of waste a year (as much as produced by a city the size of Surrey). The cost of WTE is between $3,000 and $8,000 per kW electrical energy (BC Hydro, 2011). WTE does not generally pay for itself through energy production, but can be cost effective when tipping fees or the cost of developing new landfills is taken into account.

The majority of solid waste in BC is deposited in landfills. Organic matter in landfills will decompose and produce methane, a potent greenhouse gas. For this reason landfill gas is often collected and flared. The landfill gas, once collected, can be used as an energy source. It is usually used to generate electricity, but can also be cleaned and injected into the FortisBC gas distribution system (e.g. Salmon Arm Landfill) (Passive Remediation Systems, 2012). Although easy to do, landfill gas is not usually used to generate heat as landfills are usually located far from buildings or other heating loads. However, there have been cases where greenhouses or other industry have been located near the landfill to take advantage of the landfill gas. If a gas collection system is in place, the cost of electricity generation equipment may be $1,700 – $2,300 per kW (LFG Energy Project Development Handbook). The cost of the gas collection system depends on the landfill, but costs are in the range of $60,000 per hectare (LFG Energy Project Development Handbook), or $700 per kW. Paybacks will depend on landfill gas flow rates and will vary by landfill, but should generally be under 10 years.

Application on the Sunshine Coast

Waste-to-energy (WTE) is not viable on the Sunshine Coast due to the small population. The Sechelt landfill is a candidate for landfill gas collection and energy generation. In 2007 a study was done on the potential to implement new technologies at the SCRD’s Sechelt Landfill to improve environmental performance of waste disposal operations. The study, completed by Golder Associates, assessed 19 different technologies using a triple-bottom-line approach. Collecting landfill gas and generating electricity from the Sechelt landfill was ranked as the preferred technology option. Since then, the purchase price of electricity has increased and there is now an ability to sell carbon credits as well. In 2007, a $1,080,000 grant was obtained.
which will offset 100% of the capital cost.

The Pender Harbour landfill is much too small to be viable for any kind of energy generation.

**Requirements, Potential Impacts and Risks**

WTE has significant health and environmental concerns due to the production of dioxins and contaminants. These concerns can all be overcome by the use of pollution controls, which may cost as much as the plant itself. Extensive environmental reviews and permitting processes would be required.

There are no health or environmental concerns associated with generating energy from landfill gas. To the contrary, there is a significant environmental benefit from the collection of the landfill gas.

Both WTE and landfill gas are somewhat in conflict with waste diversion programs. Aggressive recycling or composting will reduce the volume of solid waste, therefore reducing the amount of energy that can be generated. This is not as significant a concern for landfill gas, as much of the methane will be generated by waste that is already in the landfill. However, an organics collection program will affect long term methane generation and should be considered in any analysis.
Conclusions

There are many opportunities to use renewable energy on the Sunshine Coast. Many renewable technologies are well established and coming down in cost as they gain wider acceptance. Using renewable is never as easy as using conventional energy sources, but it can have a large benefit in terms of the environment, energy resiliency for the community, and long term economic benefits.

With so many renewable energy alternatives available, the intent of this atlas is to help narrow down the choices. Which technologies make sense depends not only on the location but also on who is making the decision. The following recommendations are not intended to discourage certain technologies, but rather to encourage the uptake of those with the best chance of success.

For Home-owners and Businesses

**Biomass** is the easiest and most familiar form of renewable energy for most people. Installing a high efficiency wood or pellet stove (or replacing an older fireplace or stove) can meet most of a home’s heating requirements and significantly reduce personal greenhouse gas emissions.

**Air-source heat pumps** are a technology that work well in our climate and are applicable to most homes and small buildings. Ductless split-system heat pumps are now available for homes without forced air. For homes located on the waterfront, **ocean loop heat pump** systems can be a good choice. **Geo-exchange** systems may be appropriate for some sites, depending on ground conditions.

Installing a **solar water heating** system makes use of our most abundant renewable energy source. There are currently a variety of government incentives available to reduce the initial costs.

For Developers and Investors

There are a number of promising **micro-hydro** sites on the Sunshine Coast that have not yet been developed. Existing micro-hydro sites have proven to be viable, and BC Hydro’s standing offer program has simplified the process and increased the revenues from selling power into the grid.

There may be sufficient **biomass** available to support a small biomass plant. A number of obstacles would need to be overcome, including fibre supply and customers for the heat produced.

**Wind power** may offer opportunities for renewable electricity on the Coast, but requires further wind monitoring or pilot projects on mountain ridges or near the coast to assess and better quantify.

For Local Governments

Renewable energy initiatives can help serve to generate both locally generated heat and electricity while creating economic development opportunities for the region. These projects can provide locally based carbon emissions offsetting opportunities and possibly options to sell carbon offsets on the carbon market.
The Sechelt landfill gas project is an excellent opportunity to meet the SCRD’s climate change commitments and develop a revenue stream at the same time.

**Micro-hydro installations** connected to existing and future water distribution infrastructure and can, can provide locally based carbon emissions offsetting opportunities for local government. There may be opportunities to generate power from existing **water distribution infrastructure** such as Pressure Reducing Valves (PRVs) or water intakes. These should be investigated further.

The Town of Gibsons has already started on a **geo-exchange district energy** utility, with the potential for further expansion of that system. There may be opportunities for other local governments to undertake similar systems. There are several ownership models for local governments to consider – depending on the degree of liability versus control they wish to have. These include 100% local government ownership; Co-operative Ownership; Public-Private Partnership and 100% Private Ownership. Innovative approaches can provide the impetus needed to stimulate steps towards Renewable Energy uptake.

Finally, local government can play an important role in **facilitating** the uptake of renewable energy. This can be done through public education, demonstration projects, incentives, and supportive bylaws – such as guaranteed buying – all which can support stronger engagement and investment. Seeking mechanisms for consistent regulations region wide for renewable energy implementation, simplifies application processes and supports businesses that provide renewable energy services.

**Community energy cooperatives** and similar approaches have proven very successful in expanding Renewable Energy uptake in Denmark and other countries. Dawson Creek’s Renewable Energy Cooperative was an important part of the regional success of local renewable energy projects and suggests a possible model to explore. A list of existing Canadian Cooperatives is listed under Additional Resources below.

This document provides the public with a resource residents, businesses and local institutions in assessing renewable energy potential. Further development of this resource might include:

- An assessment of current local government zoning bylaws and policy and recommendations to encourage desirable renewable energy types and reduce barriers to desirable renewable energy development.
- A more detailed analysis of building loads and some renewable sources to enable more accurate and easy business-casing for prospective projects.
- Zoning overlays and development maps on the renewable energy maps to assist local planners and developers.
Appendices

Incentives

Incentive programs change regularly – visit http://www.scrd.ca/Green-Grants-and-Rebates for current sets of links to program information and application deadlines as well as contact information for certified energy advisors for home-energy assessments (e.g. to aid with air-to-air heat pump or home scale solar PV installations). In addition, local utilities provides information

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Current as of October 15, 2012
Additional Resources on Renewable Energy

List of Canadian Energy Cooperatives – A partial list

Canadian Co-operative Association

Community Energy Cooperative (New Brunswick)
http://www.communityenergynb.ca/

Peace Energy Cooperative (Dawson Creek, BC)
http://www.peaceenergy.ca/

TREC Renewable Energy Cooperative
http://www.trec.on.ca/

Canadian Wind Energy Association
A non-profit trade association that promotes the appropriate development and application of wind energy in Canada including suitable policy www.canwea.ca

Green Energy Futures
Sharing stories of green energy pioneers – doing incredible things just below the radar of the conventional media. www.greenenergyfutures.ca

Home Power www.homepower.com
Editorial venue for homeowners, business owners, and renewable energy professional to exchange equipment, design, installation and system performance experiences. (left: sample cover resource article 143)
Powerful Energy for Everyone (Trailer: [http://www.powerfulthemovie.com/trailer.html](http://www.powerfulthemovie.com/trailer.html))

A Canadian made documentary explores how we might individually and collectively grow our ability to generate locally sourced energy and reduce our climate change impacts. Available for loan at your local library and reading rooms ([www.scrd.ca/actionkits](http://www.scrd.ca/actionkits)).

District of North Vancouver – GEOweb Solar online application

This application allows users to assess the suitability of solar hot water systems for single family residential buildings within the District of North Vancouver. To launch the resource, visit [www.geoweb.dnv.org/applications/solarapp](http://www.geoweb.dnv.org/applications/solarapp).

SolarBC [www.solarbc.ca](http://www.solarbc.ca)

A solar hotwater support and research project administered by the BC Sustainable Energy Association (BCSEA).
### Table of Potential Small Hydro Sites (0.5 to 12 MW) on the Sunshine Coast

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**Source:** BC Hydro Green Energy Study for BC, Phase 2
Works Cited


BC Hydro and Canadian Cartographics Ltd. (2002). *Green Electricity Resources of British Columbia (map).* Coquitlam, BC: Canadian Cartographics Ltd.

BC Hydro and Canadian Cartographics Ltd. (2002). *Green Electricity Resources of British Columbia (map).* Coquitlam: Canadian Cartographics Ltd.


*LFG Energy Project Development Handbook.*


Map 1. Energy Demand GJ/hectare

Legend
- Sunshine Coast Hwy
- Road Network
- Hydro Transmission Lines
- Electoral Areas

Energy Demand (GJ/ha)
- < 1,000
- 1,001 - 5,000
- > 5,001

November, 2011

Map 1. Energy Demand GJ/hectare
Map 2. Solar Radiation

Legend

Annual Solar Radiation
- Low
- Moderate
- Medium
- Electoral Areas
- Sunshine Coast Hwy
- Road Network
- Hydro Transmission Lines

November, 2011

Map of the region with various areas marked by different colors indicating solar radiation levels.
Map 3. Biomass Power Potential
Map 4. Potential Wind Power

Source: Wind Resource Map of BC was developed for BC Hydro by TrueWind Solutions using the MesoMap system and historical weather data.
Map 5. Existing and Potential Hydro Power
Map 6. A detailed wind energy asset map - the result of a one year detailed assessment of renewable energy assets on Cape Breton Island in Nova Scotia. Strait-Highlands Regional Development Agency (www.strait-highlands.ca)