



Council of the Haida Nation

Haida Gwaii Community Electricity Plan

Executive Summary

February 12, 2008
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The Sheltair Group

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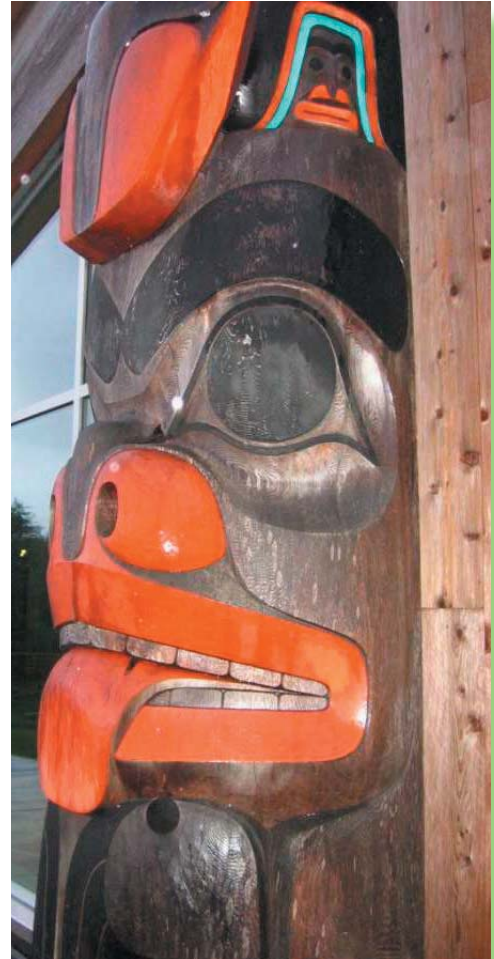
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Glossary

Cogeneration	The simultaneous production of electrical or mechanical energy and useful heat energy from a single source. For example, forest sector mills can burn woodwaste in a boiler to generate electricity and use low-temperature steam from the generator in pulping processes.
Conservation Potential Review (CPR)	<p>An assessment of the potential for electricity conservation in BC Hydro's service area under certain defined conditions compared with the expected level of electricity consumption in the absence of any new Power Smart initiatives.</p> <p>The CPR uses the following additional terms:</p> <p><u>Economic potential</u>. An estimate of the reduction of electricity consumption, relative to the reference case, that would occur if all electricity-consuming equipment were upgraded to the efficiency level that is cost-effective as calculated using the cost of conserved energy (CCE).</p> <p><u>Achievable potential</u>. The portion of the savings identified in the economic potential that could realistically be achieved within the study period.</p> <p><u>Demand impacts</u>. In the context of the Conservation Potential Review 2002, demand impacts refers to the average load reduction over the 6 am to 10 pm period during an average weekday in December and January that is anticipated to result from the various electricity-saving technologies, programs or actions presented in the 2002 Review.</p>
Cost of Conserved Energy (CCE)	The annualized unit of energy cost of a demand side management measure, used to determine its cost effectiveness compared with the cost of additional electricity supply (as part of the Total Resource Cost Test). It is calculated as the annualized incremental cost (including annual operating and maintenance costs) of the measure divided by the annual energy savings achieved, excluding any administrative or program costs to achieve full use of the technology or measure.
Demand	<p>The rate at which electric power is delivered to or by a system: it is generally expressed in kilowatts (kW) or megawatts (MW) when it refers to a given instant and in kilowatt-hours (kWh), megawatt-hours (MWh) or gigawatt-hours (GWh) when averaged over any designated time interval.</p> <p><u>Peak Demand</u>: The maximum instantaneous demand on a power system. Normally the maximum hourly demand.</p>
Demand Side Management (DSM)	Actions that modify customer demand for electricity, helping to defer the need for new energy and capacity supply additions.
Discount Rate	A rate used to determine the present value of expenses and revenues that will occur over a period of time, reflecting the cost of capital.
Distribution	Delivery of electricity to retail customers, generally at voltages lower than 69 kV.
Distribution System	Electrical lines, cables, transformers and switches used to distribute electricity over short distances from substations to the customer, generally at voltages lower than 69 kV.

Energy Efficiency	A reduction in energy usage as a result of customers improving efficiency of equipment, optimizing processes, or other forms of energy conservation.
Feeder Circuits	A utility term used to refer to the main trunk line is a distribution system.
Green Energy	Energy produced from a green power project. As defined by BC Hydro, green power projects are renewable, environmentally and socially responsible and licensable.
Greenhouse gases (GHG)	Gases that contribute to global climate change, or "greenhouse effect". Measured in tonnes of carbon dioxide equivalents. Carbon dioxide equivalents refer to the total equivalent greenhouse gases, weighted by their global warming potential. Different gases have different global warming potentials. Global warming potential is a relative measure used to compare the ability of a gas to trap heat in the atmosphere relative to another gas. For example: 1 unit CO ₂ = 1 CO ₂ e 1 unit CH ₄ = 23 CO ₂ e 1 unit N ₂ O = 310 CO ₂ e
Kilowatt-Hour (kWh)	One thousand watts; the commercial unit of measurement of electric power. A kilowatt is equivalent to the flow of electricity required to light ten 100-watt light bulbs.
Load	The amount of electricity required by a customer or group of customers.
Megawatt-hour (MWh)	Equivalent to 1000 kWh
Independent Power Producer (IPP)	A privately owned electricity generating facility that produces electricity for sale to utilities or other customers.
Genset	An abbreviation for generating set, it refers to the combination of combustion engine driving an electrical generator (which turns mechanical energy from the engine into electrical energy).
MVA	Mega-Volt-Amp. 1,000 kVA. One million volt amperes; the unit of measure of apparent power.
Primary line	A distribution line operating at primary voltage. On Haida Gwaii, the primary voltage is 25 kV.
Reclosers	A programmable switch used in power systems.

Note: The majority of definitions are extracted from BC Hydro's 2006 Integrated Electricity Plan.



Community Electricity Plan

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1.1 Introduction

A CEP addresses both the supply and the use of electricity. It identifies ways to conserve electricity and use it efficiently, and recommends options for the supply of electricity. As is required for such a plan, the CEP for the islands was developed with input from the island community and includes residents' expressed values and goals.

Haida Gwaii, also known as the Queen Charlotte Islands, is the ancestral home of the Haida Nation. The archipelago, located off the northwest coast of British Columbia, is one of BC Hydro's non-integrated areas (NIA) or 'off-grid' areas. BC Hydro's NIA group provides electricity to residential, commercial and industrial consumers via two separate generation-distribution systems. The two systems, at Masset and Sandspit, are not connected and are approximately 10 km apart at the nearest point. Electricity on Haida Gwaii is provided by either three-phase 25kV or single-phase distribution lines.

The Masset system provides power to approximately 1,430 customers in Masset, Old Masset and Port Clements by BC Hydro's seven-unit diesel generating system (capacity 11.37 MW). The Sandspit system provides power to approximately 1,650 customers in Sandspit, Skidegate, Queen Charlotte and Tlell by a 5.7 MW hydroelectric plant owned and operated by Queen Charlotte Power Corporation (QCPC), an Independent Power Producer. Back-up power is provided by BC Hydro's seven unit 9.15 MW diesel generating system in times of generation shortage during the spring and summer.

Several of the diesel generators are nearing the end of their useful life and are in need of replacement. BC Hydro is in the process of replacing three stationary diesel units in Masset as part of the ongoing capital replacement plan.

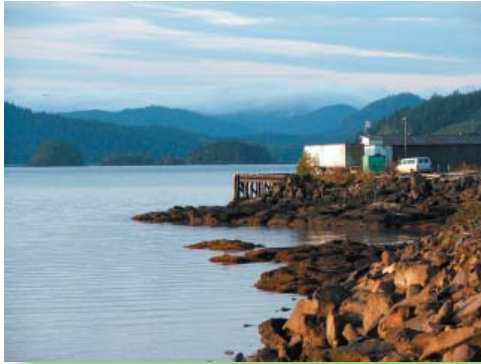
Residents on the islands have indicated that continued and expanded use of diesel generators is not desirable for environmental and economic reasons, since the current fossil fuel-based system is a source of air pollution and greenhouse gas emissions.¹ In addition, the sustainable expansion of the islands' economic base is constrained by the capacity of the current generating systems. For BC Hydro, there are negative economic impacts; costs associated with running the current system are higher than what is recovered through the Non-Integrated Area (NIA) tariff, resulting in the necessity of a considerable annual subsidy.

Background and Context

The Council of the Haida Nation (CHN) and BC Hydro agreed to undertake the development of a Community Electricity Plan for Haida Gwaii. The CHN contracted The Sheltair Group, a Vancouver consulting firm to conduct the CEP Process.

Footnote:

¹ Personal communications, Haida Gwaii residents to the consultant team, 2007.



At the Union of British Columbia Municipalities conference in September 2007, the Premier announced that this spring the government plans to introduce legislation that will “require 50 per cent of all new incremental power needs to be offset through conservation by 2020”. In addition, the Province will also introduce legislation requiring all new electricity to have net zero greenhouse gas emissions, all existing generation to have net zero greenhouse gas emission by 2016, and all coal-fired electricity projects to have 100 per cent carbon sequestration.² As part of this initiative, BC Hydro will be installing smart meters to measure consumption automatically and help to track energy use and demand. Also, during the 2005 Annual House of Assembly, the Council of the Haida Nation passed a resolution in support of the Kyoto Accord.

As a result, there is a need and a desire, on behalf of the Council of the Haida Nation, the residents of Haida Gwaii and of BC Hydro, to explore alternatives to the current system. This CEP provides a technical assessment of several electricity supply and conservation options, developed in consultation with the island community. This planning process identifies an opportunity for the communities of Haida Gwaii to become the first in BC to fully meet their electricity needs through demand side management programs, and renewable and alternative energy resources.

Overall Project Objectives

The objectives of the CEP are to:

- Identify technically and financially feasible options for power generation and electricity distribution on Haida Gwaii that meet residents' needs and reflect their expressed values and goals;
- Involve the island community in the planning process, ensuring a sense of ownership of the CEP; and
- Inform BC Hydro's future plans for electricity generation procurement, conservation efforts, and distribution on the islands.

Footnote:

² The Province of British Columbia, Office of the Premier News Release, September 28, 2007 (http://www2.news.gov.bc.ca/news_releases_2005-2009/2007OTP0143-001211.htm)

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Other key community objectives as expressed by the community and the working group were:

1. Move away from diesel to cleaner energy
2. Improve reliability of the electricity system
3. Allow for economic development and growth
4. Shared ownership/ management (Protocol agreements etc.)

Island residents had several opportunities to provide input into the various stages of the technical assessment. A Standing Technical Committee consisting of technically knowledgeable and interested residents and key BC Hydro personnel was formed to work with the consultant team and to provide input on specific technical issues.

A public involvement program was also conducted, to solicit and incorporate islanders' views, opinions and values regarding both electricity supply and conservation options. The consultant team convened a Working Group consisting of members of the CHN and BC Hydro as well as elected officials from the various island communities and representatives of the Haida Hereditary Chiefs. This group worked in an advisory capacity and helped guide the technical assessment and the public involvement program.

Scope of Project

This project presented a mix of opportunities and challenges for the communities of Haida Gwaii. In particular, the primary challenge was to develop a plan, which had broad public support and incorporated the values expressed by the various communities while also able to meet the current and forecasted energy demands. The plan also needed to be executable by BC Hydro, and provide recommendations for locally sourced, BC Clean generation technologies. The scope of the CEP for Haida Gwaii was focused on exploration of those alternatives over which BC Hydro has jurisdiction. However, during the community engagement process and Working Group discussions, other recommendations were also identified that are outside of the BC Hydro mandate. For completeness, both recommendations are included. For example, the analysis excludes natural gas for heating and fuel for vehicles. Other technologies were excluded due to provincial energy policy (such as nuclear energy and methane hydrates).

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It was agreed that the CEP would be finalized before BC Hydro would make a Call for Energy in 2008. As such, work for the plan would be ongoing for approximately one year and would be completed in the fall, 2007.

Report Structure

The CEP report is divided into seven main chapters (not including the Introduction and the References). These chapters are as follows:

- Chapter 2 – Public Involvement Program
- Chapter 3 – Existing Equipment Assessment
- Chapter 4 – Existing Demand Assessment
- Chapter 5 – Demand Side Management Options
- Chapter 6 – Future Electricity Consumption
- Chapter 7 – Supply and Distribution Options
- Chapter 8 – Strategy and Implementation

Appendices are a separate document and are labelled by chapter number and letter indicating multiple appendices for the same chapter, i.e. for Chapter 2, the first appendix is called Appendix 2-A.

Recommendations are made throughout the report and are summarized in Chapter 8.

1.2 Community Engagement Process

An integral part of the CEP process is a Public Involvement Program. The primary purpose of involving the island community in the planning process is to ensure that the objectives and values of the residents are incorporated into the CEP, thus ensuring that the final plan has broad public support. The community of Haida Gwaii presents a unique situation, not only because of its remote location and the fact that it is 'off the grid', but because of the variety of communities that co-exist, and collaborate on island-wide initiatives. This requires a tailored approach to public engagement activities, hence the use of an Adaptive Management model for designing the Public Involvement Program. The Program was developed with guidance and assistance from the Council of the Haida Nation and the Working Group.

This section provides a review of the vision and goals of the island community, and describes the public involvement process and techniques that were implemented as part of the CEP.

Goals and Objectives

The overall goal of the public involvement program is to ensure that the CEP has broad-based understanding and support among residents of Haida Gwaii. The specific objectives are:

- To provide opportunities for island residents to be kept up-to-date and involved in the planning process; and
- To incorporate residents' values and goals into the CEP.

The consultant team has made itself available to meet with WG members and other residents on Haida Gwaii. Communication has been open and regular and has been encouraged to occur on an as-need basis. This has helped to build agreement within the island community on the general approach and conclusions obtained throughout the process.



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Approach to Public Involvement

The consultant team used an adaptive management approach in developing the CEP and tailored the process to fit the needs of the residents of Haida Gwaii. We recognized that the CHN and community leaders have the best information on the most appropriate ways to involve the island community in the CEP process. Ongoing development of the public involvement program included regular meetings between the consultants, the CHN and the Working Group, all of whom provided advice and direction on the design of the Plan. There were also opportunities for involvement from the general public through ongoing communications with the consultant team and two rounds of public sessions.

Working Group

A Working Group was convened to advise the consultant team and the Council of the Haida Nation on issues related to process and planning. The Working Group was composed of elected officials from the island communities, and representatives from the Haida Hereditary Chiefs, BC Hydro and the Council of the Haida Nation. A representative of the BC Ministry of Energy, Mines, and Petroleum Resources participated as an ex-officio member.

The role of the Working Group was two-fold:

- To be involved in the technical component of the planning process and to provide input on community growth scenarios, criteria for evaluating demand side management and supply options, preferred options and implementation strategies, and
- To advise the consultant team on process and planning issues, such as providing ideas on ways to involve their constituents in the development of the CEP.

Standing Technical Committee

The consultant team established a Standing Technical Committee comprised of island residents with an interest and background in electricity and energy. Ads were placed in the Queen Charlotte Islands Observer and interested individuals were asked to apply for membership in writing, explaining their

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experience. Seventeen residents joined the committee and technical experts from BC Hydro also provided their expertise. The role of this committee was to advise the consultant team on demand reduction options, electricity supply options and implementation strategies as these relate specifically to the Haida Gwaii situation.

Island Residents

Public meetings were held throughout the islands to explain the project, provide updates and solicit input and feedback from the general public. Other opportunities were also arranged to enable residents to be involved in the development of the CEP:

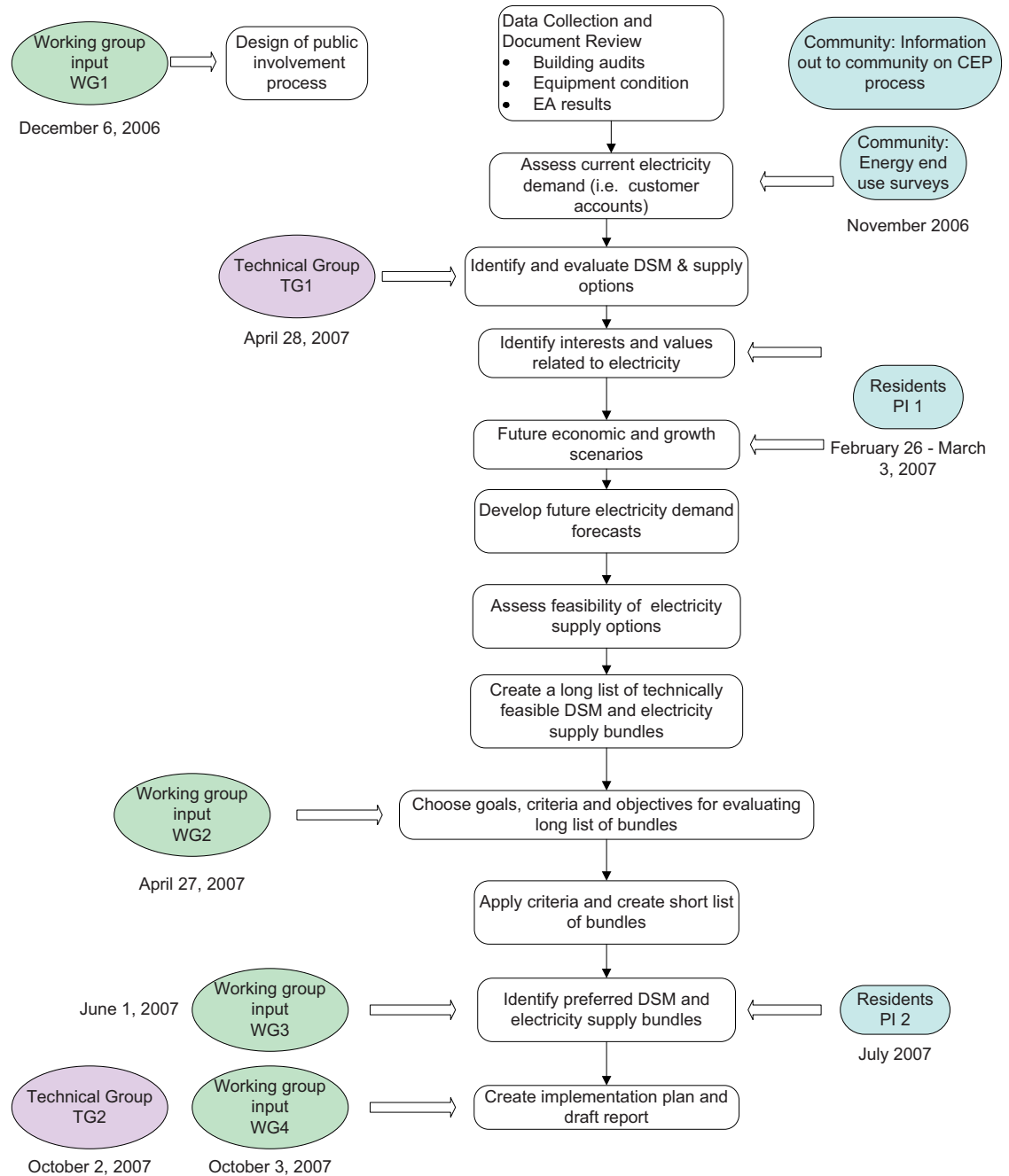
- Coffee sessions were held in all of the island communities to provide an informal way for residents to meet with the consultant team;
- A website was created and updated regularly, with announcements of meetings and events as well as copies of meeting minutes and relevant reports;
- A 1-800 line was established to enable residents to speak with the consultant team free of charge; and
- Written communications were encouraged, both by e-mail and by regular mail.

The public had a variety of ways to keep informed on the development of the CEP. The consultant team developed and maintained effective working relationships with elected officials, members of the Council of the Haida Nation and other residents of Haida Gwaii. Members of the WG, STC and the public contacted the consultant team directly with input and feedback and any concerns were attended to quickly and effectively.

Chronological Process

The steps in the public involvement program are shown in Figure 1-1.

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Note: Technical steps are not necessarily sequential

Figure 1-1: Haida Gwaii Community Electricity Plan Steps and Community Involvement Approach

1.3 Existing Equipment Assessment

Electricity is currently supplied in Haida Gwaii by three generation plants servicing two separate distribution systems. The northern system is supplied by the Masset Diesel Generating Station (DGS) and serves Old Masset, Masset, and terminates in Port Clements. The southern system is supplied by the Sandspit DGS and the Mitchell Inlet IPP, and serves Sandspit, Queen Charlotte, and Skidegate and terminates in Tlell. Both Masset and Sandspit DGS have seven diesel generator sets (gensets) each, and BC Hydro's Five Year Plan looks to replace the two oldest gensets at Sandspit and the four oldest gensets at Masset. The plans have not been finalized and the configuration and distribution of new equipment is still under consideration, but the goals of the upgrades are to:

- reduce emissions,
- lower fuel consumption, and
- increase reliability of the power supplied.



The Masset System

The Masset diesel generating station is the source of prime power for the communities of Masset, Old Massett and Port Clements and consists of 7 diesel generators of differing capacities with a total nameplate generating capacity of 11.4 MW. This represents considerable excess capacity at this time and could in fact be enough to service the public's scenarios identified in Chapter 2. The current plan is to remove all but two 850 kW road mobile units and replace them with three 2.8 MW gensets in the powerhouse.

The performance of the Masset distribution system is variable year-to-year, but is generally about average in comparison to systems in other Non-Integrated Areas. System reliability; including frequency of blackouts and brownouts were frequently cited as issues by community members. The reliability of the system is affected by a number of variables such as the weather and motor vehicle accidents, with the majority of incidents of known causes attributed to birds, trees and fallen branches. Planned upgrades to improve the system's performance include upgrading switches to sectionalizing Port Clements, a 10-year plan to replace aging infrastructure in Old Masset, bird guards, and stanchions to mitigate the impact of motor vehicle accidents.

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Diversifying the electricity supply system on Haida Gwaii may also contribute to reducing the number of blackouts because the new diverse sources may also be able to provide backup power. However, the extent to which new supply will improve reliability depends upon the type of technology developed and the location. It will not affect system outages due to weather or birds.

The Sandspit System

The Sandspit system serves the communities of Sandspit, Queen Charlotte, and Skidegate and extends to Tlell. The Queen Charlotte Power Corporation (QCPC) operates a 5.7 MW hydroelectric facility on Moresby Island that supplies two-thirds of the local electricity demand and is the primary source of power for the system. The residual demand and backup power is supplied by the Sandspit DGS, also on Moresby Island, which was built in 1962 and has a total nameplate capacity of 10.2 MW. This system consists of a total of seven diesel generators of differing sizes. Several of the diesel gensets are nearing the end of their useful life and there is currently a capital plan to review the replacement of these gensets.

The Queen Charlotte Power Plant at Mitchell Inlet on Moresby Island was acquired in 2004 by EPCOR, the only IPP operating in Haida Gwaii.

The performance of the Sandspit distribution system is variable year-to-year, but is generally better than the Masset system and about average in comparison to systems in other Non-Integrated Areas. The reliability of the system is affected by a number of variables such as the weather, with the majority of incidents of known causes attributed to birds and equipment failure. Planned upgrades to improve the system's performance include installing bird guards and SCADA reclosers to expedite outage restoration times.

At present there is limited capacity on the Sandspit system, as most of the electricity is supplied by the Queen Charlotte Power Plant. The terms of the contract between BC Hydro and EPCOR are confidential and it is unclear whether there is the potential for another IPP to service this system without an inter-connection of the distribution systems.



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Connecting the Distribution Systems

Connecting the distribution system between the Masset and Sandspit systems has been widely discussed and is generally supported by the communities on the Islands. Interconnection would require at minimum:

- Additional supply in the middle of the two systems,
- Building approximately 20 km of new, three-phase line,
- Upgrading 70 km of existing single-phase line,
- Substation upgrades,
- Protection coordination (difficult to achieve with the existing sources), and
- Other additional equipment (e.g. tie breakers to isolate faults).

There are also operational and communication issues that would need to be resolved prior to connecting the two existing systems. Currently, with the existing system configuration, there is minimal benefit to connecting the two distribution systems – it would not improve system reliability or decrease the number or outages or brownouts. However, this may change if a high capacity reliable source comes on line and the resulting feasibility study indicates that it would improve the system. In addition, a connected system will increase opportunities for an IPP feeding into the south system and prepare the system for the proposed HaidaLink project.



1.4 Demand Assessment

This section describes the current energy and capacity demands on Haida Gwaii. The data for this section were provided by BC Hydro.

Customers

Generally, electricity customers can be separated into three main categories: residential, commercial and industrial. In addition to these categories, BC Hydro also tracks the electricity used by its own operations and for street lighting.

The majority of residential customers heat their homes with oil or wood. Less than a quarter use electricity for space heating and a smaller proportion use propane for heating. Most water heaters are electric.

Small commercial customers make up the majority of the commercial sector, with 534 accounts listed as General – Under 35 kW. There are 39 large commercial customers (General – 35 kW and Over). Commercial customers include retail, restaurant, administration, education and resource based businesses.

BC Hydro defines industrial customers as those receiving transmission service at 60,000 volts or higher. Based on this classification, there are no industrial customers on Haida Gwaii. The electrical system on Haida Gwaii does not supply electricity at transmission voltages, only at distribution voltages (25,000 volts). By comparison, residential service is supplied at 120 volts.



Consumption

On Haida Gwaii, residential customers consume 56 per cent of the total electricity. Small and large commercial customers consume 22 per cent each (see Figure 4-1).

The average residential customer consumes 10,800 kWh in a non-electrically heated home or 14,500 kWh for an electrically heated home.

Residential and commercial consumption has remained relatively constant over the past ten years, averaging 26,600 MWh and 19,500 MWh annually, for residential and commercial customers, respectively.

In general, large electricity consumers in Haida Gwaii include

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schools, hospitals and health care facilities, but restaurants and food retail have the highest energy use per square foot.

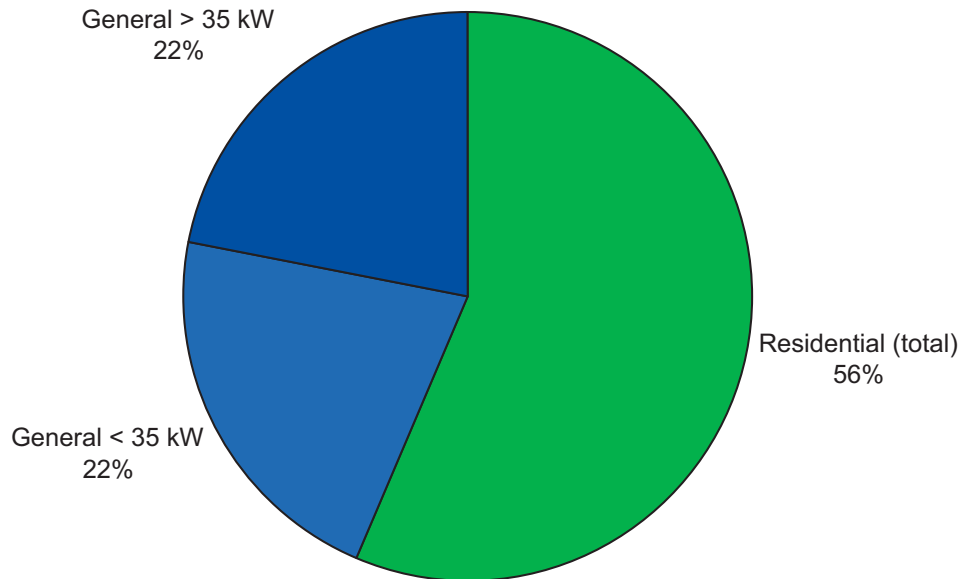


Figure 1-2: Electricity Consumption by Sector (2006)

Costs

Customer rates for electricity are regulated by the BC Utilities Commission and are among the lowest rates in North America. Haida Gwaii customers are in Zone II, meaning it is part of the non-Integrated Area, and not connected to the provincial grid. Zone II customers pay a lower rate for the first block of electricity, then a higher rate for remaining consumption. Residential customers pay \$0.0615 per kWh for the first 3,000 kWh and \$0.1056 for all additional kWh, plus a basic charge. For commercial customers, electricity rates are dependent on the type of service they receive, although the initial rate per kWh is similar to residential rates.

The cost of electricity production on Haida Gwaii is approximately \$0.26 per kWh (average cost of electricity per kWh billed for north and south systems). Currently, the costs to provide electricity exceed the revenue from customers so the system operates at a loss. Table 1-1 shows the “profit and loss”

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statement in thousands of dollars for 2006 for the Haida Gwaii/Queen Charlotte Islands system. Given the high operating costs and significant operating losses, significant opportunities exist for investing in demand side management and a range of renewable energy options. These are outlined in Chapter 5.

Table 1-1: Profit and Loss Statement for Haida Gwaii Electricity Generation, 2006 (\$000s)

	Masset	Sandspit	Total
Revenues	2,068.0	1,812.0	3,880.0
Cost of Energy	5,127.5	4,425.1	9,552.6
Other Costs	971.0	926.0	1,897.0
Contribution Margin	(4,030.5)	(3,539.1)	(7,569.6)

EnerGuide Audits

An "A audit" is a detailed energy evaluation conducted on homes to determine their current energy efficiency. The A audit makes recommendations on how to improve the energy efficiency of the home. A "B audit" is conducted after energy efficiency upgrades are made (e.g., windows are replaced or insulation is improved). Only homes that have been audited by a licensed auditor are eligible for a grant through the ecoENERGY program.

Building Stock and Energy Efficiency

On Haida Gwaii, the Energy Savings Plan (ESP) program completed over 50 EnerGuide A audits of residential homes prior to the January 31, 2007 deadline. Twenty-eight homeowners completed work and received a follow-up audit. On average, homeowners received a grant of \$2,200, which included the assessment subsidy. Almost one-third of homeowners increased their EnerGuide rating by more than 20 points.

Energy Awareness, Attitudes and Behaviours

BC Hydro placed a Power Smart Outreach Team on Haida Gwaii from fall, 2006 - Spring 2007. The goal of the Team was to increase awareness of Power Smart and other energy efficiency programs, and provide information to residents on energy efficiency solutions for their homes and businesses. The Team delivered Residential End Use Surveys, and provided free energy efficient saving products, giving away compact fluorescent light bulbs and water efficient showerheads. They held coffee shop meeting in six island communities, where residents completed almost 200 surveys.

The Outreach Findings Report indicates there is a need for energy efficiency information but also that there is a general perception in the community that energy efficient appliances and measures are more costly than standard appliances.

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There is also interest in understanding the environmental and financial benefits to energy efficient products. The Power Smart Outreach Team noted that there seemed to be a lack of connection between personal energy use habits and its cost and environmental impacts.

The Power Smart Outreach Team also solicited comments from local retailers. Barriers identified by retailers include lack of training of retailers and staff on energy conservation, and an inconsistent supply of energy efficient products. An additional barrier identified is that building materials are expensive and difficult to obtain on island.

Survey results from the Residential End Use Survey (REUS) on attitudes towards energy conservation indicate that the majority of individuals surveyed on Haida Gwaii agreed with the statement “*I really don't care much about energy and see little reason to conserve*”. In addition, over 80 per cent of respondents indicated that they felt “*there is not very much any individual can do to conserve energy that will have much effect in the long run*”. However, those surveyed conveyed a willingness to pay more for energy as consumption increases, contrary to the results from the Integrated Area REUS conducted in 2006.

As part of the survey, respondents were also questioned on their energy use behaviours. Many residents reported undertaking energy conservation practices like turning down the thermostat at night or dressing warmly in cold weather to reduce heating needs. Residents also practice water conservation (and its associated energy conservation benefits) by washing clothes in cold water and only doing laundry with full loads in their washing machines. The survey results also indicate that residents regularly use the minimum number of lights required and turn the lights off when no one is in the room.

The Demand Side Management program outlined in Chapter 8 addresses many of these barriers to action at the residential level.

Increasing the profile of energy conservation programs may have an effect on residents' purchases.

One retailer noticed an increase of 10 – 15% in window purchases, during the time the Energy Saving Plan program audits were occurring.



1.5 Demand Side Management Options

Energy conservation on the customer side of the meter is commonly known as demand side management (DSM). DSM measures include actions that reduce consumption through building improvements, equipment upgrades and behavioural changes.

A variety of DSM options were identified for Haida Gwaii communities and sorted into the following categories:

- Existing Building Envelope
- Space Heating, Cooling and Ventilation
- Domestic Hot Water
- Major Appliances
- Household electronics
- Lighting
- New Building Design

We also discussed and considered behavioural changes.

DSM options in each category were evaluated based on their technical, environmental and social attributes:

- Energy Savings
- Cost – incremental (\$)
- Cost – full (\$)
- Life of the appliance or retrofit (years)
- Cost of Conserved Energy – incremental (\$/kWh)
- Cost of Conserved Energy – full (\$/kWh)
- Suitability to Climate
- Environmental Benefits / Impacts
- On-Island Employment

Significant technical and economic opportunity for demand side management (DSM) has been identified in the Haida Gwaii Community Electricity Plan during this project. As part of the decision analysis completed, Demand Side Management was highlighted as a preferred resource option, with strong support expressed by members of the Working Group. The DSM analysis presented here identifies a comprehensive set of actions for the residential and commercial sectors.

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Methodology

DSM measures were identified and developed based on:

- Input from the Standing Technical Committee (STC), composed of 17 island residents, representatives of the CHN, and technical experts from BC Hydro and The Sheltair Group;
- The BC Hydro 2007 Conservation Potential Review, Residential and Commercial Sector Reports; and
- Team experience.

Potential energy savings were combined with incremental cost to estimate the cost of conserved energy for a range of actions. Based on this information, significant electricity savings potential exists for various DSM measures on Haida Gwaii.

Residential Measures

A summary of residential DSM measures is provided in Table 1-2. Each of the measures outlined in the table were assessed and a list of measures with a business case was developed (Table 5-3 in Chapter 5).

Table 1-2: Details of Residential DSM Measures

Residential Measures	Details
5.2.1 Existing Building Envelope	High-Performance windows Air leakage sealing Attic insulation Wall insulation Foundation insulation Crawl space insulation Comprehensive envelope upgrade
5.2.2 Space Heating, Cooling and Ventilation	Programmable thermostat Air source heat pump Ground source heat pump High-efficiency heat recovery ventilator

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Residential Measures	Details
5.2.2 Domestic Hot Water	Low-flow shower heads and faucets Water tank insulation Pipe insulation Heat traps
5.2.2 Major Appliances	Microwave/convection oven ENERGY STAR® refrigerator High-efficiency freezer ENERGY STAR® dishwasher ENERGY STAR® top loading clothes washer
5.2.2 Household electronics	Reduction in standby losses Flat screen computer monitor (LCD) ENERGY STAR® compliant computer ENERGY STAR® television LCD television
5.2.2 Lighting	Compact fluorescent lighting (CFL) LED holiday lighting
5.2.3 New Building Design	EnerGuide for Housing 80

The Standing Technical Committee also identified specific barriers to implementing DSM measures:

- **Lack of qualified building inspectors** - Currently there is only one qualified building inspector, located in Masset. Other communities do not have building inspectors.
- **Lack of training opportunities for trades and construction workers** - Education on appropriate building materials for the climate is needed.
- **Lack of education for consumers, retailers and suppliers on energy efficiency** - Education on available energy efficiency measures is needed.
- **Energy efficient building materials are difficult to obtain** - For example, windows must be ordered and can take up to eight weeks to arrive.
- **Significant financial barriers** - EnerGuide audits and associated energy efficiency measures may not

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be undertaken due to lack of available financial resources.

- **Weak, un-enforced or non-existent bylaws** - There is a lack of enforcement to ensure that building retrofits (e.g. installation of heating equipment) is done to code.
- **Lack of local Council involvement** - There is a perception of a lack of 'buy-in' from public officials. Their involvement is crucial for programs to be successful at the community level.

Further barriers were identified through the surveys and meetings and included:

- Perception that energy efficient (and environmentally friendly) products are more expensive than their regular counterparts;
- Lack of information on energy conservation and energy conservation programs;
- Inconsistent supply of energy efficient products in local stores;
- Lack of training for retailers and staff on energy conservation;
- Limited disposable income to use on energy conservation products.

These barriers were addressed in the program described in Table 2-3 and in Chapter 8.

Proposed Residential DSM Program

The proposed residential DSM program is summarized in Table 1-3. The discount rate is assumed to be six per cent.

Costs reported in this section are only for the product itself and do not include installation or other administrative costs such as salary or program administration. Program costs and savings are based on existing homes (2006 Census) occupied by residents (i.e. does not include vacation residences). All proposed programs are five years intensive programs, with the exception of 2A) Lighting Incentives, which is assumed to operate for 15 years.

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Table 1-3: Details of the Proposed Residential DSM Program

Program Name / Measure	Total Program Investment	Annual Savings After Full Implementation		Energy Savings over Product Lifetime		Product Life	Benefit – Cost Ratio
	\$	kWh	\$	kWh	\$		
1. Capacity Building							
1A) Residential Construction	Not applicable						
1B) Retailers							
1C) Building Inspectors							
2. Product Incentives							
2A) Lighting Incentives	\$306,000	784,000	\$203,840	3,920,000	\$1,019,200	5	3.3
2B) Appliance Trade In Program	\$5,700,000	2,255,000	\$586,000	39,116,000	\$10,170,000	-	
Refrigerators	\$1,500,000	600,000	\$156,000	10,200,000	\$2,652,000	17	2
Freezer	\$900,000	450,000	\$117,000	7,650,000	\$1,989,000	17	2
Clothes washer	\$1,800,000	567,750	\$147,615	8,516,250	\$2,214,225	15	1
Dryer	\$1,500,000	637,500	\$165,750	12,750,000	\$3,315,000	20	2
2C) DHW Efficiency	\$109,000	407,592	\$105,974	7,048,000	\$1,832,000	-	n/a
Low-flow shower heads and faucets	\$75,480	169,830	\$44,156	2,547,450	\$662,337	15	9
Water tank insulation	\$7,548	101,898	\$26,493	2,037,960	\$529,870	20	70
Pipe insulation	\$1,510	50,949	\$13,247	764,235	\$198,701	15	132
Heat Traps	\$24,531	84,915	\$22,078	1,698,300	\$441,558	20	18
2D) Solar Hot Water Heating System	\$648,000	288,000	\$74,880	5,760,000	1,497,600	20	2
2E) Programmable Thermostats	\$70,000	388,240	\$100,942	6,988,300	\$1,817,000	18	26.0
3. Building Envelope Retrofits							
3A) Audits	\$175,000	n/a	n/a	n/a	n/a	n/a	n/a
3B) Building Envelope Retrofit	\$11,400,000	6,586,250	\$1,712,425	98,793,800	\$25,686,000	15	2.3
4. First Nation Housing							
4A) New Homes	To be determined						
4B) Existing Homes							
TOTALS	\$18,408,000	10,709,082	\$2,784,061	161,626,100	\$42,021,800	15	2.3

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Commercial/Institutional Measures

There are a number of opportunities related to lighting, refrigeration equipment, pumps and fans that are suitable for commercial building stock in Haida Gwaii. Audits have not been completed for the commercial building stock but many of the commercial buildings are residential buildings modified for commercial business activity or small, stand-alone retail. Therefore, opportunities for the commercial building stock are narrow and further analysis (i.e. costs of conserved energy) have not been calculated. As a first step to understanding commercial sector energy efficiency opportunities, benchmark data on typical commercial buildings should be collected. In addition, energy audits should be conducted on key commercial buildings.

Behavioural Changes

Changing people's behaviours is perhaps the most challenging component of any energy efficiency program. It requires constant and positive reinforcement combined with information on why change is needed and how it is beneficial to participants, as well as tracking and feedback on results.

While behavioural changes can have a significant impact on energy use, achieving these behavioural changes requires educating the community about conservation practices such as running the dishwasher outside of peak hours, washing clothes in cold water, turning the thermostat down at night or taking shorter showers. Results can be impressive- the Village of Queen Charlotte recently reduced its electricity consumption in municipal facilities by 48.23 per cent in a Power Saving challenge.⁴ In general, 10-15 per cent electricity savings are possible with behavioural change.

1.6 Future Electricity Consumption

In order to develop estimates of electricity consumption for the next 20 years (for planning purposes), three scenarios were developed: Base Case, Scenario 1 and Scenario 2. These scenarios provide a range of electricity consumption estimates that help bound the planning process. The electricity consumption estimate considers improvements made in the building stock and any energy reductions that may be achieved through

Footnote:

⁴ Personal Communication with Andrew Yeates, Chief Administrative Officer, Village of Queen Charlotte, February 7, 2008.

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demand-side management (conservation) efforts. “Future growth” estimates have also been developed and do not include energy efficiency improvements.

Base Case

BC Hydro typically forecasts the next 20 years (to 2027) of electricity consumption for planning processes. The BC Hydro electricity forecast for Haida Gwaii predicts, on average, 0.5 per cent annual growth in total (residential, commercial and industrial) electricity consumption on the islands. For the purposes of the CEP, the BC Hydro forecast has been used as the Base Case scenario.

Scenario 1 and Scenario 2

In the first round of public meetings, residents identified a range of population growth and potential facilities and economic developments that they would like to see occur over the next twenty years. Based on this information, estimates for population, the number and type of dwellings and new infrastructure, services and facilities have been prepared. Census data from past years were included to provide a baseline.

Both Scenarios identified in the public meetings represent a significant increase over the Base Case scenario and reflect the communities’ hopes and dreams. Scenario 1 represents a smaller population than Scenario 2 and, consequently, fewer services and facilities. Scenario 2 includes all infrastructure, facilities and services identified by residents in the first round of public meetings. Note that location of where growth occurs will be important in the subsequent development of the electricity estimates – although some assumptions will remain constant, including the average number of persons per household and the breakdown of dwelling types.

Residential electricity consumption in 2027 was estimated for both Scenarios. Based on the current system capacity, it is roughly estimated that the current generating systems are capable of meeting the needs of Scenario 2 residential sector in 2027.

Note:

BC Hydro is required to plan for historical, statistical and evident load growth. This is the Base Case. It is based on:

Recent trends of electricity usage in the Masset System and Sandspit System, broken down by rate category;

Same growth rates in use per account assumed for Haida Gwaii/Queen Charlotte Islands as for Northern Region of the BC Hydro Integrated System ; and

Population growth provided by BC Stats for Queen Charlottes Health Area.

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High and moderate population estimates made by each community for 2027 were used to approximate the island-wide population in 2027. Based on the current population in 2006 and estimates for 2027, the annual growth rates were calculated. These are:

- Scenario 1 – 2.8 per cent
- Scenario 2 – 4.4 per cent

The projected electricity consumption associated with each of these Scenarios and the Base Case was estimated both with and without Demand Side Management measures. Estimates were also created for consumption associated with new facilities envisioned by residents. We did not examine specific technical requirements for potential increased industrial activity on the Islands - more research is needed to understand both the potential demand and the capacity of the current system to supply the demand.

The results of the scenario analysis for both the North and South grids (including the addition of new infrastructure) are presented in Figure 1-2 and Figure 1-3.

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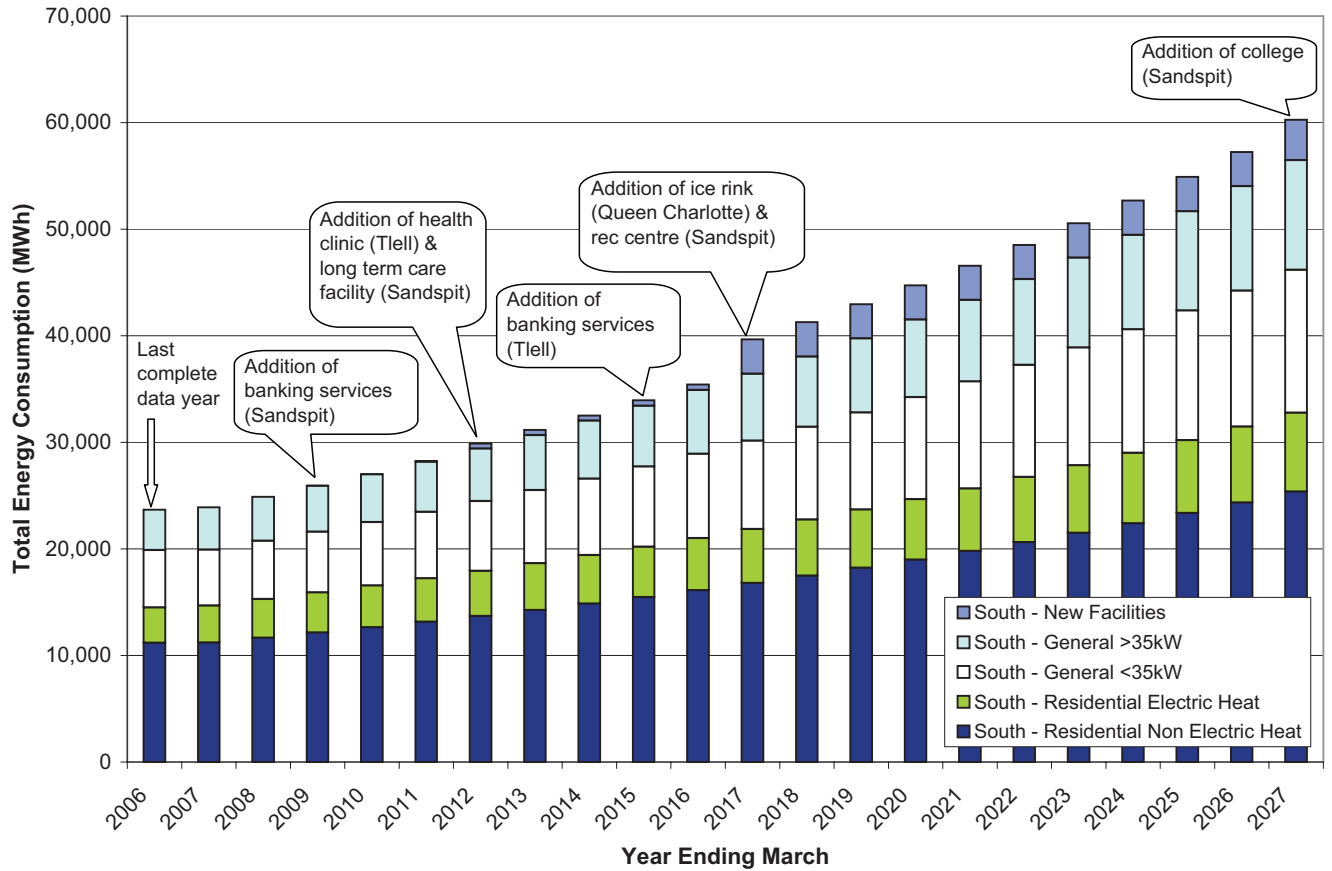


Figure 1-3: Southern System Scenario 2 – Growth Estimate (2007 – 2027)

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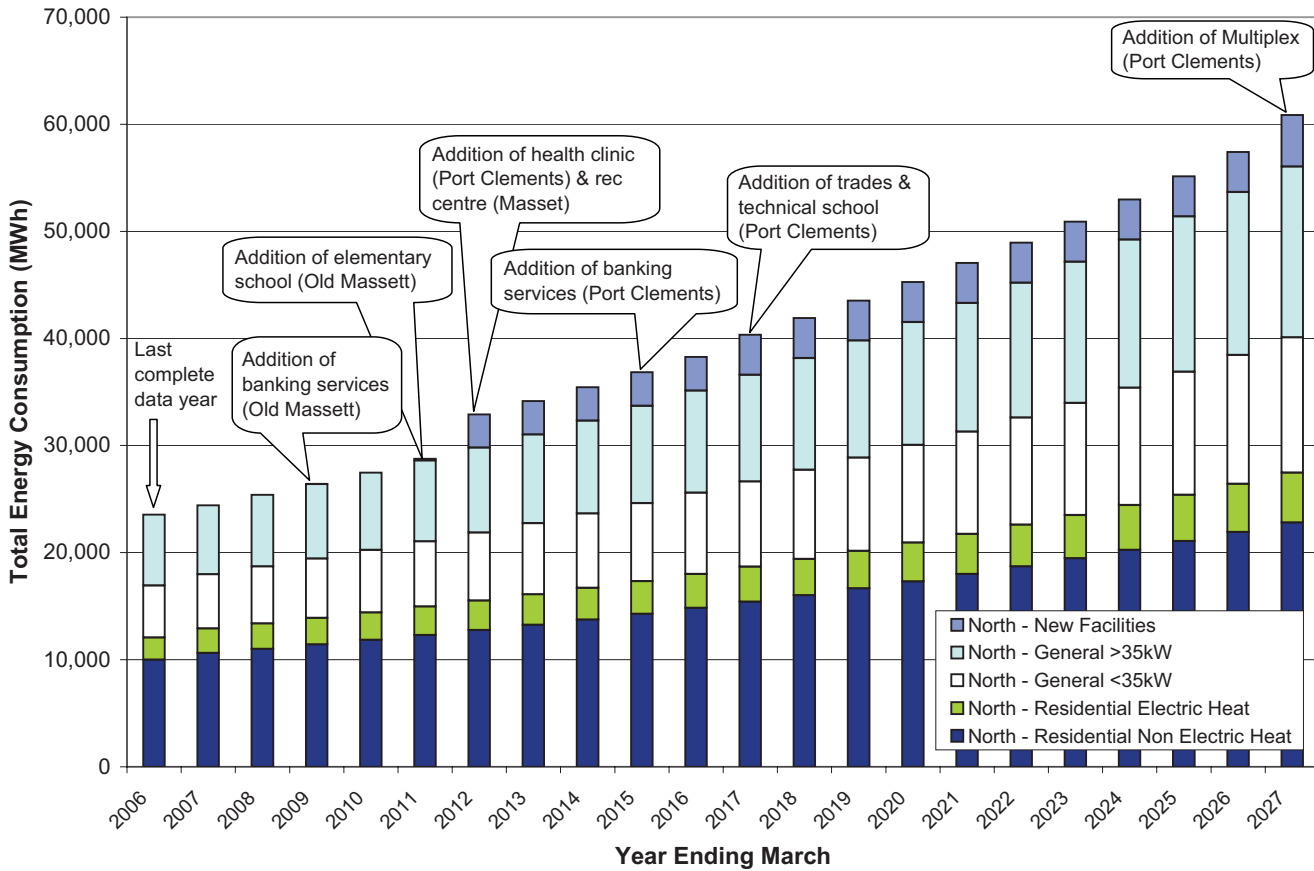


Figure 1-4; Northern System Scenario 2 – Future Growth Estimate (2007 – 2027)

1.7 Supply Options

Residents have expressed preferences for clean energy and for moving away from diesel. Generation supply alternatives and potential distribution options are described in this chapter.

The key findings related to Supply are presented in Table 1-4.

Table 1-4: Key Findings of Alternative Supply Options

Section	Supply Option	Feasible?	Local Availability	Estimated Unit Energy Cost (\$/kWh)	Comments
7.1 Supply Alternatives	Small Hydro	Yes	Yes, numerous small streams	0.20 - 0.40	Stream flow monitoring required
	Wind	Yes	Yes, multiple potential sites	0.2 - 0.26	Wind monitoring required
	Biomass	Yes	Yes, but supply and energy requirements to operate are uncertain	> 0.38	Shipping material distances greater than 100 km not economical
7.2 Other Potential Supply Sources	Geothermal	Unlikely, too far from population and distribution system	Uncertain, some potential sites but further exploration is required	-	Exploration expensive, adds significantly to cost per kWh
	Coal	Unlikely, small scale of plant makes it uneconomical	Yes, some coal seams have been documented, amounts uncertain	-	Mining operations can have significant impacts
	Natural Gas	Unlikely, lack of natural gas supply	Uncertain, further exploration required	-	Environmental impacts associated with natural gas extraction, current moratorium on off-shore exploration
	Landfill Gas	Available amounts limited	Minimal amounts from existing landfill- further study required to determine supply	-	May be uneconomical due to small volumes of gas
	Co-Generation	Yes	Potential linked to industrial/ commercial/ institutional sites	-	Improves the overall efficiency of generator system

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Section	Supply Option	Feasible?	Local Availability	Estimated Unit Energy Cost (\$/kWh)	Comments
7.3 Near Commercial Technologies	Tidal	Yes	Feasibility study underway	> 0.25	Cost based on 43 MW installation
	Solar PV	No, not economical for the amount of solar energy received	Some, but not enough	-	Solar hot water is possible, but not for electricity generation.
	Wave Energy	No, further development of technology required	Yes, but best wave resources on west coast, distant from population and distribution system	0.68 (rough estimate)	
	Fuel Cells	No, technology still developing	n/a	-	
	Energy Storage	No, technology still developing	n/a	-	

2 Key Findings

2.1 DSM

A business case can be made for an aggressive Demand Side Management program for residential buildings in Haida Gwaii, accompanied by an education and information program. Based on calculations of return on investment and advice from the Working Group, Technical Committee Members and the public, a Demand Side Management program was designed that includes (for approximately \$18 million):

1. Energy efficiency audits;
2. Training and capacity building – providing training to construction tradespersons, on-island retailers and building inspectors;
3. Education and Awareness – providing energy efficiency information;
4. Bulk Purchasing and Product Incentives such as:
 - a) Lighting Incentives,
 - b) Appliance Trade-Ins,
 - c) Hot Water Efficiency Upgrades,
 - d) Solar Hot Water System,
 - e) Programmable Thermostats, and
 - f) Financial support of existing on-island recycling program (for appliance replacement).

2.2 Supply

Reducing dependence on diesel generators was clearly identified by residents as a priority. Local renewable resources were highlighted as the preferable technologies. In particular,

- Small hydro,
- Wind, and
- Biomass

were identified as having significant resource potential, sufficient capacity factor and acceptable costs.



2.3 Distribution

While the distribution system was considered peripheral to the study, it was identified as a key element to improve service quality and system reliability. Connecting the distribution system between the Masset and Sandspit systems has been widely discussed and is supported in Island communities. Currently, with the existing system configuration, there is minimal benefit to connecting the two distribution systems – it would not improve system reliability or decrease the number of outages or brownouts. However, this may change if a high capacity reliable source comes on line and the resulting feasibility study indicates that it would improve the system. Changes and upgrades to the distribution system are dependent on the type and location of new supply sources on the islands. System studies will need to be conducted to determine how the new source will interact with the existing system and what upgrades or changes will be needed to ensure the continued reliability of the Haida Gwaii distribution system.

3 Recommendations

The CHN and the Province are hereafter referred to as ‘the Parties’.

Recommendation 1: That BC Hydro and the CHN collaboratively undertake a study to determine the benefits and challenges of linking the two power grids on Haida Gwaii.

Recommendation 2: That BC Hydro and the CHN collaboratively undertake analysis and identify potential solutions to improve the performance and technical capabilities of the existing distribution system. Capacity and reliability are two key reliability issues.

Recommendation 3: That the BC Hydro and CHN incorporate the evaluation and weighting criteria created within the CEP process into the anticipated Request for Proposals for Clean Energy and obtain comments from the Working Group on the proposed process.

Recommendation 4: That CHN and BC Hydro collaboratively identify and enter into partnerships with other responsible agencies to create a Demand Side Management (DSM) program and implementation plans for Haida Gwaii.

Recommendation 5: That BC Hydro and the CHN collaboratively conduct a study and make recommendations regarding the quality of electricity being generated on Haida Gwaii and its impact on the lifespan of appliances, including ENERGY STAR® appliances.

Recommendation 6: That the Province assist with applications for programs such as the CAEE, LiveSmart and remote community clean energy programs to provide incentives for new and existing houses to achieve EnerGuide 80 standards.

Recommendation 7: That BC Hydro and CHN explore the feasibility of waste heat utilisation in thermal generation projects.

Recommendation 8: That the CHN and the Province collaboratively identify and negotiate funding to conduct an Island Energy Plan to address broad energy issues such as transportation, heating fuel and fuel switching.

Recommendation 9: That the CHN define and enforce an environmental standard for electricity generation on Haida Gwaii through ongoing government-to-government processes.

Implementation 4

Given the uniqueness of the Haida Gwaii electricity system and the communities on the Islands, we believe that the call for tenders and evaluation process should closely reflect Island residents' preferences and concerns. Through this CEP process, we have provided a summary of those preferences and concerns. The next steps for BC Hydro are to take this information and develop draft TOR and CFT and an evaluation process. Further consultation with the CEP WG will be required should they express an interest in continued involvement in energy planning. The CHN should take the lead in managing the process on-island, but it is our opinion that the WG should be maintained and plays an integral role in the next steps. The collaborative model that is being supported by the CHN is to be commended.

The next step for developing a DSM program is in the hands of BC Hydro. If the general framework of the program is accepted by BC Hydro (i.e. the outline and investment), the next steps are to design a program that, in addition to achieving the outlined electricity savings, also builds capacity within the community by making maximum use of on-island resources and potential partnerships. For example, training could be conducted on-island through partnerships with BC educational institutions. Housing upgrades could be conducted in partnership with DIAND or CHMC.

Implementation of the recommendations should begin in 2008. These steps include:

1. Confirm the general framework and approach of the program (e.g. budget, administration, planning process)
2. Identify potential funding and delivery partners
3. Design the program (to include goals, objectives, resource requirements and monitoring)
4. Begin implementation
5. Monitor and report on progress

5 Next Steps

The Next Steps will be defined in negotiations between the Parties.