Royal Roads University Solar Colwood Project

Baseline Assessment for Energy Consumption and GHG Emissions, Recommendations for Best Methods of Measuring Social Diffusion and Economic Benefits, and Recommendations for Best Methods for Reporting to Public, Academic and Government Audiences

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1.0 Executive Summary

This report aims to obtain a baseline assessment of energy use as well as identify methods used to effectively demonstrate and monitor the economic benefits and social diffusion of solar hot water projects. Several case studies have been identified and interpreted, as well as a comprehensive literature review to determine how the social diffusion and economic benefits have been measured in the past, and which of these are most applicable to the City of Colwood, Solar Colwood project. The Solar Colwood project, developed by City of Colwood Councillor Judith Cullington, includes upgrading energy efficiency of existing buildings, installing electric vehicle charging stations and retrofitting existing homes with solar hot water systems.

Energy consumption data for both electricity and natural gas were obtained from BC Hydro and Fortis BC, respectively. The SolarBC method for completing a baseline assessment was modified for use with the Solar Colwood Project. Comparison of the baseline assessment completed by SolarBC and purSun Solutions produced variations in the amount of energy saved as a result of the installation of solar hot water systems. This variation was concluded to be attributable to deviation in energy usage within the home, and varying energy savings of a given system.

The baseline assessment completed by purSun Solutions indicates that Colwood homeowners that currently use electricity for heating hot water could expect a monthly energy savings of between 0.62-0.76 GJ depending on the solar thermal hot water system installed; households using natural gas could experience an energy reduction of between 0.73 – 0.90 GJ per month.

Several methods were identified as effective in terms of measuring the social diffusion of clean energy concepts and the acceptance and adoption of solar hot water systems through a community. These methods include indicators, surveys and focus groups which provide qualitative and quantitative measurements of social diffusion. In terms of economic benefits, it has been determined that the three most effective measures to monitor the success of Solar Colwood include direct energy and cost savings, job creation, and increased home values.

It was determined that one of the most effective methods for reporting and tracking a project through a community was through the use of social media applications, such as Facebook and Twitter. The message can be adapted to address various target audiences and is inexpensive and easy to use. Use of social media applications allows access to larger audiences (i.e. worldwide) than traditional methods of reporting (i.e. letters sent by post, public meetings). Use of interactive applications, such as Google maps, on websites was also found to be effective, as viewers are able to customize the information accessed on the website. With regards to academic and government audiences, the same results were found. It was also found that language and tone of reports should be adapted to the level of knowledge of the audience.

2.0 Introduction

2.1 Project Scope

The scope of this project is to develop a baseline assessment of energy use and GHG emissions for single family homes within Colwood, recommend a list of measurables for social diffusion and economic benefits, and recommend methods of reporting the project to audiences such as government, public and academia. The intended use of this research is to develop a monitoring program for the Solar Colwood project.

2.2 Research Question

By what methods can the changes in energy usage and GHG emissions be monitored for the Solar Colwood project? How can changes in social attitudes towards clean energy and economic benefits to the City of Colwood Solar Colwood project be measured? What are the best methods of reporting the progress of the project to the public, government and academic audiences?

2.3 Background

The City of Colwood, located within Vancouver Island, B.C. (Figure 1) developed an ambitious multi-faceted plan on September 1, 2010 to position itself as a clean-energy leader among Canadian cities. The Solar Colwood project is driven by a practical long-term vision of community energy sustainability, which balances short-term and anticipated future energy requirements with the social and economic needs of the community. Aspects of the project include: upgrading the energy efficiency of existing buildings within the community, working with designers and developers to model and build new energy efficient buildings, installing electric vehicle charging stations and retrofitting existing homes with solar hot water (SHW) systems. On January 24, 2011, 3.9 million dollars was pledged by Natural Resources Canada (NRCan) through its Clean Energy Fund in partnership with Royal Roads University (RRU) and the City of Colwood. The Solar Colwood project commenced in May of 2011, with the first offer of incentives made available to homeowners on this date (Natural Resources Canada, 2011).

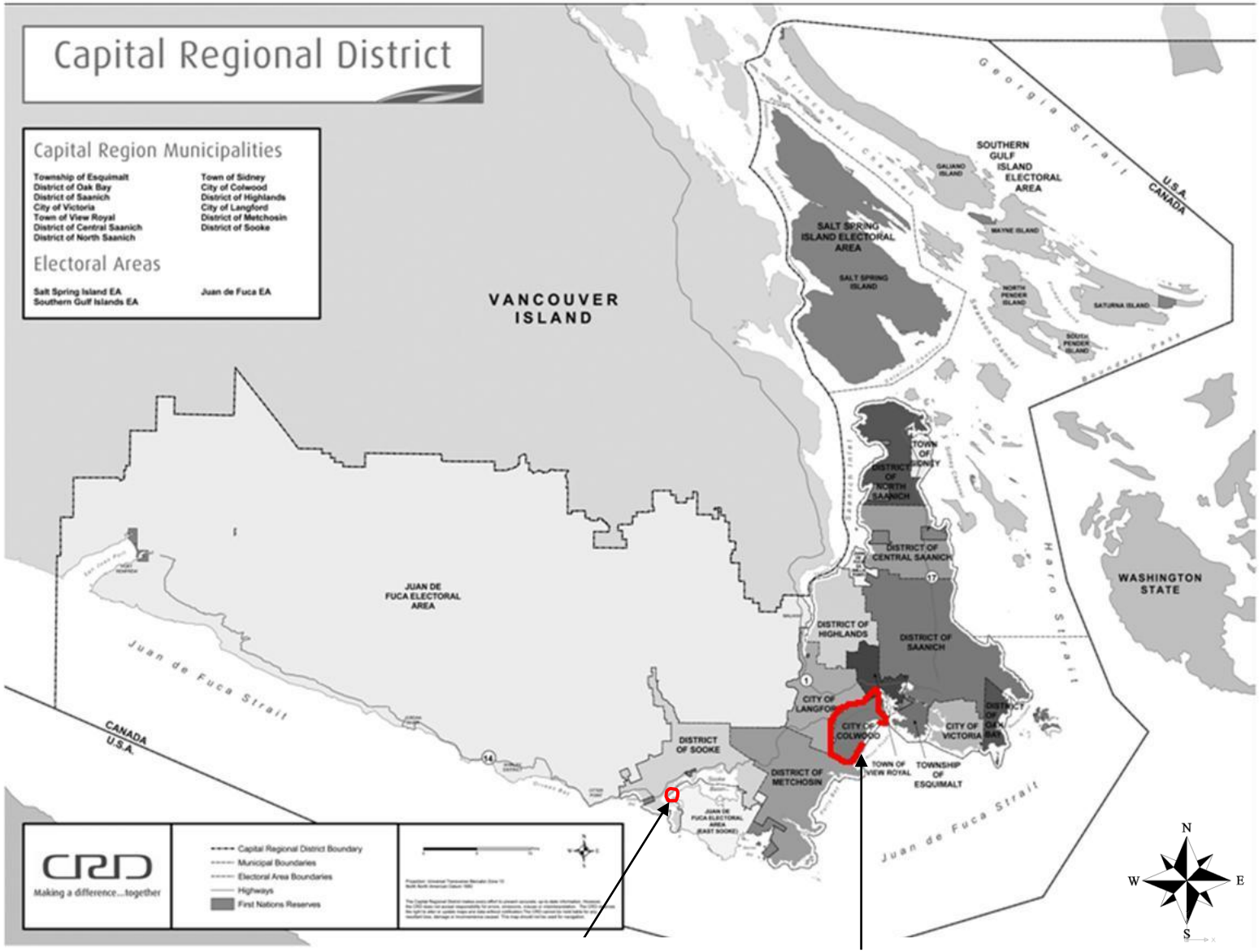
The Solar Colwood project offers homeowners within the community an incentive to retrofit their homes with SHW and other clean energy upgrades over the next three years. One of the main goals of the Solar Colwood project is to retrofit 900 of its nearly 6000 existing homes with

SHW systems during the three-year lifespan of the project (Cullington, Personal Communication, 2011). SHW has been proven to be a clean, reliable and efficient technology that has been demonstrated to displace conventional energy usage and greenhouse gas (GHG) production on a household level (Solar Heating Canada, 2009). In order to demonstrate a reduction in energy use per household, and by extension, at a community level as a result of the installation of solar thermal hot water systems, a baseline assessment and monitoring recommendations are required. To this end, the City of Colwood has partnered with Royal Roads University to research and design a system of monitoring:

- Changes in energy usage;
- GHG emissions;
- Changes in social attitudes towards clean energy;
- Economic benefits to the community directly attributable to the implementation of the SHW retrofit incentive program.

The Solar Colwood project was developed and brought to fruition by Judith Cullington, City of Colwood councillor, who was responsible for completing the application for the *Clean Energy Fund – Renewable and Clean Energy Demonstration Projects*, in order to receive funding of 3.9 million dollars from NRCan. One of the main project goals for the Solar Colwood as stated in the funding application form is to provide verifiable reporting on the aspects of the project, including impacts on energy use, GHG emissions, economic benefits, and social diffusion of clean energy concepts (Cullington, 2010, pp. 8-9).

Figure 1: Map of Capital Regional District in Vancouver Island, BC, highlighting the City of Colwood and T'Sou-ke First Nations.



T'Sou-ke First Nation **City of Colwood**

2.4 Introduction to Case Studies

Several communities that have previously implemented solar technologies were researched and used as case studies to determine if a baseline assessment had been completed, if changes in energy usage, social diffusion and economic benefits were monitored and to observe the methods used for reporting to various audiences. The case studies researched in this report include Dawson Creek, BC, Drake Landing, Alberta (AB), Esquimalt, BC, and T'Sou-ke First Nations, BC.

Dawson Creek is a city of approximately 12,000 people in the Peace River Regional District. It has received two Green City Awards from B.C. Premier Gordon Campbell, and has initiatives to become a more sustainable community through reducing the City's environmental impact, improved social well-being, and more (City of Dawson Creek, n.d.).

Drake Landing, Alberta is a neighbourhood within the town of Okotoks that has established a solar community. This neighbourhood is unique because it is heated by a district heating system which stores solar energy underground during the warmer summer months. This solar energy is later distributed to homes for space heating needs during the winter months. This system can meet 90% of the communities heating requirements, giving the community less dependency on fossil fuels for space heating. This system increases the payback of the technology and reduces greenhouse gas emissions, making this community the first of its kind in North America. (Drake Landing Solar Community, n.d.).

The township of Esquimalt was designated as a Solar Community by SolarBC (Corporation of the Township of Esquimalt, 2008). Under the SolarBC program, Esquimalt provided financial incentives for plumbing permits, as well as providing rebates for homeowners who installed solar thermal hot water heating systems before December 31, 2010 (Corporation of the Township of Esquimalt, 2008). A solar thermal hot water heating system was installed on the Municipal Hall with a projected greenhouse gas emissions reduction of 20kg/year (Corporation of the Township of Esquimalt, 2008). This building is used as a demonstration project for solar thermal hot water heating systems for the residents of Esquimalt (Kelly, 2010).

T’Sou-ke First Nation consists of two reserves residing on 67.2 hectares of land on the southern part of Vancouver Island, B.C. (Figure 1) (T'Sou-ke Nation, n.d.). T’Sou-ke First Nation has retrofitted 25 homes, the fish hatchery, community hall, band hall and canoe shelter with solar thermal hot water systems and solar photovoltaic units (SolarBC, 2008).T’Sou-ke First Nation adopted solar thermal hot water heating and solar photovoltaic technology in 2007 to generate 75 kilowatts of energy for the community, making it the largest solar energy producer in BC (Kimmett, 2009).

3.0 Methods

3.1 Baseline Assessment

A system for monitoring changes in energy usage and GHG emissions resulting from the Solar Colwood Project was researched using a variety of online sources. Four case studies of similar existing solar projects were examined. A literature review was conducted to fill in any information gaps not addressed by the case studies.

3.1.1 Identification of Energy Suppliers and Collection of Energy Usage Information

Through conversation with Judith Cullington, City of Colwood Councillor, it was determined that electricity is supplied to the City of Colwood by BC Hydro, and that natural gas is supplied by Fortis BC. Travis Streb from BC Hydro and Bob Davidson from Fortis BC were contacted by email and telephone with requests for electricity and natural gas consumption, respectively. Consumption data at a household level was requested from both. BC Hydro was able to provide electricity consumption data based on housing type within the community, and Fortis BC provided natural gas consumption for residential properties at a community level only.

3.1.2 Conversion of Energy Used to GHG Emissions Based on Generation Source

Energy consumption data was obtained from BC Hydro and Fortis BC for the City of Colwood at a community level. Emissions factors from the Climate Secretariat were used to convert electricity and gas consumption to CO_2 equivalents. This community level data was then compared to the province wide data available from NRCan and data produced using a similar method from the SolarBC project.

3.1.3 Selection of Method

The baseline assessment method used by the SolarBC project was selected to serve as a guide for the production of a baseline assessment for the City of Colwood for the following reasons:

- Ease of Use and Accessibility of data: this method uses easily accessible provincial level average data from Natural Resources Canada (NRCan) including residential sector energy use (NRCan, Table 1, 2010), energy end-use (NRCan, Table 2, 2010) and water heating energy (NRCan,Table 10, 2010); and
- Directly Comparable: a similarity in geographical location and available SHW system efficiency and savings allows for direct comparison between the baseline assessments produced for SolarBC and Colwood.

3.1.4 Modifications to Method

It is preferable to use direct household level energy use measurements when quantifying emissions related to hot water heating that uses conventional energy generation methods (i.e. hydro power or natural gas). This is preferred as direct energy measurements are specific to individual homes and, therefore, are not sensitive to changes in energy use at the community level. Using these values would allow for direct comparisons of energy usage and GHG emissions before and after installation of a SHW system in Colwood. However, a lack of specific household level data requires the use of surrogate data. The SolarBC project was province wide and used provincial energy use averages produced by NRCan; the scope of the Solar Colwood project is limited to the City of Colwood and as such community level energy usage data for single family homes was provided by the local utilities, BC Hydro (electricity) and Fortis BC (natural gas). This data was used in conjunction with NRCan provincial level energy end-use data (NRCan, 2010[c]) of the proportion of energy use for the heating of water from 2008 as a surrogate, as no such estimate exists for the community of Colwood.

The Intergovernmental Panel on Climate Change (IPCC) offers steps as best practice regarding the use of surrogate data in the calculation of energy usage and GHG emission baselines. The steps include the development of a clear physical relationship and a significant correlation between the actual energy usage/emissions and the surrogate data (IPCC, 2006).

The breakdown of energy end use (i.e. portion of total energy use for hot water compared to space heating) depends heavily on climate, for example, a household in Fort St. John would use a higher portion of total annual energy consumption on space heating than a similar (in size and energy efficiency) household in Colwood. In 2008, 1,437,449 of the 1, 748, 863 households in BC (82.2%) were located on Southern Vancouver Island, the Coastal lower mainland and the southern interior of BC; this similarity in geographic location results in areas of a similar climate to that of the community of Colwood (Province of BC, 2010). The 2008 provincial average energy end use data reflects the distribution of households within BC and represents values that are based on the majority of households being located in a climate that is similar to Colwood and so demonstrates a clear physical relationship with the actual data.

As illustrated in Table 3, the provincial estimates of total energy intensity per home and that of non-electric homes in Colwood is nearly identical at 89.53 and 90.56 GJ, respectively. This consistency is significant because the Colwood home values were calculated using actual community level energy usage data, while the provincial average values were created using provincial level energy use data. The similarity between these two values, obtained using community and provincial level energy use data coupled with provincial household distribution data satisfies the IPCC requirements for the use of surrogate data and so validates the use of provincial level energy end use data as a proxy for unattainable community level data.

3.1.5 Limitations of Method

The limitations of the SolarBC methodology for baseline assessment will be discussed in this section.

Scope of Method

It should be noted that those homes using home heating oil have been excluded from these calculations and the overall community level baseline due to a lack of reliable information regarding the amount of home heating oil used. Also, only single family detached homes were used for calculations; row houses, condominiums, apartment buildings and commercial buildings were excluded from these calculations as the energy consumption data for these buildings were not measured as individual units, but as a whole.

Community Level Energy Usage

While the SolarBC method is capable of predicting average energy usage and savings on a household level, it is limited in its ability to predict specific energy savings for a given household, which depends primarily on the difference in the efficiency of the conventional hot water system that was replaced and the new solar system, as well as water use habits within the home. This method is also limited in its ability to measure the actual energy savings experienced by a household which has installed a solar hot water system due to its use of average energy consumption data.

3.2 Research Methods for Monitoring Economic Benefits, Social Diffusion and Methods for Reporting to Various Audiences

Table 1 shows the methods used to gather information on case studies, economic benefits, social diffusion, and reporting methods. The methods used vary from face-to-face interviews to using online sources, such as websites and online peer-reviewed literature. A "+" indicates the method was used for research purposes within that component of the report, whereas a "-" indicates the method was not used.

Table 1. Methods of Research Utilized for Case Studies, Baseline Assessment, Social Diffusion, and Economic Benefits aspects of the Royal Roads University Solar Colwood Project.

	Literature Review		Interviews		
	Online	Peer Reviewed Journals	In person	Telephone	Email
Case Studies	+	+	+	+	+
Baseline Assessment	+	-	-	+	+
Social Diffusion	+	+	+	+	+
Economic Benefits	+	+	+	-	+
Reporting Methods	+	-	-	-	-

4.0 Results

4.1 Baseline Assessment

Table 3 presents the process used to account for the total use of both electricity and natural gas in non-electric Colwood homes. For the purposes of this report, non-electric homes are those homes that use natural gas to heat their domestic hot water. A total energy consumption of 191,438.305 GJ (Table 3) was determined for the 2,114 non-electric homes in the Colwood area translating into an average energy intensity of 90.56 GJ/non-electric household. This value is consistent with the provincial estimate of 89.53 GJ/ BC household (BC Hydro, 2009).

Following the methods used in the baseline assessment performed for the SolarBC project, Table 4 shows a monthly household average energy usage for the production of hot water of 1.37 GJ

and 1.63 GJ for Colwood homes using electricity and natural gas, respectively. These values are consistent with the province-wide average value of 1.61 GJ despite a ratio of 54:46 homes using electricity vs. natural gas as the energy source for hot water within Colwood compared to a 15.5:82.9 split on the provincial level (NRCan, Table 10, 2010). Given this similarity, it is not surprising that the projected energy savings from the installation of a SHW system are within 0.01 of a GJ of each other at 0.733 GJ to 0.725 GJ for Colwood homes using natural gas and the provincial average home (Table 2). Table 2 also projects that Colwood homes using electricity for hot water can expect an average monthly savings of 0.62 GJ. Based on the values presented in Table 2, single family homes within the City of Colwood are using a total of 82994.8 GJ/year on the heating water.

In order to demonstrate the sensitivity of these projections to the range of energy savings predicted for individual systems, calculations for a 45% savings, representing the midpoint of NRCan estimates of energy savings (NRCan, 2003) and 55% energy savings, the value which SolarBC accepted as a reasonable average of expected savings (SolarBC, 2007) were completed. As shown in Table 3, at 45% and 55% savings, Colwood homeowners using electricity could expect a monthly energy savings of 0.62 GJ and 0.76 GJ respectively; while Colwood households using natural gas could experience an energy reduction of between 0.73 GJ and 0.90 GJ per month respectively.

Table 2. Total Energy Consumption for Homes in the City of Colwood using Natural Gas as Energy Source for Hot Water Generation.

Energy Consumption for Non-electric Homes[a]	
KWh Consumption[b]	24319403
Non-Electric Single Family Homes[c]	2193
KWh Consumption/Non-electric Single Family Home	11089.55905
Fortis BC Residences[d]	2114
Total KWh for Fortis BC Residences	23443327.83
GJ of Electricity for Fortis BC Residences[e]	84395.30504
GJ of Natural Gas Consumed by Fortis BC Residences[f]	107,042
Total Energy Use in Fortis BC Residences (GJ)	191438.305
Electricity Consumed as part of Total Energy Consumed	0.440848581
Ratio of Electricity/Gas Energy Consumed	44/56

[a] Non-electric home uses another form of energy for space heating and hot water production as defined by BC Hydro

[b] Note: This number represents total consumption of electricity for Non-Electric homes using both natural gas and home heating oil as the energy source for space and water heating; provided by BC Hydro in the 2009 CEEI Report

[c] Note: This number represents homes using both natural gas and home heating oil as the energy source for space and water heating; 2009 CEEI Report

[d] Number of Colwood Homes supplied using Natural Gas for space and water heating; provided by Fortis BC

[e] Note: Calculated using 1 GJ= 277.78 KWh

[f] Fortis BC, 2011

Table 3. Comparison of Projected Energy Savings and GHG Emission Reductions Savings for Homes in the City of Colwood using Electricity and Natural Gas as the Energy Source for Hot Water Generation and the Provincial Average.

	City of Colwood		NRCan Provincal Estimates	Conversion Factors Used
Hot Water Heating Source	Electricity[a]	Natural Gas[b,c]	All Sources	1 PJ = 1000000 GJ
Provider	BC Hydro	Fortis BC	All Providers	1 GJ = 277.78 KWh
Total Energy Consumption (GJ)	192,766.31	191,438.31	156.017818 PJ	1 KWh = 0.0036 GJ
Number of Homes	2,527	2,114	1742667	
Total Energy Intensity (GJ/Home)	76.28	90.56	89.53 [d]	GHG Emission Factors[j]
Hot Water Energy Use (Of total)[e]	0.216	0.216	0.216	BC Hydro Electricity
Annual Energy Use HW (GJ)	16.48	19.56	19.34 [f]	0.00002592 tCO_2/KWh
Monthly Energy Use HW (GJ)	1.37	1.63	1.61	0.007200058 tCO2/GJ
Projected SHW Savings[g]	0.45	0.45	0.45	Fortis BC Natural Gas
Monthly Savings (GJ)	0.62	0.73	0.73	0.0503 tCO2/GJ
Monthly GHG Emission Reduction (tCO_2)	0.004448685	0.036895795	0.031048299 [h]	
Projected SHW Savings SolarBC[i]	0.55	0.55	0.55	
Monthly Savings (GJ)	0.76	0.90	0.89	
Monthly GHG Emission Reduction (tCO_2)	0.005437282	0.045094861	0.037947921 [h]	

[a] Information on consumption and number of electric and non-electric homes provided by BC Hydro in the 2009 CEEI Report

[b] Information on natural gas consumption for non-electric homes provided by Fortis BC

[c] Note: This value is a product of calculations presented in TABLE: ENERGY CONSUMPTION FOR NON-ELECTRIC HOMES

[d] Note: This value was obtained by converting the product of dividing total energy consumption by the number of homes to gigajoules using the conversion factors provided.

[e] Natural Resources Canada - British Columbia, Residental Sector - Table 2: Secondary Energy Use and GHG Emissions by End-Use of Residental Sector of BC, 2010

[f] Natural Resources Canada - British Columbia, Residental Sector- Table 10: Water Heating Secondary Energy Use and GHG Emissions by Energy Source, 2010

[g] Note: This value represents the midpoint of NRCan projections of energy savings (40-50%) produced through the installation of a solar thermal hot water system; taken from Natural Resources Canada Solar Water Heating Systems Buyer's Guide (2003)

[h] Note: This value is calculated using 15.5% and 82.9% for the percentage of homes in BC which use electricity and natural gas respectively, as their energy source for water heating according to Natural Resources Canada - British Columbia, Residental Sector- Table 10: Water Heating Secondary Energy Use and GHG Emissions by Energy Source.

[i] Note: This value was supplied by Liz Kelly of SolarBC as an average value for energy savings from the installation of a solar water heating system

[j] Climate Action Secretariat - Emission Factions for Use in Reporting Public Sector Greenhouse Gas Emissions. V. 2.0 (Sept. 2009)

4.1.1 Energy Suppliers

Electricity within the community of Colwood is provided by BC Hydro. BC Hydro provides 80% of British Columbia's electricity requirements through the operation of hydroelectric generating stations on the Columbia and Peace River (BC Hydro, 2011). Energy is generated by 30 integrated hydroelectric stations, two gas-filled thermal power plants and a combustion turbine power station (BC Hydro, 2010b).

Hydro power is generated by the conversion of the potential energy stored in water as it falls through a penstock in a dam to produce mechanical energy, which is used to turn a turbine. The rotation of the turbine converts the kinetic energy of the moving water into electric energy. In order for this energy to be moved through the grid system to the end user its voltage is increased using a step-up transformer. The electricity then travels to a distribution substation where its voltage is reduced to a level that can be used by the end consumers (BC Hydro, 2010a).

BC Hydro generates over 43,000 gigawatt hours of electricity on an annual basis and supplies 1.6 million customers through an interconnected grid system of 73,000 kilometres of transmission and distribution lines (BC Hydro, 2010a).

Rates for electricity depend on the amount used based on monthly bills as of April 1, 2010

- Users of 625kWh: $0.072/kWh
- 750 kWh: $0.07348/kWh
- 1000 kWh: $0.07793/kWh (BC Hydro, 2010c)

Fortis BC is the local supplier of natural gas, the second major source of energy for water heating. Natural gas is collected from within the Earth's crust where it is formed through the natural decay of plant and animal matter. Collection of the gas occurs through a well, which is simply a hole drilled through the confining rock layer into the reservoir, which contains the pressurized gas. Impurities such as water, hydrogen sulphide and carbon dioxide are removed from the gas before the gas is shipped via transmission (pipelines) to the distribution company to be passed on to consumers (Fortis BC, 2011a).

Rates for natural gas for residential properties from Fortis BC (effective March 1, 2011):

- Basic monthly charge: $10.50
- Per GJ: $14.325

(Fortis BC, 2011b)

4.1.2 GHG Based on Generation Source

As shown in Table 3, the GHG conversion factors are 0.007200058 tCO2/GJ for hydro electric power and 0.0503 tCO2/GJ for natural gas; these values were taken from Climate Action Secretariat - Emission Factions for Use in Reporting Public Sector Greenhouse Gas Emissions. V. 2.0 (Sept. 2009).

4.2 Research Results for Baseline Assessment, Economic Benefits, Social Diffusion, and Reporting Method

Table 4 summarizes the results obtained from research involving the four case studies, Dawson Creek, Drake Landing, Esquimalt, and T'Sou-ke First Nation. The results state which communities from the case studies performed an activity related to the main research components of the report: baseline assessment, economic benefits, social diffusion, and reporting methods to audiences. A "+" indicates that the activity was performed by the community, whereas a "-" indicates that the activity was not performed.

Table 4. Results of Applicable Case Study Research Questions Regarding Baseline Assessment, Economic Benefits, Social Diffusion, and Reporting Methods

	Baseline Assessment		Economic Benefits			Social Diffusion		Reporting Methods	
	Performed Energy Use Baseline	Performed GHG Emissions Baseline	Tracked Job Creation	Tracking of Utility Bills or Energy Saving	Installed Monitoring Systems	Performed Community Outreach	Measured Social Diffusion	Report to Public Audiences	Report to government and academic audiences
Dawson Creek, BC	+	-	-	-	-	+	+	+	+
Comments: This project applies to municipal buildings only. Measured social diffusion of social well being of community using indicators. Energy baseline was gathered, but no subsequent data on current energy use to demonstrate energy savings has been completed.									
Drake Landing, AB	-	-	-	-	-	+	-	+	+
Comments: Energy comparisons were calculated based on new energy efficient homes compared with "typical" homes.									
T'Sou-ke First Nation, BC	-	-	+	-	-	+	-	+	-
Comments: Monitoring equipment was available but not properly installed. Direct job creation involved local community members hired for installation as well as local artists.									
Township of Esquimalt, BC	-	-	-	-	-	+	-	+	-
Comments:									
Solar BC	-	+	-	n/a	n/a	+	-	+	+
Comments: Tracking energy and installation are not applicable as Solar BC involves several individual projects, each with different outcomes. Job creation was not tracked; however the number of persons entering solar installation training programs has been tracked for the year from Sept 2008 – March 2009.									

4.3 Social Diffusion Results

Tables 5 and 6 outline possible success criteria, indicators, baselines and methods of measurement which may be used to provide an observer with information about trends within a community. The success criterion is the observer's goal for which specific data is collected (i.e. what you want to know). The indicator is used as the identifying factor for determining if the goal is achieved (i.e. how you will know). The baseline also aids in determining if the goal was achieved as it provides comparable data (i.e. what the data has been; the norm). The method of measurement is the way in which data is collected. Table 5 summarizes the methods of measurement for the social diffusion of information and education, whereas Table 6 summarizes the methods of measurement for metering and feedback of sustainable behaviour projects (MECHanisms, n.d.).

Methods of measurement may provide both qualitative and quantitative results. One method of qualitative measurement includes the use of self reporting surveys to record changes in sustainable behaviour including energy consumption awareness. Other methods will provide more quantitative results for example, the comparison of household electricity consumption before and after installation of SHW systems (MECHanisms, n.d.).

Table 5. Information and Education Campaigns: Examples of Success Criteria, Indicators, Baselines and Methods of Measurement[a]

Possible success criteria	Possible indicators	Possible baselines	Method of measurement
Reaching a particular audience with the intended message	Products delivered by the campaign, media & partners involved, number of people exposed to the message	Amount and quality of information existing	Number of newspaper/online items, number of readers, clicks on webpage
Changes in awareness, knowledge, attitudes and internalized norms (i.e., what people feel they should do)	Changes in awareness, knowledge attitudes	Pre-project survey on the level and quality of consumer's knowledge and skills	Survey, self-report on awareness, attitude; information
	Increased information search on energy-efficient products Awareness of energy efficient products and changes in future decision-making processes	Pre-project sales statistics on energy efficient products, interviews with salespersons	Sales statistics/market share information/ information from appliance shops
Changes in behavior	Self-reported behavior	Pre-project survey	Survey, self-reports e.g. via energy diary

[a] Table obtained from MECHanisms-Make Energy Change Happen Toolkit. (Examples of success criteria, indicators and baselines for different types of projects).

Table 6. Metering and Feedback: Examples of Success Criteria, Indicators, Baselines and Methods of Measurement[a]

Possible success criteria	Possible indicators	Possible baselines	Method of measurement
Increased customer awareness of energy use	Attention to and use of feedback – self-report from survey	Pre-project survey: check of current awareness and use of feedback (if any)	Comparison of awareness before/after project on the basis of surveys
Reduced energy use	Changes in energy use after feedback	Energy use before provision of feedback	kWh/gas/oil consumption
Overall satisfaction with the project (e.g. the extent to which it is perceived of as useful and interesting by the recipients)	Customer survey: overall satisfaction (project, process, outcomes)	Customer expectations	Customer/stakeholder survey

[a] Table obtained from MECHanisms-Make Energy Change Happen Toolkit. (Examples of success criteria, indicators and baselines for different types of projects).

Through research summarized below, three applicable methods for measuring social diffusion have been determined:

(1) Social indicators
(2) Surveys
(3) Focus Groups

Social indicators are a quantitative method of measurement. Social indicators can be used to measure the impacts of trends (i.e. policies, programs, initiatives, etc.) in a community for the purpose of tracking the progress and success of the trend. Examples of indicators are outlined in Tables 5 and 6 and described in detail in the Discussion section of this report. The City of Dawson Creek has outlined the following criteria for selecting indicators for use in any area of measurement.

- data not only available but easily accessible
- data are easily understood by a range of people
- data are valid and reliable
- data are collected regularly to reveal trends over time

(Istvanffy, 2008)

Surveys and focus groups are qualitative methods of measurement. Surveys are performed individually in interview format via mail, email, telephone, or a face-to-face. Focus groups are performed in a group setting. In this method, questions are asked to determine the opinions, attitudes, and beliefs of each person within the group toward a trend.

Liz Kelly, project manager for SolarBC, and Emily Kendy, project coordinator for the residential program at SolarBC, concluded from their experience working for SolarBC that the public is willing to share personal data, such as their experience or opinion on solar thermal technology, but prefer to provide this information in different formats (Kelly & Kendy, Personal Communication, 2011).

4.4 Economic Benefits Results

The literature review for economic benefits has been focused on the Canadian Solar Industries Association (CanSIA) and the Pembina Institute, as well as information gained from the textbook, Environmental Economics, by Barry Field & Nancy Olewiler. The results of the literature review have revealed a variety of case related, and project specific benefits including direct energy savings resulting both short term and long term economic benefits, local job creation, economic incentives from local, provincial and federal bodies, long term benefits such as increased energy independence, and other economic spin-off benefits such as increased home value and carbon reductions.

Direct energy savings are one of the most notable features that can be used to determine the feasibility and success of the City of Colwood, Solar Colwood project in comparison to homes without SHW. A solar thermal system provides a substantial contribution towards heating water or air under optimal solar incidence (CanSIA, 2010). As a result, these systems can reduce or eliminate the need for a conventional form of energy. For example, a SHW system can be used to preheat water for electric water heaters (reducing the electricity requirements), whereas a seasonal system used for heating a pool can completely eliminate the need to rely on a conventional pool heater and the natural gas required for operation. There are several different uses for solar thermal systems, each with their own savings based on the type of fuel they are replacing (Figure 2), household characteristics, and energy prices (Gill & Goldwater, 2008).

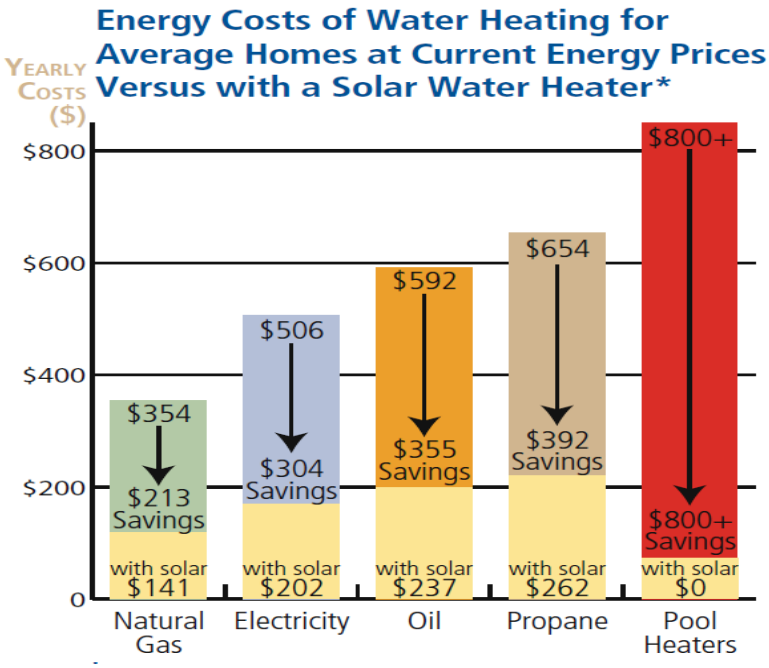


Figure 2. Summary of the various uses of solar thermal technology and their associated monetary savings based on various energy sources. Diagram featured is based on Enbridge Gas Distribution 2003 and will vary with fluctuating energy prices. Assumes an average household population of three residents (Gill & Goldwater, 2008).

Job creation is another important measurable benefit seen from the implementation of SHW projects such as Solar Colwood. It was estimated by the Pembina Institute for Appropriate Development that for every million dollars invested, an average 36.3 jobs are created in the energy efficiency sector, with 12.2 jobs created in the renewable energy sector, and only 7.3 jobs in the development of conventional energy (Pembina Institute for Appropriate Development , 1997). Job creation from SHW systems can be derived from areas including research, production, installation, maintenance and energy assessments and audits (CanSIA, 2010). It is estimated by CanSIA that jobs created in Canada due strictly to solar thermal will increase to approximately 6,400 by 2025, not including job potential derived from exportation (CanSIA, 2010).

Municipal, Provincial and Federal incentives also promote the use of renewable energy alternatives including SHW (Gill & Goldwater, 2008). Providing these incentives allows for the reduction of the high upfront costs associated with solar thermal installations.

In terms of long-term benefits, while upfront costs may be high, the return on the investment will last for decades (up to 25 years) (Gill & Goldwater, 2008). As traditional fuel prices increase, the payback period (years) will decrease making solar thermal a more viable option, with increased long-term benefits. The benefits of SHW systems may be enhanced in the long-term, as the economic stability of oil prices tend to fluctuate, and are expected to increase over the coming years. To that end, the acquisition of a solar thermal system can act to buffer these market price fluctuations. SHW systems may also be used to promote small businesses as being "Green". The businesses may benefit by not only decreasing their energy bills for the business, but may also notice an increase business from members of the community who wish to shop at environmentally conscious businesses.

SHW systems may be used as a selling tool for increased rent, or increased future home value when selling a home fitted with solar thermal technologies. It has been estimated that for every $1 saved in annual utility bills in a home, the value of that home increases by $20 (National Renewable Energy Laboratory (NREL), 2008). For example, if a homeowner were to save $200 annually on their utility bills, the added value to their homes would increase by $4000, covering a significant portion of the upfront cost of a solar thermal installation. In addition, a survey was conducted that reported 8 out of 10 Americans would be willing to pay up to 10% more for a home equipped with a solar system (National Renewable Energy Laboratory (NREL), 2008).

The last area of focus includes the possibility of tax credits, or carbon credits that the City of Colwood may benefit from after the installation of solar thermal systems. Although the amount of carbon reduction on a per household level will be minimal, the 900 home target set out by the Solar Colwood project can allow for Colwood to not only meet its carbon neutral targets, but may also allow for the allocation of excess carbon credits to other communities in BC, through avenues such as the Pacific Carbon Trust, or simply through the open market. This can provide further benefits to the municipality as it may become an additional source of future revenue.

4.5 Results Reporting to Various Audiences

Traditionally, reporting to the general public or public information has taken the following forms: townhall meetings, direct mail-outs and surveys, newsletters, and media features (newspaper articles, radio and television stories/interviews). The growth of the internet and the diversity of its users have provided a low cost, rapidly updatable and interactive medium for

reaching audiences, with an increasing large target audience (Clow & Baack, 2007). The common goals of all of these methods is to: make the audience aware of the project, inform them about the project, get individuals to "like" the project, convince the audience to prefer this project over other similar projects and provide opportunities for the audience to identify and relate to aspects of the project in order to convince them to take action. These steps make up what is referred to in advertising as the hierarchy effects model (Clow & Baack, 2007).

The website for SolarBC contains a number of different levels of reporting to various audiences. For the general public, they have a searchable Google map of the solar installations to date across BC, and each installation can be examined for a number of factors including type of system installed and links to solar communities. News articles, stories and events are presented to update visitors to the SolarBC website about the happenings of the project while keeping readers up to date. Links to other features, such as an e-newsletter signup and a link to the BC Sustainable Energy Association website, allow interested visitors to obtain more information about the SolarBC project, and other sustainable projects in general. A link to the SolarBC Facebook page is also presented, allowing site visitors to connect with a larger community of like-minded individuals. Through the use of a Facebook page, the language and content can be tailored to a specific audience (SolarBC, 2008).

Project Porchlight is an example of community engagement and reporting to the general public. It used existing community leaders to connect with the community as a whole; a role model approach. It was also used as a social marketing campaign. Like SolarBC, an interactive Google map is present on their website, allowing individuals to view which homes are participating in the project which serves to develop self regulation within the community; in a sense homeowners are influenced by a "keeping up with the Jones" mentality (Project Porchlight, 2010). Project Porchlight also utilized social media links to Facebook, Twitter, StumbleUpon, Digg.com and YouTube. All of these sites allow for information to be tailored to a specific audience, as well as reaching a range of age groups and allows for tracking of the most effective methods to reach different groups within the general project (Focus.com, 2010). The website also provided a sign-up for an email newsletter and photo gallery where participants in the project can post their own photographs (Project Porchlight, 2010).

Project Porchlight also partnered with businesses, BC Hydro PowerSmart and EnCana. This allowed them to further spread their message and reach other consumers. A give-away project for free CFL bulbs was developed as a means of incentive to the general public (Project Porchlight, 2010).

On the Drake Landing website, an interactive and real-time display of the operation, energy-use and energy savings associated with their solar collection array is presented. Visitors are able to view the current conditions of the community, including outdoor temperature, level of solar incidence, solar energy collected, solar fraction and space heating load. It also provides links to other energy savings groups associated with the community (Drake Landing Solar Community, 2011).

MECHanisms is an online toolkit developed by the European Union 7th Framework Programme Energy theme. Its goal is to encourage changes in the behaviour of energy users and contains a number of general set-ups, marketing and monitoring guidelines that can be applied to clean energy or energy reduction projects. It also provides a step by step guide to preparing, designing and evaluating energy projects. Using step 2 of the provided guide, "Getting to know your target group," provides valuable information and allows for the design of a series of specific messages that will speak directly to the interests of target groups (MECHanisms, n.d.).

One case study presented on the MECHanisms website focuses on a Latvian apartment building and illustrates the importance of understanding the interests and motivations of the target group toward the success of a project. A survey was prepared for the residents to inquire about their interests, level of understanding of the technologies involved and concerns regarding energy efficiency renovations. Researchers used their findings to tailor the project to reflect these concerns, to create specifically directed reporting measures as well as to ensure that the project would be supported by the community (MECHanisms, n.d.). Organizers of the project point to knowing their target group as the key to effective reporting and the key to the project in general.

The methods used to report to academic audiences and government were much simpler and less diverse than those used to report to the general public. When reporting to academic audiences and government, it was found that a simple link on the community website to an annual report is the current best practice.

The Dawson Creek website provides a link to a baseline assessment of the energy usage of the municipal buildings, and was written to municipal audiences by the Pembina Institute. An annual report was also prepared and is available through a separate link on their webpage. This report revealed that while the solar hot water retrofit completed on City Hall did provide a cost savings, it was deemed to be important as a symbol of the community's commitment to energy conservation (The Pembina Institute, 2005).

The websites for SolarBC and Drake Landing provided links to annual reports on their projects. These documents summarized all aspects of the implementation and monitoring of the projects including the scope, marketing methods, equipment, costs and energy savings associated with the project.

5.0 Discussion

5.1 Baseline Assessment

A modified version of the baseline assessment method used in the SolarBC program was used to calculate the baseline of energy use and GHG emissions for the community of Colwood. A discrepancy was found between our results (Table 3) and those produced for the SolarBC despite being developed using the same method of calculation and source material (i.e. NRCan BC Residential Sector Tables 2 &10). Based on a 55% savings, SolarBC predicted a monthly savings of 0.96 GJ (268 KWh) and 1.65 GJ for electric and natural gas hot water systems respectively, compared to the Table 2 projections at a 55% energy savings of 0.76 GJ for electric and 0.73 for natural gas. This discrepancy is due to the different estimates of the energy used for hot water on the household level. In the SolarBC calculations a BC Hydro estimate of 21 GJ/year was used for electric homes and an estimate of 36 GJ/year from Terasen Gas (now known as Fortis BC) compared to the 16.48 GJ/year, calculated using data from BC Hydro and 19.56 GJ/year (Fortis BC/ BC Hydro) for electric and natural gas, respectively, used in Table 3. The energy consumption and GHG emission baseline estimates produced for Colwood are based on NRCan estimates of 21.6% of household energy being used to generate hot water developed using energy usage information from 2008 (NRCan, Table 2, 2010). SolarBC claimed a 30% share of energy use within the home for hot water from 2004 information but this value was inconsistent with the values presented in the material referenced in their calculations (24.1%); Natural

Resources Canada, British Columbia, Residential Sector Table 2: Secondary Energy Use and GHG Emissions by End-Use. Clearly, even these simple calculations are subject to large variations depending energy usage (i.e. the amount of energy used to heat water within the home) and the energy savings of a given system.

In order to provide the most accurate measure of energy savings and thereby GHG emissions avoided as a result of participation in the Solar Colwood project, the utility bills for homes which have installed a SHW system should be collected prior to installation and monitored after the system is in place. Direct household level energy use measurements are not sensitive to the external influences that limit the accuracy of average (i.e.- community or provincial level data) such as variations in personal energy use behaviours due to lifestyle. The use of direct household data would allow for reporting of system specific energy savings and GHG emission reductions to potential participants within the community and direct comparison between systems. As the collection of utility bills is an easily repeatable method of baseline assessment for any future solar retrofit projects, this method also allows for comparison between projects as well as for the prediction of potential savings of future projects.

5.2 Monitoring

5.2.1 Social Diffusion

To determine a best method for measuring social diffusion of SHW systems, social indicators from Tables 5 and 6 were analysed from MECHanisms (2010). Social indicators from the City of Dawson Creek were also analysed, along with qualitative methods for measuring social diffusion, such as surveys and focus groups.

The information in Table 5 can be applied to measuring the social diffusion of SHW technology in the City of Colwood Solar Colwood project. The first goal, reaching a particular audience with the intended message, may be used to record the distribution of information pertaining to the City of Colwood Solar Colwood project. For example, to determine the number of people exposed to the SHW systems, the number of newspapers or fliers distributed may be used; whereas, the number of hits on a website may be used to determine the number of people interested in SHW systems (MECHanisms, n.d.). Error may be introduced in the collected data

as some of the website visits may not be intentional. Also, this method does not provide any information as to the extent of the readers' interest. For example, the reader may only glance at the title and not read further.

The second goal, changes in awareness, knowledge, attitudes, and internalized norms, may be used by the City of Colwood Solar Colwood project to determine changes in the mindset of the community changes, and how quickly this change occurs (MECHanisms, n.d.). This also determines the effectiveness of social diffusion methods of community outreach performed by the City of Colwood Solar Colwood project, as stated in the Results section of this report. Which of the three indicators used for measurement depends on the desired results of the observer, as the first is opinion-based and the other two are based on quantitative data collection.

Increased awareness and knowledge of SHW systems may make the consumer more confident in purchasing a new technology. In addition, increased knowledge of the technology due to adoption may make the homeowner more likely to share personal opinion and experience about SHW systems with peers (Valente, 1996). This can be measured through the use of pre-project and subsequent surveys monitoring the knowledge, awareness and attitude of SHW. By conducting a pre-project survey a baseline can be achieved allowing for comparisons to be made indicating the success of educational campaigns and advertisements. Pre-project sales statistics, marketing information, and interviews with salespersons can gauge changes in interest from the consumer and increased demand for SHW (MECHanisms, n.d.).

The third goal, changes in behaviour, can be estimated through self-reported behaviour. However, this method is subject to behaviour which may not be persistent. Changes in behaviour may increase the likelihood of adoption for technologies like SHW, or contribute to other utility savings from energy conservation due to increased awareness. Behavioural changes can be measured through surveys, self-reports, or energy diaries (MECHanisms, n.d.). These methods need to consider household behaviours and can be focused on hot water use such as dishwasher frequency, number of showers, or low flow shower heads in the home. The methods can also have a broader focus towards complete household energy efficiency such as the adoption of other green technologies like fluorescent light bulbs or turning off the lights when leaving a room.

Increased customer awareness of energy use can be caused by the customers desire to observe energy savings created by the installation of a SHW. The customer will be interested to find out

how much money the new SHW will save on the energy utility bills in order to determine if they feel it was a good investment for their home (Kelly & Kendy, Personal Communication, 2011). This can be measured by self-monitoring reported in a survey (MECHanisms, n.d.). Behaviours such as only using dishwashers or washing machines during peak sunlight hours could be considered as indicators when creating survey questions. For example, Liz Kelly has adopted SHW, including a monitoring system. She stated that this technology has made her more aware of energy consumption in her home. As a result, she has begun using appliances at the most efficient timing for usage (Kelly & Kendy, Personal Communication, 2011). To measure progress, surveys can also be conducted before and after the project to indicate changes taking place over time.

Another positive result correlated to solar projects includes reduced energy usage for the purpose of water heating. This is often due to increased awareness of hot water use once the SHW system is installed. Customers become more aware of their hot water use, in hope that the SHW system will be capable of fully supplying their hot water needs to reduce their utility bill.

Overall satisfaction with the project and perceived effectiveness is useful feedback in relation to social diffusion. When consumers are satisfied with the project results they are more likely to share information and encourage their peers to participate as well (Valente, 1996). This can be measured through customer surveys comparing their expectation and overall satisfaction towards the project, process, and outcomes.

Through observation of the T'Sou-ke First Nation, energy conservation behaviours are a positive result from introducing new green technology such as SHW systems (Moore, Personal Communication, 2011). The behavioural changes affecting utility consumption can be measured by comparison of energy or fuel consumption data before and after project completion for individual participating homeowners.

Social indicators are one of the best methods available for measuring social diffusion as this method provides quantifiable data. However, when using this method it is difficult to discern the exact cause of change within the indicator due to the complexity of social diffusion (Istvanffy, 2008). For example, if the City of Colwood Solar Colwood project measured the number of homeowners between the ages of 20 and 30 years who installed solar thermal water heating systems, the reason for a change in the values may be indiscernible. This barrier can be

overcome by using as many indicators as feasible to aid in the understanding of changes over time and to provide a more holistic view of the impacts of the new trend (Istvanffy, 2008). For example, the data for homeowners between the ages of 30 and 40 years could be compared to those between the ages of 20 and 30 years to try and determine the reason for the change.

Bias is another barrier to measuring social diffusion via surveys and focus groups. In a survey, bias can be introduced through the wording of the questions, the opinion or authority of the interviewer, and the specified responses chosen for the interviewee. For example, answers such as “all the time”, “some of the time” or “none of the time” may be chosen for the interviewee instead of allowing the interviewee to freely respond to the question.

In a focus group, bias can be introduced through the group setting, as one person’s opinion, attitude or belief could sway another’s. Bias can also be unknowingly introduced in these two types of measurement through the sample population which is interviewed. For example, a group of early adopters may be the only ones to respond to the survey, providing information that is only representative of that particular group. The time at which focus groups or surveys are conducted can also introduce bias, as opinions, attitudes and beliefs can change over time. (Ling, Personal Communication, 2011).

Liz Kelly and Emily Kendy’s conclusion on personal data collection is beneficial as it provides an advantage for obtaining feedback from the public for the City of Colwood Solar Colwood project as it suggests that any of the aforementioned methods could be used to measure social diffusion, but specific methods will appeal to different individuals or groups. Therefore, Solar Colwood would benefit from using different methods of feedback for the public to increase the probability of collecting more data.

5.2.2 Economic Benefits

The economic benefits of solar projects may be realized in a variety of ways. Obtaining a baseline of energy information that looks at individual homes and/or businesses and comparing them before and after installation can give an accurate value of the total energy savings, which can then be converted into actual cost savings using current energy prices. This technique is one of the most important and simplistic methods to measure the economic successes of a project such as Solar Colwood. The information obtained from baseline energy usage is accurate (if

taken on an individual home basis), and can be tracked into the past through older utility bills obtainable through the energy provider. Installation of monitoring equipment can also provide real-time data to the homeowner as well as any interested parties which can provide further incentives to reduce energy usage and subsequently save money.

There are, however some issues related to gathering this baseline information or installing monitoring equipment to obtain energy savings. If SHW systems are being installed on new homes rather than retrofits, past data will not be available to compare the energy savings obtained specifically from the install. In addition, while homes retrofitted with SHW systems may reduce their energy consumption, it is difficult to assume these reductions are based solely on the SHW system, and not due to additional changes home/business owners make. For example, installing monitoring equipment may cause increased awareness of energy use resulting in more sustainable practises (using less water, turning off un-needed electronics, etc).

Table 1 summarizes the case studies that have been researched for this report, and shows that none of the communities with similar solar projects have obtained accurate baseline information regarding past energy consumption. By not obtaining past data it becomes difficult to measure and portray the economic successes of the projects, which can in turn affect the number of interested homeowners who may be willing to invest into their own system.

A second method of measuring the economic successes of solar projects is by tracking the number of jobs created, in a project specific manner. Tracking the number of employees directly tied to a project can demonstrate how the local community may benefit from individual projects (CanSIA 2010). By using project specific job creation, the measured economic benefits will be more accurate, relative and more easily obtainable as project managers can simply inquire about the number of installers required for the project, duration of employment, etc. Alternatively, using a website, such as Stats Canada, would give a broad overview of expected growth in a sector such as renewable energy, which may account for a variety of different job titles unrelated to solar thermal.

As most installers hired for projects (such as those seen in the case studies and the projected companies for Solar Colwood) are expected to go through a training program specific to solar thermal systems, information could be obtained on the number of individuals who attend these programs. This could be easily tracked if certain standards or requirements were set, such as

standardized certification programs (which CanSIA is currently working on) (CanSIA, 2010). As it currently stands, there are a variety of different training programs located throughout the province of BC which may make it particularly difficult to follow.

While tracking job creation specifically tied to a certain project may be more easily attained, it is restricted to demonstrating only a small portion of the actual number of jobs created from SHW projects. Areas such as research, manufacturing and transportation are all components of SHW projects that provide economic stimulus in terms of job creation, but are more difficult to observe from a project specific standpoint (Gill & Goldwater, 2008).

Of all the case studies researched in this report, T'Sou-ke First Nations, BC, was found to be the only community that tracked the number of employees hired for their project (SolarBC, 2008). As the solar project was quite small in scale, the community easily tracked the number of trained individuals who were hired to install the panels/tanks as well as artistic pieces. By doing this, they have been able to report these tangible benefits that can then be portrayed to other communities and First Nations groups.

In terms of job creation, the Pembina Institute has also reported that investing in renewable technologies and efficient energy technology created substantially more jobs per $1 invested (Pembina Institute for Appropriate Development , 1997). This information demonstrates the emerging potential that renewable energies has on the job market, and continued investments in these industries could provide a number of new jobs that would otherwise not exist. By monitoring and tracking job creation in new solar projects, this statistic can be continually updated and may create further opportunity for investments in this sector.

Another benefit that can be measured from installation of solar systems on homes is the increased valuation of homes with solar compared to those without. A study from Lawrence Berkeley National Laboratory showed strong evidence towards homes with solar PV selling for a premium over those without, averaging at $5.50 USD per watt of capacity. In their study, the typical capacity for the solar PV system was 3100 watts, which equated to a price premium of about $17,000 USD. Although this value is representative of only solar PV systems and for a certain watt-range, it can be used as an example of how the benefits of SHW can be measured from a different standpoint than simply measuring energy savings. (Barringer, 2011)

A second study by the US Department of Energy showed that homes equipped with solar systems not only have increased valuation, but also sell faster too. The decreased lag time for selling homes with solar systems subsequently increases profits to the homeowner due to shorter sales cycles and reduction of inventory. The report also outlines that a home fitted with a solar system will increase in value by $20 for every $1 saved in annual utility bills. For an average annual reduction of $200 in utility bills, this equates to an increase of approximately $4000 in the value of the home. The report also conducted a survey which stated that 8 of every 10 Americans surveyed would be willing to pay up to 10% more for a home equipped with a solar system. (National Renewable Energy Laboratory (NREL), 2008). These types of studies provide statistics that are easily understood by the public, leading to increased awareness of the tangible benefits of investing in SHW systems.

These benefits could be realized immediately by the homeowner in terms of decreased energy bills, but also in the long term by adding valuation to their homes. The problem that arises with these values is the fluctuation of energy types and prices that occur throughout the world. In BC for example, the main energy source is derived from hydroelectric which is less polluting and less expensive to purchase (Table 3). This decrease in energy cost equates to decreased valuation of the system if we consider the energy savings to the increased home value relationship mentioned earlier.

5.3 Reporting to Various Audiences

When considering reporting methods with respect to the Solar Colwood project, it is important to recognize that the goal of the project is to install solar hot water systems on homes within the Colwood area. In order to achieve this goal, homeowners must ultimately be convinced to participate in the program. The goal of reporting then becomes not only to inform the public, but to link the project with the values of Colwood homeowners in order to illicit participation; in this case the reporting methods used will also acts as marketing tools.

As previously stated in Section 4.5, the methods used by several solar and clean energy projects were examined in order to determine existing best practices in terms of reporting to the public, academic and government audiences. It was found that the key to reporting is to identify and understand who the target group is, their knowledge level, their interests and motivations regarding energy usage behaviours, and clean energy projects in particular (MECHanisms, n.d.)

This information can then be used to inform the design, content and media used in the reporting efforts of the case studies examined. In this section, the results of research into reporting methods will be organized by the intended audience: the general public, academia and government audiences.

General Public

Dawson Creek, Drake Landing, Project Porchlight and SolarBC all maintain a web-based presence for their clean energy projects; each of these has various links to audience specific information. Both Project Porchlight and SolarBC provide a searchable Google map of the installations associated with their project (Section 4.5). These interactive maps are particularly effective as reporting tools by allowing visitors to direct their own experience on the website to only the information that they feel is relevant; effectively visitors can chose which message they want to hear from the website. For example, if a website visitor is interested in the types of solar hot water systems that were installed in their geographic area as part of the SolarBC project, information on the type of system and the name of the installer is available. In some cases personal testimonials can even be accessed via the searchable map (SolarBC, 2008). This searchable map encourages a level of self-regulation between members of the community, which will translate into higher levels of participation as homeowners attempt to match the behaviour of the earlier adopters or community leaders within the community who have installed SHW systems (i.e. "Keeping up with the Jones'").

The "Solar Champions" section of the SolarBC website provides a forum for homeowners that have installed a SHW system, as part of the SolarBC project, to share their experiences. This section is a particularly effective method of reporting to the general public as it allows potential participants to relate directly with a real person who has had a positive experience, not only with the SolarBC project, but with the installation and operation of their SHW system as well. Presenting these personal testimonies serves as a form of the "word of mouth" advertising of the past, but on a much larger scale (i.e. all internet users have access to the site) and through a different medium. This method of reporting encourages visitors to identify with the project by identifying with their neighbours and other homeowners who are participating in the project.

Another trend demonstrated in the examination of the case study websites is the use of social media to inform and connect visitors to their sites (Section 4.5). Social media has proven to be a

useful mechanism for building networks among target audiences. The size and the demographics of the user base of social media applications such as Facebook and Twitter is constantly growing; 49% of the 16, 636, 880 Canadian Facebook users are over 30 years of age (Facebook, 2011) and 57% of the 106 million Twitter users worldwide are between 26 and 44 years of age (Hepburn A. , 2010). Given that the median age of Colwood residents is 38.7 years (StatsCan, 2010), the 26 - 44 age group likely represents existing homeowners and those individuals that are looking to get into the housing market in Colwood. These results indicate that the target audience for the Solar Colwood project, being potential participants in the project, can be directly engaged through the use of social media applications.

The use of social media applications as a reporting tool holds several advantages over more traditional methods. Firstly, social media applications are highly cost effective compared to direct mail-outs or traditional newsletters. The information presented on a social media page or post can easily be maintained and updated by one person electronically with none of the associated printing and postage costs of traditional methods. This low cost facilitates the creation and operation of a number of pages or online profiles, the content of each targeted towards the interests and knowledge level of a specific audience (i.e. one page could be directed to youth within the Colwood area with information on ways that they can participate in the Solar Colwood project). Secondly, social media offers a more dynamic and interactive experience for the user and allows for more timely feedback on its design or content. Public interest may be tracked on Facebook through “likes” and page visits, which allows for the determination of interest level and the effectiveness of messages (Focus.com, 2010). The Twitter application can be optimized for the marketing purposes including techniques for maximizing the impact and exposure of your message; real time tracking of the number of users, users of associated links within your profile, and followers of your profile; user impressions of your message, the number of times another users profile “retweets” one of your posts (Twitter, 2011).

Thirdly, the use of social media can be used to build a community by connecting members of one community with other like-minded groups through links to the websites and/or reposting interesting or relevant information presented by another group (i.e. “retweeting”). Through this practice, the Solar Colwood project could potentially connect to a larger, worldwide community by linking with the followers of the original post. Twitter posts can be used to link other media from the same user (i.e. websites, Facebook pages, etc.) and are searchable through internet

search engines (i.e. Google, etc.). For example, an internet search for “solar community” may bring up all of the Solar Colwood project communication tools including the website, Twitter and Facebook pages. Finally, users of social media applications can receive updates and information directly on their mobile devices, which provides a higher level of engagement than an e-mail newsletter containing the same information and also serves to keep the project fresh in the minds of the target audience.

The use of social media provides constant contact with existing and potential participants in the project and providing specifically tailored messages to the public creates awareness of the project, informs the public, measures and can provide feedback on whether the intended message is reaching the intended audience. It can also help determine how many people like the project, and how many homeowners can sufficiently identify with the values of the project, causing them to take action. For these reasons, it is clear that social media can be used to effectively market and report the progress of the Solar Colwood project to the general public. (Clow & Baack, 2007).

Government and Academic Audiences

As discussed above, the methods of reporting to different audiences depends on their interests, motivations and knowledge level. When reporting to academic and government audiences it is important to understand that overall goals of making them aware of the project and informing them about the project are shared with reporting to public audiences (Clow & Baack, 2007); the difference being the language and media used to accomplish those goals. To be effective, reporting to these groups requires information that can be identified as either helpful for the development of a similar project or as supporting evidence for the arguments presented in an academic paper.

The goals of reporting to academic and government audiences are to clearly detail the methods used and demonstrate repeatable, quantitative findings for the performance of all aspects of the project. For example, in the SolarBC annual report, the energy use baseline assessment is presented including the methods used, assumptions and limitations of the model used. Predictions of pay-back period, energy saved and GHG emissions avoided are also presented (SolarBC, 2009).

Greenhouse gas reductions and energy savings were also presented in the baseline assessment of the Dawson Creek municipal building retrofit project. Again, this paper includes a discussion of the limitations to the accuracy of the assessment process.

Simply put, as with public audiences, the key to reporting to government and academic audiences is to understand their interests and knowledge level. As demonstrated in the annual reports presented in the case studies, tailoring the format and content of a summary report to include all of the aspects of a well written scientific report including an introduction to the project scope and goals, clearly defined methodology and comprehensive materials section, the unbiased reporting of the results of your project and discussion section that explains the meaning of the findings. A properly formatted scientific report represents current best practise in regards to reporting to academic and government audiences.

6.0 Recommendations

6.1 Baseline Assessment

Based on the research and baseline assessment completed for the City of Colwood Solar Colwood project, it is recommended that the following information be collected from homeowners during the application process:

- General Information
    - Family Name, Street Address including postal code
- Household Information
    - Number of occupants, age of home, slope and aspect of roof, type of hot water system currently present in the home (i.e. electric, natural gas or home heating oil)

Homeowners could also be asked to disclose the utility bills from their home for the applicable energy source used to generate hot water within the home for one year prior to the installation of a solar hot water system. They could also be asked to provide their utility bill for that same utility for the remaining duration of the project after installation of a SHW system.

Collection of the above information will allow for accurate monitoring of changes in energy usage and GHG at a household level, rather than a community level, as was completed for this

report. This data will also allow for simple determination of the efficiency of the SHW system, as well as allow for an accurate determination of the SHW system payback period.

6.2 Monitoring

6.2.1 Social Diffusion

Based on the research for success criteria and indicators of social diffusion by the MECHanisms report the following criteria are recommended for assessment to determine the success of social diffusion of the Solar Colwood project:

- Measure the size of audience reached by recording the number of newspapers bought or taken from dispensers, attendees to open project meetings or visits to project website. This may be a basic or imprecise number depending on the observer's intent, but can approximately gauge interest in the project or spread of the message.
- Measure changes in awareness, attitudes, satisfaction and internalized norms by using a survey for people to self-report before and after project completion, but be aware of the bias that can be introduced through this type of measurement, as mentioned previously.
- Measure the reduction of energy consumption as a positive spin off from the project, as energy-reduction behaviour is a positive spin-off of adopting a green technology.

For the City of Colwood, Solar Colwood project, it is recommended that indicators be developed which relate specifically to SHW technology and that these indicators are selected based on the criteria outlined by the City of Dawson Creek. Since the desired outcome of the City of Colwood, Solar Colwood project is to provide verifiable reporting on the aspects of the project (Cullington, 2010, pp. 8-9), social indicators should be used as the main method of measuring the social diffusion of solar thermal water heating technology as it provides quantitative data. As it may be difficult to determine the exact cause of change within indicators using this method, this type of measurement may be used in coordination with a qualitative method, such as a survey or focus group, to aid in determining the cause of change within indicator.

It is also recommended that the method used to collect personal data from the public on opinions, experience, etc. not be uniform but collected through a broad range of methods, such as personal interviews, focus groups, etc. to increase the probability of obtaining more data from more of the public. Lastly it is recommended that the best methods for each group be identified.

6.2.2 Economic Benefits

The economic benefits of the Solar Colwood project may be effectively monitored by incorporating some of the ideas discussed throughout this report. These include: gathering baseline information of utility bills and using them to compare pre and post installation; creating a baseline of companies hired on for the Solar Colwood project and tracking job creation over the life of the project; following solar installation training programs to determine trends of overall interest in the trade; and obtaining information prior to installation regarding approximate home valuation to compare with over the life of the project.

Most of the data gathering required to measure these economic benefits is actually quite simple (such as past energy use from utility provider), and could provide many long-term benefits to home and business owners alike. By gathering the baseline of information regarding the aforementioned ideas and following them over time, Solar Colwood can become a leader in practise, setting new trends and making the data available for subsequent projects of a similar nature.

6.3 Reporting to Various Audiences

It is recommended that the Solar Colwood project use social media (i.e. Facebook and Twitter) to reach target audiences within the City of Colwood. Social media has been shown to be a useful tool to connect and inform visitors to the sites and building networks among target audiences, as indicated though previous clean energy projects. Social media applications are not only inexpensive, but easy to use and an effective method for reaching various target audiences. It also allows for a simple determination of how effective the Solar Colwood project has been at reaching individuals; a measure of the progress of the project.

With regards to reporting to academic and government audiences, the tone and language of any report will need to be written to the audience's level of understanding. It is recommended that the Solar Colwood website provide a link to the Baseline Assessment for energy usage and GHGs emission, as well as links to any annual reports.

7.0 Acknowledgements

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9.0 Appendices

Appendix 9.1

Baseline Assessment Research

Source	Andrew Moore	**Date Reviewed**	Feb. 22, 2011
Subject	T'Sou-ke First Nations Solar Project Visit		
Reference/URL	Andrew Moore (2011) Personal Communication.		
Findings			

- "Saving energy is cheaper than investing in new technology"
- Community Engagement: challenging the children of the community has driven a new attitude towards energy consumption within the community

- Measuring energy savings is accomplished through the comparison of hydro bills before installation and after installation
- A Master's student from UVIC Jessica is working on creating a baseline methodology for similar projects; he will provide her information

Conservation
- Energy Savings Kits from BC Hydro: light bulbs, low-flow shower heads, window treatments etc.
- Energy Conservation: increasing insulation, changing appliances

Social Marketing
- In his experience it has been important to engage the children in order to influence the behaviour of the parents
- Investing in the solar panels (PV) is costly and the payback period is long but it has functioned to get the community thinking about solar power and energy conservation in general

Energy Audits
- During or after a home energy audit, homeowners will receive a list of applicable grants and incentives that apply to their homes
- By combining ESK/ECAP and SHW, homeowners can save nearly 40% on their hydro bills

Off-grid Demonstration
- The goal of their project was to demonstrate that First Nations communities can achieve self-sufficiency in terms of economic activity, food production, energy generation while maintaining cultural integrity
- They are using a Xantrex battery back-up(inverter/charger)

Source	BC Hydro	**Date Reviewed**	May 17, 2011
Subject	Electricity Generation; Mar. 25, 2010		
Reference/URL	www.bchydro.com/about/our_system/generation/electric_generation.html;		
Findings	www.bchydro.com/about/our_system/generation/our_facilities.html (Mar. 26, 2010)		

Hydro power is generated by the conversion of the potential energy stored in water as it falls through a penstock in a dam to produce mechanical energy, which is used to turn a turbine. The rotation of the turbine converts the kinetic energy of the moving water into electric energy. In order for this energy to be moved through the grid system to the end user its voltage is increased using a step-up transformer. The electricity then travels to a distribution substation where its voltage is reduced to a level that can be used by the end consumers.

BC hydro generates over 43,000 gigawatt hours of electricity on an annual basis; supplies 1.6 million customers through an interconnected grid system of 73,000 Km of transmission and distribution lines.

BC Hydro is the supplier of electrical energy for the area; energy is generated by 30 integrated hydroelectric stations, two gas-filled thermal power plants and a combustion turbine power station. (Our facilities)

Source	BC Hydro	**Date Reviewed**	May 3, 2011
Subject	Residential Electricity Rates		
Reference/ URL	http://www.bchydro.com/etc/medialib/internet/documents/appcontent/your_account/na_rates_compare.Par.0001.File.na_rates_compare.pdf		
Findings			

Rates for electricity depend on the amount used:

- Users of 625kWh: $0.072/kWh
- 750 kWh: $0.07348/kWh
- 1000 kWh: $0.07793/kWh

Based on monthly bills as of April 1, 2010

Source	Best practices and Better Protocols, BC Ministry of Environment	**Date Reviewed**	April 12, 2011
Subject	Energy Use and GHG Emissions Baseline		
Reference/URL	http://www.env.gov.bc.ca/cas/pdfs/ceei-inven-best-pract.pdf		
Findings			

This paper was written in preparation of creating the CEEI, in 2007, by Holland Barrs Planning Group

- Hyla Environmental Services produced software to create an inventory of energy usage on a community level, with further development;
- Clinton Climate Initiative inventory software could be used with modification;
- Since corporate emission are a subset of community emissions, consider how data collection and management can facilitate the development of the inventory process

Source	Bob Davidson	**Date Reviewed**	April 28, 2011
Subject	Fortis BC Gas Consumption Data for Colwood		
Reference/URL	1-604-312-0166		
Findings			

Bob stated that he had the 2008 breakdown for commercial and residential gas consumption for Colwood, as well as the number of connections for each. The number of residences includes all residence types (i.e. Single family dwelling, apartment buildings, condos and farms).

Source	Drake Landing Okotoks AB	**Date Reviewed**	May 3, 2011
Subject	Monitoring system		
Reference/URL	http://www.dlsc.ca/how.htm		
Findings			

Drake Landing is a solar community located in Okotoks, AB. It is heated by a district heating system which stores solar energy underground during the warmer summer months. It is later distributed to homes for space heating needs during the summer months. This system can meet 90% of each home within the communities heating requirements, giving the community less dependency on fossil fuels for space heating (Drake Landing Solar Community, n.d.).

The solar collection system for the district heating system utilized in Drake Landing consists of 800 flat plate glazed collectors with dimensions of 4.24 cm x 1.18 m. These panels contain 50% propylene glycol antifreeze and are mounted on the roofs of garages. There are mounted on four rows of garages, with two rows of solar collectors per garage (Drake Landing Solar Community, n.d.).

Each home also has two self regulated solar panels (a solar thermal hot water system) which supplies up to 60% of the homes domestic hot water usage annually. Hot water demands are supplemented by traditional hot water heating systems utilizing natural gas (Government of Canada, n.d.).

Each of the 52 homes has an individual solar thermal hot water system that supplies 60% of the energy requirements for the homes hot water usage. In designing the community, the homes were oriented to ensure optimum solar collection. The systems use a glycol solution that flows from the panels to a heat exchanger, which in turn heats the water. In addition to the solar thermal hot water systems, the homes in Drake Landing also utilize higher efficiency power vent, natural gas hot water heaters, as well as low water consumption devices. It is estimated that the 52 homes in Drake Landing will use 65 to 70% less natural gas for hot water heating. (Drake Landing Solar

Community, n.d.).

There is an application on Drake Landing Solar Community website that allows visitors to the website to see the current conditions of the community, including outdoor temperature, incident solar, solar energy collected, solar fraction and space heating load, however this information only applies to the district heating system, not the solar thermal hot water systems. (Drake Landing Solar Community, 2011).

The majority of the Drake Landing project is focused on the district heating system, and specifics of what types of information is being monitored on the solar thermal hot water systems was not available. Aspects of their monitoring system for the district heating system may be applicable to monitoring the solar thermal hot water systems installed in the City of Colwood.

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Source	Fortis BC	**Date Reviewed**	May 17, 2011
Subject	Natural Gas Supply and Rates on Vancouver Island		
Reference/URL	http://www.fortisbc.com/NaturalGas/AboutNaturalGas/SupplyStorage/Pages/default.aspx http://www.fortisbc.com/About/RegulatoryAffairs/GasUtility/NatGasTariffs/Documents/Tariffs_termsandconditions_FEVI.pdf		
Findings			

Natural gas is collected from within the Earth's crust where it is formed through the natural decay of plant and animal matter. Collection of the gas occurs through a well, which is simply a hole drilled through the confining rock layer into the reservoir, which contains the pressurized gas. Impurities such as water, hydrogen sulphide and carbon dioxide are removed from the gas before the gas is shipped via transmission (pipelines) to the distribution company to be passed on to consumers.

Rates(effective October 1, 2010):

Basic monthly charge: $10.50

Per GJ: $14.325

Source	Intergovernmental Panel of Climate Change	**Date Reviewed**	May 17, 2011
Subject	Use of Surrogate Data		
Reference/URL	IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.		
Findings			

2006 IPCC Guidelines for
National Greenhouse Gas Inventories

Volume 1, General Guidance and Reporting Chapter 2, p7

IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National

Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds).

PubWhile it is preferable to use lished: IGES, Japan.

Obivously it is preferable to use direct energy use measurements when quantifying emissions related to hot water heating using conventional energy generation methods (i.e.- hydro power or natural gas). However, a lack of specific household level data requires the use of surrogate data, in this case community level data.

IPCC recommends the following steps as good practice for the use of surrogate data:

1. confirm and document the physical relationship between the emissions and the surrogate data
2. confirm and document a significantly correlation between the emissions and the surrogate activity data

   In the case of the Solar Colwood baseline, the surrogate for individual home energy use will be the community level average data as given by NRCan.

The disadvantage in using this information is two-fold: firstly, average data does not effectively represent the differences in hot water and therefore energy use based on lifestyle and demographic differences on individual households; and secondly, a baseline created using this community level data is sensitive to an increase in population and so the energy savings and GHG emissions avoided as a direct effect of the installation of solar thermal hot water systems will be difficult to assess.

Source	Marlene Lagoa	**Date Reviewed**	February 3, 2011
Subject	Township of Esquimalt Solar Hot Water Installation		
Reference/URL	250-414-7114		
Findings	marlene.lagoa@esquimalt.ca		

Baseline assessment

Township of Esquimalt installed a Globe Solar Energy IP-195 Solar Collector on their municipal building. This system includes the solar collectors and a water tank on the roof.

No formal baseline assessment was completed prior to installation of the system.

Source	Pembina Institute Report	**Date Reviewed**	Feb. 11,2011
Subject	Dawson Creek Solar Hot Water Installation		
Reference/URL	Pembina Institute Report		
Findings			

Notes on Dawson Creek Baseline

- Assessment of energy use patterns and options (hydro vs. gas) in order to identify potential future risks and areas for improvement

- Data sources similar to those that we've identified: BC Hydro, natural gas supplier (Terasen)
- Identified that multi-use buildings reduced accuracy of consumption, this situation will be similar to identifying only hot water heating energy savings
- GHG gas emissions were calculated as we planned: determine an average carbon dioxide equivalent for each unit of energy consumed- Canada's Greenhouse Gas Inventory (2002)
- Recognized but did not measure the benefits of being seen to be green by installing a solar hot water retrofit on City Hall, while it doesn't currently save money, its worth it.
- Provide specific reductions based on model of water system used (p. 24):
    - Natural Gas Savings (GJ/year) = 20.8 GJ / year
    - Natural Gas Savings ($/year) = $185 / year – based on current prices of $8.886 / GJ
    - Greenhouse Gas Emissions Reductions = 1.1 tonnes CO2e / year

Source	Pembina Institute	**Date Reviewed**	May 17, 2011
Subject	Energy Efficiency and Renewable Energy Improvements for New Homes in Dawson Creek		
Reference/URL			
Findings			

Version 3 – June 2007

Several energy efficiency improvements and solar hot water heating systems that have potential use in Dawson Creek were analyzed to determine their effectiveness for the community (Machado & Horne, 2007). It was found that energy efficiency improvements provide greater opportunities for economic return and environmental benefit than solar hot water systems (Machado & Horne, 2007). In the best case scenario, solar hot water heating systems continue to have a slightly negative economic return (Machado & Horne, 2007). Both options do still provide environmental benefits as well as protection to home owners from the fluctuation of energy costs (Machado & Horne, 2007).

Source	Pembina Institute	**Date Reviewed**	May 17, 2011
Subject	Energy Efficiency and Renewable Energy Improvements for New Homes in Dawson Creek		
Reference/URL	Report Obtained from the City of Dawson Creek		
Findings			

Version 3 – June 2007

Several energy efficiency improvements and solar hot water heating systems that have potential use in Dawson Creek were analyzed to determine their effectiveness for the community (Machado & Horne, 2007). It was found that energy efficiency improvements provide greater opportunities for economic return and environmental benefit than solar hot water systems (Machado & Horne, 2007). In the best case scenario, solar hot water heating systems continue to have a slightly negative economic return (Machado & Horne, 2007). Both options do still provide environmental benefits as well as protection to home owners from the fluctuation of energy costs (Machado & Horne, 2007).

Source	Pembina Institute	**Date Reviewed**	May 17, 2011
Subject	Baseline Assessment for Dawson Creek		
Reference/URL	PDF Report Supplied by the City of Dawson Creek BC		
Findings			

Municipal Operations Energy Baseline Report – August 2005

An Energy Baseline Report was completed for the Municipal Operations of Dawson Creek in 2005 by the Pembina Institute (Horne & Cobb, 2005). The scope of the report was limited to the municipal operations in Dawson Creek and looked to determine the current and future energy consumption patterns to allow for an assessment of different energy options (Horne & Cobb, 2005). Dawson Creek has plans to develop and implement a community energy plan, and this was the first step in doing so (Horne & Cobb, 2005).

The operations assessed included buildings, other infrastructure and non-stationary applications such as transportation and mobile equipment (Horne & Cobb, 2005). The energy sources were identified for each of the municipal operations (electricity, natural gas, gasoline or diesel) and data was collected from the applicable sources (Horne & Cobb, 2005). Electricity information was obtained from BC Hydro, natural gas from Pacific Northern Gas (PNG) and gasoline and diesel was obtained from Dawson Co-operative Union (Horne & Cobb, 2005). As all energy requirements are billed to the City of Dawson Creek, access to the electricity information was obtained online and through bill statements, and cost data from the City was used when assessing the information from PNG (Horne & Cobb, 2005). The Co-op provided combined purchases and costs for gasoline and diesel consumption based on bulk purchases (Horne & Cobb, 2005). This was supplemented with mileage records provided by the City (Horne & Cobb, 2005).

The greenhouse gas emission (GHG) associated with the consumption of the above mentioned energy sources were calculated using 2002 emissions intensity factors and

all consumption data was converted to MWh (Horne & Cobb, 2005). Energy costs for all of the various municipal operations were also determined for each energy source (Horne & Cobb, 2005).

Based on the information gathered during the baseline assessment, seven investigations and opportunities were made for the town (Horne & Cobb, 2005). Of these seven, there is one that relates to the Solar Colwood Project; City Hall Solar Hot Water Heating (Horne & Cobb, 2005).

Installation of a Solar Hot Water system was recommended for City Hall as part of a demonstration project to demonstrate the City's commitment to clean energy (Horne & Cobb, 2005). A quote for the installation on City Hall was prepared by Taylor Munro Solar Water Systems, and it was found that there was a negative net present value (Horne & Cobb, 2005). This indicates that the installation of a solar hot water system on City Hall offers no cost savings compared to the use of natural gas heating systems, based on 2005 market conditions (Horne & Cobb, 2005). Despite this information, the installation was still recommended based on the significant demonstration value for the community, as well as commercial and residential developers (Horne & Cobb, 2005). The expected financial loss is also expected to be quite low (Horne & Cobb, 2005).

The Baseline Assessment completed for the municipal buildings in Dawson Creek does not directly apply to the Solar Colwood project as the installation of solar thermal hot water systems will be completed on residential homes. However there are several methodologies that were adapted to suit the Solar Colwood Project.

Electricity consumption was obtained from BC Hydro for the City of Colwood at a community level and categorized into housing type. Natural gas consumption was obtained at the community level, and was not categorized into housing type. Emission's intensity factors (CO_2 equivalents) were applied to the electricity and gas data to determine the GHG emissions for the community from each source.

Similar to the installation of the Solar thermal Hot Water system on City Hall, the City of Colwood is planning to install both a solar thermal hot water system and solar photovoltaic panels on the roof of the Fire Hall. This is to be a demonstration project for

the Community.

Works Cited

Horne, M., & Cobb, P. (2005). *City of Dawson Creek Community Energy Planning - Municipal Operations Energy Baseline Report.* Vancouver: The Pembina Institute.

Source	Solar BC	**Date Reviewed**	July 5, 2011
Subject	SolarBC Residential Program Remote Monitoring		
Reference/URL	Report Provided by Liz Kelly from Eaga, SolarBC		
Findings			

The monitoring systems installed by SolarBC look at obtaining the following information:

- Solar irradiation
- Ambient temperature
- Hot water consumption
- Net amount of energy used for hot water
- Net solar thermal contribution
- Inlet water flow
- Inlet water temperature
- Solar tank temperature
- Outlet solar water flow
- Collector temperature

Energy Alternatives were contracted to design, supply and install the monitoring systems as well as look after the remote collection of the performance data of the systems. The design of the systems is to be universal, as to account for the various models of solar thermal hot water systems installed across BC. This will allow for the collected data to be compared directly.

Source	Statistics Canada	**Date Reviewed**	May 3, 2011
Subject	Colwood Community Profile		
Reference/URL	www.statcan.gc.ca: 2006 Community Profiles		
Findings			

- 5501 private dwellings occupied by usual residents
- 38.7 years median age of population
- 56.8% (of 5500) dwellings are single-detached houses
- 3,855 dwellings were built before to 1986
- 1,645 dwellings were built between 1986 to 2006
- Average rooms per home: 7.4
- Number of 2.9 persons per family (all census families)
- 3.1 persons per married couple family
- Average household size 2.7 persons

Select data categories for this product

Geography [Geographic index]

Colwood, CY

Structural type of dwelling (10)

Total - Structural type of dwelling

Housing tenure (4)

Total - Housing tenure

Submit

Colwood, CY

Period of construction (11)	Condition of dwelling (4)			
	Total - Condition of dwelling	Regular maintenance only	Minor repairs	Major repairs
Total - Period of construction	5,500	3,820	1,420	260
1920 or before	30	15	20	0
1921 to 1945	150	75	30	40
1946 to 1960	500	310	160	30
1961 to 1970	880	510	305	60
1971 to 1980	1,500	930	500	70
1981 to 1985	795	550	220	30
1986 to 1990	670	560	95	15
1991 to 1995	315	240	65	10
1996 to 2000	160	155	10	0
2001 to 2006 [1]	490	480	10	0

Note(s) :

1. **2001 to 2006**
   Includes data up to May 16, 2006.

Data quality note(s)

- Data quality index showing, for the short census questionnaire (100% data), a global non response rate higher than or equal to 5% but lower than 10%.
- Data quality index showing, for the long census questionnaire (20% sample data), a global non response rate higher than or equal to 5% but lower than 10%.

Source: Statistics Canada, 2006 Census of Population, Statistics Canada catalogue no. 97-554-XCB2006023 (Colwood, CY Code5917041)

Geography [Geographic index]

Colwood, CY

Structural type of dwelling (10)

Single-detached house

Housing tenure (4)

Total - Housing tenure

Submit

Colwood, CY

Period of construction (11)	Condition of dwelling (4)			
	Total - Condition of dwelling	Regular maintenance only	Minor repairs	Major repairs
Total - Period of construction	3,120	2,230	740	155
1920 or before	10	0	0	0
1921 to 1945	80	45	10	30
1946 to 1960	250	160	75	10
1961 to 1970	605	400	175	30
1971 to 1980	795	520	235	35
1981 to 1985	475	340	120	15
1986 to 1990	485	400	75	15
1991 to 1995	150	100	45	10
1996 to 2000	30	30	0	0
2001 to 2006 [1]	240	240	0	0

Source	Travis Streb	**Date Reviewed**	April 28, 2011
Subject	BC Hydro Electricity Consumption Data for Colwood		
Reference/URL	1-604-453-6225 (Office)		
Findings			

Travis stated that he would forward us the 2009 electricity consumption data for the City of Colwood. It is separated into housing type (i.e. Apartment, single family dwelling, farm etc). He didn't think that we would see much of a change in electricity consumption before and after the installations; he thought that there would likely be a larger difference in the natural gas consumption. He stated that once we have done our analysis, if we would like for him to look over the information, he is more than willing to. He also stated that if we have any questions regarding the data in the spreadsheet to give him a call.

April 29/11

Upon receipt of the information, it was noted that there are two categories for each residence type; Single Family Dwelling (Electric) and Single Family Dwelling (Non-electric). I phone Travis to get clarification about what this means and if the non-electric would include natural gas and home heating oil. Also, we are wondering what types of residences are included in Residential other. We also need to determine how many homes are connected to electricity (number of connections).

We are going to use electricity consumption data for the single family dwellings, as these residences would be eligible for the Solar Colwood installations; Row houses and apartments would not.

Source	TRNSYS	**Date Reviewed**	April 12
Subject	Use for RRU Solar Colwood Project		
Reference/URL	http://www.trnsys.com/about.htm		
Findings			

Liz Kelley from SolarBC mentioned the TRNSYS program in her presentation and said that it may be a useful tool. It is not community or neighbourhood specific, but rather Canada wide. We thought that perhaps it could be used to compare the Canada wide energy usage to that of Colwood, but were not sure if the information would be collected from the same sources or if the information would be relevant. The website lists training programs that are over $1000 to attend. It was decided that the TRNSYS program would not be used for this reason.

Source	SHW Spreadsheet	**Date Reviewed**	May 10, 2011
Subject	Impact of SHW Pilot Program		
Reference/URL	Liz Kelly, Solar BC Information		
Findings			

- p. 1: Estimate of Household Energy Use for HW production (2007/ Reference?):
    - NRCan Estimate: 26.5 GJ or 7367 kWh
    - Terasen Gas Estimate: 36/10008
    - BC Hydro Estimate: 21/5838
- Conversion Factors used:
    - 278 kWh → 1 GJ
    - 1 kWh → 0.0036 GJ
- SHW Savings 55% of energy
    - Where does this number come from?
- BC Residential Energy End Use 2004 Breakdown:
    - Water Heating, 30%

http://www.oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tablestrends2/res_bc_1_e_4.cfm?attr=0

Figure X

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Residential Sector

Historical Database – August 2010

British Columbia[1]

Table 1: Secondary Energy Use and GHG Emissions by Energy Source

	2004	2005	2006	2007	2008
Total Energy Use (PJ)	**145.3**	**152.9**	**155.9**	**152.6**	**156.0**
Energy Use by Energy Source (PJ)					
Electricity	63.1	63.4	63.8	60.9	63.7
Natural Gas	72.6	79.1	81.5	80.2	80.2
Heating Oil	1.2	0.9	0.9	1.0	0.9
Other[2]	1.0	1.4	1.1	1.1	1.2
Wood	7.4	8.1	8.6	9.6	10.0
Shares (%)					
Electricity	43.4	41.5	40.9	39.9	40.8
Natural Gas	49.9	51.7	52.3	52.5	51.4
Heating Oil	0.9	0.6	0.6	0.6	0.6
Other[2]	0.7	0.9	0.7	0.7	0.8
Wood	5.1	5.3	5.5	6.3	6.4
Activity					
Total Floor Space (million m^2)	223.8	233.3	244.1	255.3	260.3
Total Households (thousands)	1,642.6	1,675.9	1,675.7	1,741.0	1,742.7
Activity					
Total Floor Space (million m^2)	223.8	233.3	244.1	255.3	260.3
Total Households (thousands)	1,642.6	1,675.9	1,675.7	1,741.0	1,742.7
Energy Intensity (GJ/m^2)	**0.65**	**0.66**	**0.64**	**0.60**	**0.60**
Energy Intensity (GJ/household)	**88.5**	**91.2**	**93.0**	**87.7**	**89.5**
Total GHG Emissions Excluding Electricity (Mt of CO_2e)	**3.9**	**4.3**	**4.4**	**4.3**	**4.3**
GHG Emissions by Energy Source (Mt of CO_2e)					
Electricity	–	–	–	–	–
Natural Gas	3.6	3.9	4.1	4.0	4.0
Heating Oil	0.1	0.1	0.1	0.1	0.1
Other[2]	0.1	0.1	0.1	0.1	0.1
Wood	0.1	0.2	0.2	0.2	0.2
Shares (%)					
Electricity	–	–	–	–	–
Natural Gas	92.4	92.3	92.9	92.5	92.2
Heating Oil	2.2	1.5	1.4	1.6	1.5
Other[1]	1.6	2.3	1.6	1.5	1.7
Wood	3.8	3.8	4.0	4.5	4.7
GHG Intensity (tonne/TJ)	**26.9**	**27.8**	**28.0**	**28.4**	**27.7**
Heating Degree-Day Index	**0.84**	**0.89**	**0.90**	**0.96**	**1.00**
Cooling Degree-Day Index	**3.54**	**1.61**	**1.65**	**1.39**	**1.59**

Data used for comparison of Colwood energy use data (BC Hydro+Fortis BC)
Data used for Solar BC project

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Residential Sector

Historical Database – August 2010

British Columbia[1]

Table 2: Secondary Energy Use and GHG Emissions by End-Use

	2004	2005	2006	2007	2008
Total Energy Use (PJ)	**145.3**	**152.9**	**155.9**	**152.6**	**156.0**
Energy Use by End-Use (PJ)					
Space Heating	72.7	79.9	83.7	84.7	88.2
Water Heating	35.0	36.5	36.4	34.7	33.7
Appliances	26.5	26.2	25.6	24.0	24.6
Lighting	9.9	9.7	9.4	8.7	8.8
Space Cooling	1.2	0.7	0.7	0.5	0.7
Shares (%)					
Space Heating	50.0	52.2	53.7	55.5	56.5
Water Heating	24.1	23.9	23.4	22.7	21.6
Appliances	18.3	17.1	16.4	15.7	15.7
Lighting	6.8	6.3	6.0	5.7	5.7
Space Cooling	0.8	0.5	0.5	0.3	0.5
Activity					
Total Floor Space (million m^2)	223.8	233.3	244.1	255.3	260.3
Total Households (thousands)	1,642.6	1,675.9	1,675.7	1,741.0	1,742.7
Energy Intensity (GJ/m^2)	**0.65**	**0.66**	**0.64**	**0.60**	**0.60**
Energy Intensity (GJ/household)	**88.5**	**91.2**	**93.0**	**87.7**	**89.5**
Total GHG Emissions Excluding Electricity (Mt of CO_2e)	**3.9**	**4.3**	**4.4**	**4.3**	**4.3**
GHG Emissions by End-Use (Mt of CO_2e)					
Space Heating	2.4	2.7	2.8	2.8	2.9
Water Heating	1.4	1.5	1.5	1.5	1.4
Appliances	0.0	0.0	0.0	0.0	0.0
Lighting	0.0	0.0	0.0	0.0	0.0
Space Cooling	0.0	0.0	0.0	0.0	0.0
Shares (%)					
Space Heating	62.3	63.3	64.2	65.2	66.4
Water Heating	36.6	35.6	34.7	33.7	32.5
Appliances	1.1	1.1	1.1	1.1	1.1
Lighting	0.0	0.0	0.0	0.0	0.0
Space Cooling	0.0	0.0	0.0	0.0	0.0
GHG Intensity (tonne/TJ)	**26.9**	**27.8**	**28.0**	**28.4**	**27.7**
Heating Degree-Day Index	**0.84**	**0.89**	**0.90**	**0.96**	**1.00**
Cooling Degree-Day Index	**3.54**	**1.61**	**1.65**	**1.39**	**1.59**

) Data on GHG emissions are presented excluding GHG emissions related to electricity production only.

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Residential Sector

Historical Database – August 2010

British Columbia[1]

Table 10: Water Heating Secondary Energy Use and GHG Emissions by Energy Source

	2004	2005	2006	2007	2008
Total Water Heating Energy Use (PJ)	**35.0**	**36.5**	**36.4**	**34.7**	**33.7**
Energy Use by Energy Source (PJ)					
Electricity	6.1	5.9	5.8	5.3	5.2
Natural Gas	28.2	29.8	30.0	28.8	27.9
Heating Oil	0.2	0.1	0.1	0.1	0.1
Other[2]	0.1	0.2	0.1	0.1	0.1
Wood	0.4	0.4	0.4	0.4	0.4
Shares (%)					
Electricity	17.5	16.3	15.9	15.3	15.5
Natural Gas	80.5	81.6	82.3	82.9	82.9
Heating Oil	0.6	0.3	0.3	0.3	0.3
Other[2]	0.2	0.6	0.3	0.2	0.2
Wood	1.3	1.2	1.2	1.3	1.2
Activity					
Total Households (thousands)	1,642.6	1,675.9	1,675.7	1,741.0	1,742.7
Energy Intensity (GJ/household)	**21.3**	**21.8**	**21.7**	**19.9**	**19.3**
Total Water Heating GHG Emissions Excluding Electricity (Mt of CO_2e)	**1.4**	**1.5**	**1.5**	**1.5**	**1.4**
GHG Emissions by Energy Source (Mt of CO_2e)					
Electricity	–	–	–	–	–
Natural Gas	1.4	1.5	1.5	1.4	1.4
Heating Oil	0.0	0.0	0.0	0.0	0.0
Other[2]	0.0	0.0	0.0	0.0	0.0
Wood	0.0	0.0	0.0	0.0	0.0
GHG Intensity (tonne/TJ)	**40.9**	**41.5**	**41.7**	**42.0**	**41.8**
Heat Loss (PJ)	**1.2**	**1.4**	**1.4**	**1.4**	**1.5**

1) Data on GHG emissions are presented excluding GHG emissions related to electricity production only.
2) "Other" includes coal and propane.

Appendix 9.2

Social Diffusion Methods of Community Outreach Performed by the City of Colwood for the Solar Colwood Project

The City of Colwood Solar Colwood project performed many different social diffusion methods of community outreach to expose the public in the City of Colwood to the project. The methods are listed below in chronological order.

1. January, 2011 – Solar Colwood Website established providing news releases, information on the project and technology, ways to contact project coordinators and managers, as well as information and applications for grants
2. January 24, 2011 – Announcement of Solar Colwood to media, such as /A\ Channel News, at Colwood Fire Hall
3. January 24, 2011 – Solar Colwood background document (booklet) distributed at Colwood Fire Hall Media Release
4. January 24, 2011 – Times Columnist news release entitled *Feds power Colwood's green plan: $3.9 million in funding to boost green municipal, residential projects*
5. January 24, 2011 – Goldstream News Gazette news release entitled *Colwood becomes a 'solar city': Feds grant $3.9 million for home solar retrofits*
6. January 25, 2011 – Colwood councillor Judith Cullington interview on CBC Radio British Columbia: On the Island.
7. January 25, 2011 – CivicInfo BC news release entitled *Colwood Powers Up Award-Winning Community Plan with Federal Clean Energy Funding*
8. January 25, 2011 – Douglas Magazine news release entitled *Funding Powers Colwood Community Plan*
9. May 6, 2011 – Times Columnist news release entitled *The next green thing: Upgrading with loan from utility*
10. May 24, 2011 – Colwood City Council meeting open to public. First ten homeowners for solar hot water incentives and first ten homeowners for ductless split heat pump incentives announced
11. June 9, 2011 – Goldstream News Gazette news release entitled *Colwood rolls out home energy retrofits*
12. June 11, 2011 – Solar Colwood Open House held at Colwood City Hall from 1pm - 4pm

Appendix 9.3

Social Diffusion Research

Source	Fostering Sustainable Behaviour: Community-Based Social Marketing	**Date Reviewed**	May 10, 2011
		Date Posted	2006-2010
Subject	Community Based Social Marketing		
URL	http://www.cbsm.com/cases/factors+necessary+for+the+social+diffusion+of+social+energy+in+new+england_120		
Reference	Sawyer, S.W. (1982). Leaders in change: Solar energy owners and the implications for future adoption rates. Technological Forecasting and Social Change, 21, 201-211.		
Findings			
"Diffusion of solar energy is most likely when the first group to adopt the innovation is well respected within the community, is well educated, and is willing to try new ideas. Furthermore, the strongest motivation for implementing solar energy is to reduce fuel bills. Concern for energy conservation and environmental issues was the second incentive. Others included the desire for self-sufficiency, recreation and to develop professional skills"			

Source	Changing Behaviour Project	**Date Reviewed**	June 21, 2011
		Date Posted	n.d.
Subject	MECHanisms: Make Energy Change Happen Toolkit		
URL	http://mechanisms.energychange.info/home		
Reference	European Union. (n.d.). *Changing Behaviour*. Retrieved June 21, 2011, from MECHanisms: Making Energy Change Happen Toolkit: http://www.energychange.info/		

Findings

Make Energy Change Happen Toolkit

Energy Diary can be used to measure changes in behaviour.

A measurement technique is to track the number of visitors to a website.

Source	Drake Landing Solar Community Website	**Date Reviewed**	May 10, 2011
		Date Posted	n.d.
Subject	Background information on Drake Landing Case Study		
URL	http://www.dlsc.ca/about.htm		
Reference	Drake Landing Solar Community. (n.d.). *About Drake Landing Solar Community*. Retrieved May 24, 2011, from Drake Landing Solar Community: http://www.dlsc.ca/about.htm		

Findings

Information for a background on the Drake Landing Solar Community was obtained from this source.

"The Drake Landing Solar Community (DLSC) is located in Okotoks, Alberta, 15 minutes south of Calgary. The unique feature of DLSC is that 90 percent of space heating needs for the community's 52 single-detached homes will be met by solar thermal energy, a feat unprecedented anywhere else in the world.

The DLSC is also the first major implementation in North America of a technology known as seasonal solar thermal energy storage. Solar thermal energy is collected in the summer, stored underground, and then returned to the homes as heat during the winter.

The Drake Landing Solar Community (DLSC) is a master planned neighbourhood in the Town of Okotoks, Alberta, Canada that has successfully integrated Canadian energy efficient technologies with a renewable, unlimited energy source - the sun.

The first of its kind in North America, DLSC is heated by a district system designed to store abundant solar energy underground during the summer months and distribute the energy to each home for space heating needs during winter months.

The system is unprecedented in the World, fulfilling ninety percent of each home's space heating requirements from solar energy and resulting in less dependency on

limited fossil fuels.

The Government of Canada and its Canadian industry partners are proud to showcase Canadian solar thermal and energy efficient technologies in this one-of-a-kind community."

Source	City of Dawson Creek Website – Planning for People	**Date Reviewed**	May 10, 2011
		Date Posted	September 18, 2008
Subject	Dawson Creek Social Plan: Final Report		
URL	http://www.planningforpeople.ca/is/sustainability_planning/community_planning/documents/Social_Plan_Final_Report.pdf		
Reference	Istvanffy, N. (2008). *Dawson Creek Social Plan: Final Report.* Vancouver: Social Planning and Research Council of BC (SPARC BC).		

Findings

"Sustainability must be community-led and consensus-based because the central issue is will, not expertise; only a community-based process can overcome the political, bureaucratic and psychological barriers to change. But citizen-led processes must be complemented by top-down government support because it is still only governments that have the regulatory powers to secure the transition to sustainable development."

Indicators for measuring social well being and the criteria for selecting indicators for any type of measurement, not just social well being, were obtained from this source.

Source	Journal of Social Issues Vol. 56 No. 3 pp. 543-554	**Date Reviewed**	March 29, 2011
Subject	Promoting Sustainable Behaviour: An Introduction to Community-Based Social Marketing.		
Reference/URL	http://www.stanford.edu/~kcarmel/CC_BehavChange_Course/readings/Mckenzie_socialmarket_2000.pdf		
Findings			

- Often economic motives are often the driving force for positive change when trying to create positive change in sustainable behaviours. Although informing the audience and acknowledging the issue is important it often does not cause change in behaviour.
- Sustainable behaviour is often traditionally advertised inefficiently as a product. Using mass media campaigns acting as if these changes are a "product to be sold" This addresses marketing for consumer preferences. But in reality targeting groups need to focus on encouraging new change in behaviour and address barriers that may prevent the sustainable activity from being preferred by the targeted group. For example weather, time or safety over riding bikes or walking to work.

COMMUNITY BASED SOCIAL MARKETING

1. Identify barriers to sustainable behaviours
2. Select which behaviour to promote
3. Create a program that overcomes the challenges presented by the barriers
4. Pilot program
5. Evaluate effectiveness

Community based social marketing is effective because it;
-Identifies perceived barriers and attempts to address them
-Targets specific groups in the public field and addresses their barriers specifically.

Uncovering barriers and selecting barriers:
It is difficult to encourage all sustainable behaviour changes therefore it is important to decide which to promote.

Designing Strategies
Effectively social marketing should remove the barrier to sustainable behaviour.
Low motivation can be enhanced through commitment strategies or incentives.
Also physiological strategy, not only informing population of "the right thing to do" but having it occur as descriptive norm.

Piloting
After developing the strategy it should be piloted before broadly unleashing to determine the most effective and economical plan.

Evaluation

Important to measure the effectiveness or success of the delivery of environmental programs and behaviour changes directly rather than self-reporting some.

Source	The Tyee – B.C.'s home for news, culture and solutions	**Date Reviewed**	May 10, 2011
		Date Posted	July 24, 2009
Subject	Background information on T'Sou-ke First Nation Case Study		
URL	http://thetyee.ca/News/2009/07/24/FirstNationSolarPower/		
Reference	Kimmett, C. (2009, July 24). *First Nation Takes Lead on Solar Power*. Retrieved May 24, 2011, from The Tyee: http://thetyee.ca/News/2009/07/24/FirstNationSolarPower/		
Findings			
Information for a background on the T'Sou-ke First Nation solar community was obtained from this source. "Photovoltaic arrays top the band hall, canoe shed and fisheries office, and single panels (connected to hot water systems) dot the roofs of neighboring homes. This 75 kilowatt project, though tiny by world standards, is the largest of its kind in British Columbia. It's being held up as a model for First Nations across the province, particularly those that are off grid and reliant upon diesel generators for electricity."			

Source	Kirsten Dales A Social Networks Article	**Date Reviewed**	May 17, 2011
		Date Posted	1996
Subject	Social Network Thresholds in the diffusion of innovations		
URL	n/a		
Reference	Valente, T. W. (1996). Social Network Thresholds in the Diffusion of Innovations. *Social Networks* , 69-86.		
Findings			
Threshold models can be used to explain the success or failure of the diffusion of innovations, such as the SHW in the City of Colwood Solar Colwood Project. This report reveals how researchers can determine which individuals will be early adopters, and how these individuals influence others to adopt. Networks are qualitative methods of measurement to determine how individuals directly or indirectly affect behavioural changes which result in adoption of innovations. They can also be used to predict how innovations will diffuse (i.e. be adopted throughout a network), and to determine who are influential individuals and who are followers in a network.			

Source	City of Dawson Creek Website – Planning for People	**Date Reviewed**	May 10, 2011
		Date Posted	n.d.
Subject	Background information on the City of Dawson Creek Case Study		
URL	http://www.planningforpeople.ca/is/index.asp		
Reference	City of Dawson Creek. (n.d.). *What We Are Doing*. Retrieved May 10, 2011, from Planning For People: http://www.planningforpeople.ca/is/index.asp		
Findings			
Dawson Creek is a city of about 12,000 people in the Peace River region of north eastern British Columbia. Our goal is to be a visionary community that works together for innovative social, cultural, economic and environmental vitality. Currently, much of our effort is focused on reducing the City's environmental impact. In January of 2005, the City of Dawson Creek initiated a Community Energy Plan that identified the type of energy consumed, the costs involved and the environmental implications (green house gas emissions).			

Source	Township of Esquimalt Website	**Date Reviewed**	May 10, 2011
		Date Posted	2008
Subject	Background information on the Township of Esquimalt Case Study		
URL	http://www.esquimalt.ca/municipalHall/sustainabilityEnvironment/solarHotWater.aspx		
Reference	Corporation of the Township of Esquimalt. (2008). *solar Hot water: Overview*. Retrieved May 10, 2011 from Township of Esquimalt: http://www.esquimalt.ca/municipalHall/sustainabilityEnvironment/solarHotWater.aspx		
Findings			
"The Township of Esquimalt is a designated BC Solar Community. The designation comes with $5000 funding to further develop solar hot water programs in an effort to promote clean energy and reduce the community's greenhouse gas emissions. In 2010, a domestic solar hot water system was installed on the Municipal Hall. The solar hot water system is anticipated to reduce the Municipal Hall's greenhouse gas emissions by 20 kg a year - moving the municipality towards its BC Climate Action Charter commitment to become carbon neutral by 2012."			

Source	Natural Resources Canada	**Date Reviewed**	June 21, 2011
Subject	Solar Domestic Water Heater Market Demand Study Executive Summary August 2008		
Reference/URL	n/a		
Findings			

"The SDWH Market Demand Study compares the results of surveys conducted via telephone and online survey. These methods are used to determine the populations' acceptance, attitudes, and awareness in relation to renting or owning a SDWH system across Canada."

"The survey compares which provinces, and urban versus rural type of community have highest and lowest acceptance levels towards renting or owning a SDWH system."

"When evaluating attitudes and awareness questions addressed include; what type of financial benefits or incentives are most effective, home-owner familiarity with solar energy for the home, advantages including energy cost savings and environmental benefits. Also concerns surrounding the reliability of SDWH technology, cost of the system, design or installation implications on the home, and homeowner's scepticism towards solar energy."

"After the surveys were conducted phone and online surveys were compared for any significant differences between results. The only question that demonstrated a significant difference between phone and online interviews occurred when telephone interviewees expressed more familiarity than online when it came to SDWH technology. It is difficult to say why, but can be speculated that it was pressure towards social acceptance that caused more phone interviews to indicate they were familiar with SDWH."

Source	Planning for People – sustainable Dawson Creek British Columbia	**Date Reviewed**	May 24, 2011
		Date Posted	n.d.
Subject	Social Well Being Diffusion of Dawson Creek		
URL	http://www.planningforpeople.ca/index.asp		
Reference	City of Dawson Creek. (n.d.). *What We're Doing: Sustainability Planning: Energy*. Retrieved May 24, 2011, from Planning for People: Sustainable Dawson Creek, British Columbia: http://www.planningforpeople.ca/index.asp		

Findings

"Sustainability must be community-led and consensus-based because the central issue is will, not expertise; only a community-based process can overcome the political, bureaucratic and psychological barriers to change. But citizen-led processes must be complemented by top-down government support because it is still only governments that have the regulatory powers to secure the transition to sustainable development."

Indicators for measuring social well being and the criteria for selecting indicators for any type of measurement, not just social well being, were obtained from this source.

Source	SolarBC Website	**Date Reviewed**	May 10, 2011
		Date Posted	May 25, 2009
Subject	DUNCAN HOME TO BC'S SECOND SOLAR HOT WATER BULK BUY		
URL	http://www.solarbc.ca/media-centre/press-releases/2009/05/25/duncan-home-bc%E2%80%99s-second-solar-hot-water-bulk-buy		
Reference			

Findings

Carbon Busters organized a Solar Energy Workshop in the spring of 2009.

Peter Nix, Carbon Buster spokesperson and bulk buy organizer

Cowichan Energy Alternatives (CEA) group in Duncan: gosolarcowichan@shaw.ca

Source	SolarBC Website	**Date Reviewed**	May 10, 2011 Posted March 3, 2009
Subject	Keeping Up With The Chéniers: Saanich resident starts the ball rolling for his solar hot water buying group		
Reference/URL	http://www.solarbc.ca/blog/emily-kendy/2009/03/03/keeping-cheniers		
Findings			

Contact name for bulk buy information – Patrick Chenier

Information about Saanich community and solar thermal hot water heating system bulk buy.

Source	SolarBC Website	**Date Reviewed**	May 10, 2011 Posted October 29, 2008
Subject	Saanich Resident Organizes Solar Hot Water Buying Group		
Reference/URL	http://www.solarbc.ca/blog/emily-kendy/2008/10/29/saanich-resident-organizes-solar-hot-water-buying-group		
Findings			

Contact name for bulk buy information – Patrick Chenier

Information about Saanich community meeting concerning bulk buys.

Appendix 9.4
Economic Benefits Research

Source	BC's Climate Action Toolkit	**Date Reviewed**	May 17, 2011
Subject	Dawson Creek –Results of research for economics		
Reference/URL	http://www.toolkit.bc.ca/success-stories/dawson-creeks-energy-		
Findings	http://www.civicinfo.bc.ca/practices_innovations/energy_plan--dawson_creek--2009.pdf		

Results of research

Dawson Creek

The City of Dawson Creek was very successful in terms of creating a partnership with the non-profit organization known as the Pembina institute. With the support of the Pembina Institute as well as staff from the City of Dawson Creek, the project was able to obtain accurate information related to baseline information of energy use on a community scale. Another accomplishment related to this project was the ability to relate energy reductions into cost savings, which can demonstrate the success of the project in a way that is more easily communicated to government, public and academic institutions. Aside from solar thermal installations on homes, Dawson Creek has also installed solar thermal hot water heaters on municipal buildings such as City Hall, Fire Hall, RCMP Building, Sudeten Hall, the Airport, and the Public Works Yard. Installations on municipal buildings can provide large reductions of GHG emissions as well as cost savings from energy use as these buildings have a higher energy demand than a typical residential home. Dawson Creek also created a life-cycle cost analysis on solar thermal systems, specific for the conditions found in Dawson Creek to determine the most cost effective approach before implementation of the project on a large scale.

Source	CanSIA	**Date Reviewed**	March 18, 2011
Subject	Future job potential, and other economic benefits		
Reference/URL	CanSIA. (2010, December). Solar Vision 2025. (D. Mitchell, Ed.) Retrieved May 10, 2011, from http://www.cansia.ca/sites/default/files/pdf/solar_vision_2025.pdf		
Findings			

The CanSIA report gives an in depth view of the benefits of solar including social and economic, the reasons why solar power has a "case" in terms of economic viability into the future, as well as some of the possible opportunities in the job sector.

In particular, CanSIA has estimated that the solar thermal industry is expected to grow rapidly in the next 15-20 years in Europe and North America. Studies have suggested that this sector will provide upwards up 750,000 direct and indirect job opportunities by 2020, with Canada expected to provide up to 6400 jobs by 2025 (not including exports)

Solar thermal also represents jobs that are decentralized, therefore creating local employment opportunities in communities across the country.

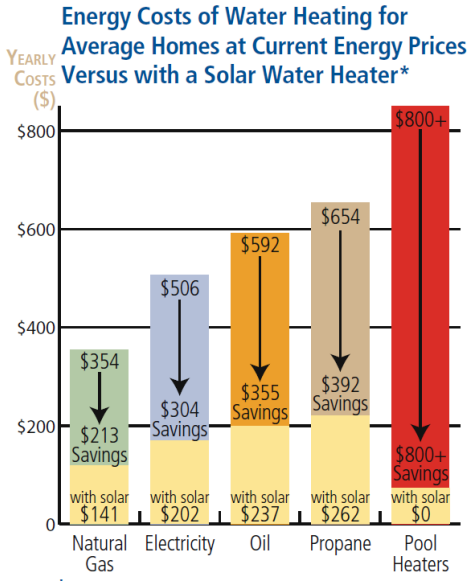
The report also demonstrates historical gas price fluctuations in Canada increasing at a rate of approximately %1 annually over the last 10 years, while manufacturing and cost of these systems have decreased over the same time period (making them more feasible every year). This is backed up by trends showing the exponential increase of the solar thermal industry over the last 10 years, and its expected growth into the next 15-20 years.

Source	CanSIA	**Date Reviewed**	May 3, 2011
Subject	Direct Cost Savings		
Reference/URL	Gill, S., & Goldwater, A. (2008). *OSEA CanSIA Solar Thermal Community Action Manual.* Ottawa: Canadian Solar Industries Association 2007.		
Findings			

Economic Benefits – Direct Cost Savings

One of the main factors affecting the economic feasibility of any solar thermal project is the cost of energy that the solar thermal system is reducing. Most of the time, a Solar Thermal system provides a partial contribution towards heating water or air. As a result, they reduce or eliminate the need for a conventional form of energy. For example, a solar DHW system that is preheating water for an electric water heater reduces the need for electricity, whereas a seasonal solar pool system can completely eliminate the need for a conventional pool heater and the natural gas required to operate it. Systems using different kinds of energy sources have varying savings. The chart on the left is an estimation of the savings for a household based on fuel type and will change with time as energy prices fluctuate.**12**

12 Goldwater Solar estimation based on 60% solar fraction – average consumption taken from Enbridge Gas Distribution 2003 data and is based on a family of 3



Consumption levels & savings will vary based on household characteristics, energy prices, the occupancy rate, and lifestyle.

Source	CanSIA	**Date Reviewed**	May 3, 2011
Subject	Economic Incentives for solar systems		
Reference/URL	Gill, S., & Goldwater, A. (2008). *OSEA CanSIA Solar Thermal Community Action Manual.* Ottawa: Canadian Solar Industries Association 2007.		
Findings			

Economic incentives

- Federal/Provincial incentives promote the use of renewable energy alternatives including solar thermal hot water. Incentives like those seen for Solar Colwood may be one of the biggest influencing factors to encourage the vast majority of homeowners to switch to these technologies. Without incentives, the high upfront costs can discourage consumers from buying in to the programs.
- Until the cost of hydroelectricity/coal/natural gas, etc. becomes much higher, these technologies *need* incentives, whether Federal or Provincial, to at least start moving in the direction of renewable energies.
- When introducing solar thermal in the Solar Colwood project, these types of incentives, as well as the sources in which to look for future incentives should be better advertised to better inform consumers.

Source	CanSIA	**Date Reviewed**	May 3, 2011
Subject	Long Term Benefits for solar systems		
Reference/URL	Gill, S., & Goldwater, A. (2008). *OSEA CanSIA Solar Thermal Community Action Manual.* Ottawa: Canadian Solar Industries Association 2007.		
Findings			

May 3 – Jeff Greene

Economic Benefits – Long term payback

- While upfront costs may be high, the return on the investment will last for decades (up to 25 years).
- As traditional fuel prices increase, the payback period will decrease making solar thermal a more viable option, with increased long-term benefits.
- Solar thermal may be used as a selling tool for increased rent, or increased home value when selling.
- May also be used to advertise small businesses who are looking to "go green", by investing in solar thermal. This may increase awareness due to the amount of people who see the thermal systems, and increase business as well.
- Economic stability – Again as oil prices fluctuate over the coming years, having a solar thermal system can act to buffer these market price fluctuations.

Source	CanSIA	**Date Reviewed**	May 3, 2011
Subject	Net Present Value (NPV) and Return on Investment (ROI)		
Reference/URL	Gill, S., & Goldwater, A. (2008). *OSEA CanSIA Solar Thermal Community Action Manual.* Ottawa: Canadian Solar Industries Association 2007.		
Findings			

Net Present Value (NPV)

Can be used in projects such as Solar Colwood, where upfront costs are high, and payback occurs over a longer period of time. Since the future value of money is not the same as it is today, NPV accounts for inflation, and interest rates to determine if the project is economically feasible and/or profitable.

Return on Investment (ROI)

The Solar Colwood Project can look upon or determine the projected ROI and payback period so that they can attract investments and justify the initial debt incurred from the project.

The main factors affecting the economics of any Solar Thermal project include:

• The cost of Solar Thermal Systems (federal funding etc.)

• The cost of energy that the solar thermal system is offsetting. (energy prices from baseline assess)

• The rate of hot water consumption. (typical Colwood home)

• The efficiency/performance of the system. (based on energy audits testing for applicability)

• Method of Financing Selected (again, Solar Colwood funding, Fed/Prov, loan options)

• Operational costs and required maintenance

• Trading Carbon credits or Renewable Energy Certificates

Source	Drake Landing	**Date Reviewed**	May 17, 2011
Subject	Results of Research for Drake Landing (economics)		
Reference/URL	http://www.dlsc.ca/www.fortisbc.com/NaturalGas/Homes/Rates/Pages/Vancouver-Island.aspx; 2011		
Findings	http://www.tess-inc.com/site-com/assets/filedownloads/Okotoks%20Project%20Summary%20-%20New.pdf		

Drake Landing has integrated an almost entirely closed loop solar community based on district heating, which will reduce the space heating needs of the 52 homes by approximately 90%. By reducing the typical need for electricity or natural gas as a form of home heating, these homes GHG emissions are reduced by about 5 tonnes per year from a typical home which produces 6-7 tonnes per year. Using a combination of space heating, and solar hot water heating, a typical Drake Landing home saves approximately 110.8 GJ per year in comparison to other typical homes. By using solar energy to heat their homes, the residents of Drake Landing also reduce their reliance on non-renewable fuels such as natural gas, as demonstrated below, which in turn buffers them from market fluctuations typically seen in fossil fuels.

The project in Drake Landing was also successful in part to the many partnerships and funding sources involved. Some of these include: The Government of Canada's Technology Early Action Measures program and Natural Resources Canada (TEAM, PERD and REDI program funding), the Federation of Canadian Municipalities' Government of Canada-funded Green Municipal Fund, the Government of Alberta's Innovation Fund, Sustainable Development Technology Canada (SDTC), Alberta Environment, United Communities, Sterling Homes, ATCO Gas, the Town of Okotoks, Climate Change Central, and EnerWorks.

Modeling was another feature of the Drake Landing project which was used as an effective tool to portray the feasibility of the project over its life cycle of approximately 50 years. The modeling was based on the powerful tool known as TRNSYS. The modeling was based on experts' knowledge in combination with TRNSYS, which was then used to further perfect and optimize the desired results.

Source	Solar BC - Esquimalt	**Date Reviewed**	May 17, 2011
Subject	Results of research –Esquimalt (econ)		
Reference/URL	http://www.solarbc.ca/blog/liz-kelly/2010/10/05/esquimalt-city-hall-goes-solar		
Findings	http://www.solarbc.ca/blog/nitya-harris/2010/10/29/township-esquimalt-holds-solar-raffle-residents		

Esquimalt

Esquimalt was recently names one of Solar BC's solar communities as of October 2010. However, through research it was found that the only recent project representing a solar thermal installation was found in the City Hall building. This building was chosen due to its similarity to that of residential homes in terms of hot water use and to act as a demonstration project for the residents of Esquimalt. When looking in terms of monitoring economic impacts of this system, the project did not record any baseline data regarding energy use in the building prior, nor did it set up effective monitoring systems after the fact to determine the economic benefits of the install. This becomes an issue because one of the main goals of the City Hall install was for educational purposes, but since there is no hard evidence regarding the effectiveness of the system; it is unlikely that residents will want to make the substantial initial investments required.

Source	Solar BC First Annual Report	**Date Reviewed**	July 5, 2011
Subject	Monitoring certified trainees for solar installations		
Reference/URL	Solar BC. (2009, March). Retrieved July 5, 2011, from First Annual Report: http://www.solarbc.ca/sites/solarbc.ca/files/pdf/SolarBC-AnnualReport-FINAL_2009.pdf		
Findings			

Results of research

The first annual report by Solar BC aims to identify all of the projects and activities related to solar project in BC over the time period of September 2008 to March 2009.

In terms of monitoring some of the economic benefits, Solar BC followed the number of students who had enrolled into the solar installer training workshops throughout the year. These figures can be used as estimates of the interest and opportunity in the field of solar technologies and can be continually updated and monitored over time to observe the trends over time. Further training programs involving CanSIA certified courses have been developed in order to achieve a uniform standard throughout the province and Canada. If in the future, all installations required a certain standard it would become easier to track the number of successful students and potential demand for this trade.

Source	New York Times	**Date Reviewed**	July 10, 2011
Subject	Increased home value		
Reference/URL	Barringer, F. (2011, April 21). Retrieved July 10, 2011, from New York Times: http://green.blogs.nytimes.com/2011/04/21/study-finds-solar-panels-increase-home-values/		
Findings			

July 10 – Jeff Greene

Increased valuation of homes with solar compared to those without.

A study from Lawrence Berkeley National Laboratory showed strong evidence towards homes with solar PV selling for a premium over those without, averaging at $5.50 USD per watt of capacity.

The typical capacity for the solar PV system was 3100 watts, which equated to a price premium of about $17,000 USD.

Representative of only solar PV systems and for a certain watt-range, but it can be used as an example of how the benefits of solar systems can be measured from a different standpoint than simply measuring energy savings, job creation, etc.

Retrofits get nearly 3 times the premium than homes with systems installed initially.

Source	U.S. Department of Energy	**Date Reviewed**	May 3, 2011
Subject	Energy Efficiency and Renewable Energy		
Reference/URL	http://www1.eere.energy.gov/solar/pdfs/planning_for_PV.pdf		
Findings			

The U.S. Department of Energy has come out with a flyer to encourage builders to start selling solar. (PV)

Their selling points to industry include:

- "Sells faster than homes without green options
- Saves money with shorter sales cycles and less inventory
- Compliments good design and quality construction
- Enhances corporate image as environmentally responsible builder"

"According to the *Appraisal Journal*, home value increases $20 for every $1 in annual utility bills. Ex. If the solar thermal panels could save $200 off of the annual utilities bill the home value would increase by $4000."

The U.S. Department of Energy believes that increased interest in solar technology is due to concerns about the environment, national security, and health.

Japan's Sharp Electronics Corp. has conducted a survey recently that identified that half of Americans surveyed would be 10% more for a solar-equipped home. Also eight out of ten surveyed want builders to offer solar options for home buyers.

Home owners benefits include:

- "Higher home resale value,
- Contribution as environmental stewards
- Substantial tax credits" (This is American, does it apply to Colwood)
- Financial incentives

Source	T'Sou-ke First Nation	**Date Reviewed**	May 17, 2011
Subject	Results of research –T'Sou-ke (econ)		
Reference/URL	http://www.solarbc.ca/blog/liz-kelly/2009/05/14/t-souke-first-nation-achieves-solar-vision		
Findings	Tour of T'Sou-ke First Nation		

T'Sou-ke

The solar project undertaken by T'Sou-ke First Nation is an excellent example that demonstrates the ability to not only save energy, but to create *local* jobs within a community, promoting renewable energy to other communities. T'Sou-ke First Nation hired 9 community members for the installations of solar thermal units on 25 homes, along with the fish hatchery, the community hall, band hall and canoe shed. A special training program was set up which was based on hands on practical application to respect the oral customs of the First Nations members. Unfortunately for this project, like many others, baseline information was not obtained, and monitoring equipment was not properly set up to ascertain the true cost and energy savings of the project.

Similarly to other projects researched, the solar project at T'Sou-ke First nations was set up as a demonstration project to be shared with other First Nations communities, and may help to further achieve economic stimulus as seen in their own solar project with job creation, energy savings, and decreased dependency on fossil fuels.

Appendix 9.5

Reporting Methods Research

Source	Digital Buzz Blog	**Date Reviewed**	July 12, 2011
Subject	Infographic: Facebook vs. Twitter Demographics		
Reference/URL	http://www.digitalbuzzblog.com/infographic-facebook-vs-twitter-demographics-2010-2011/		
Findings			

In 2010 Twitter had 106 million total users and of that number, the largest age groups were 26 to 34 at 30% and 35 to 44 at 27%. This age group likely represents homeowners, of which would be the target group for any social marketing campaign associated with the Solar Colwood project. (Hepburn, 2010)

Hepburn, A. (2010, December 21). *Infographic: Facebook vs. Twitter Demographics*. Retrieved July 12, 2011, from digitalbuzz blog: http://www.digitalbuzzblog.com/infographic-facebook-vs-twitter-demographics-2010-2011/

Source	Drake Landing, Okotoks AB	**Date Reviewed**	May 3, 2011
Subject	Reporting to Public		
Reference/URL	http://www.dlsc.ca/how.htm		
Findings			

There is an application on Drake Landing Solar Community website that allows visitors to the website to see the current conditions of the community, including outdoor temperature, incident solar, solar energy collected, solar fraction and space heating load, however this information only applies to the district heating system, not the solar thermal hot water systems. (Drake Landing Solar Community, 2011).

Drake Landing Solar Community. (2011, May 3). *Current Conditions*. Retrieved May 3, 2011, from Drake Landing Solar Community: http://www.dlsc.ca/how.htm

Source	Focus.com	**Date Reviewed**	July 5, 2011
Subject	Facebook and other Social Media as a Marketing/Reporting Tool		
Reference/URL	http://www.focus.com/fyi/facebook-marketing-toolbox-100-tools-and-tips-tap-facebook/; copyright 2010		
Findings			

- This webpage serves a toolbox for using Facebook as a marketing tool and many of these techniques can be applied to its use as a reporting tool as well as.

- There are several links to pages with information on Facebook user demographics, proven consumer engagement (marketing) techniques/methods, advertising methods/opportunities (reporting methods)
    - Example: there is a page describing how to use a Facebook page, which is basically just an enhanced user profile, to connect with a target audience; this audience can be chosen by age, interests or location.
- A link to such a page from a website or e-newsletter can help to connect potential participants with each other as well as with directed information and content and to create a community around a business or in this case a project
- A list of available tools building relationships with visitors is presented including tracking and mapping tools to help identify the location of users.
- Step-by-step outlines of the applicable features are available on using Facebook to effectively reach a target group with a directed message for free

(Inside CRM Editors, 2011)

Inside CRM Editors. (2011). *The Facebook Marketing Toolbox: 100 Tools and Tips to Tap the Facebook Customer Base*. Retrieved July 5, 2011, from Focus: http://www.focus.com/fyi/facebook-marketing-toolbox-100-tools-and-tips-tap-facebook/

Source	Facebook	**Date Reviewed**	July 12, 2011
Subject	Facebook Demographics		
Reference/URL	Facebook. (2011, 01 15). *Facebook Demographics 2011*. (A. Verde, Ed.) Retrieved July 12, 2011, from Slideshare.net: www.slideshare.net/amover/facebook-demographics-2011		
Findings			

- 596,371,760 Users Worldwide

- 16, 636, 880 Users in Canada (of 34, 030, 589 total population = 48.8% penetration)
- 80+% of Canadian Users are older than 20 years
- 49% of Canadian users are older than 30 (Facebook, 2011)

Facebook. (2011, 01 15). *Facebook Demographics 2011*. (A. Verde, Ed.) Retrieved July 12, 2011, from Slideshare.net: www.slideshare.net/amover/facebook-demographics-2011

Source	Intergovernmental Panel of Climate Change	**Date Reviewed**	May 17, 2011
Subject	Use of Surrogate Data		
Reference/URL	IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National		
Findings	Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.		

2006 IPCC Guidelines for
National Greenhouse Gas Inventories

Volume 1, General Guidance and Reporting Chapter 2, p7

IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National

Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds).

PubWhile it is preferable to use lished: IGES, Japan.

Obviously it is preferable to use direct energy use measurements when quantifying emissions related to hot water heating using conventional energy generation methods (i.e. - hydro power or natural gas). However, a lack of specific household level data requires the use of surrogate data, in this case community level data.

IPCC recommends the following steps as good practice for the use of surrogate data:

3. confirm and document the physical relationship between the emissions and the surrogate data
4. confirm and document a significantly correlation between the emissions and the surrogate activity data

In the case of the Solar Colwood baseline, the surrogate for individual home energy use will be the community level average data as given by NRCan.

The disadvantage in using this information is two-fold: firstly, average data does not effectively represent the differences in hot water and therefore energy use based on lifestyle and demographic differences on individual households; and secondly, a baseline created using this community level data is sensitive to an increase in population and so the energy savings and GHG emissions avoided as a direct effect of the installation of solar thermal hot water systems will be difficult to assess.

Source	MECHanisms	**Date Reviewed**	July 5, 2011
Subject	Energy Change Project Reporting		
Reference/URL	http://mechanisms.energychange.info/home		
Findings			

- This site was developed by the EU 7th Framework Programme Energy theme and serves as a toolkit for encouraging changes in the behaviour of energy users; it contains a number of general guidelines that can be applied to clean energy or energy reduction projects
- A step by step guide to preparing, designing and evaluating energy projects is available
- Using Step 2 of this process: "Getting to know your target group" will provide valuable information and allow for the design of a series of specific messages that will speak directly to the interests of target groups
    - For example: a survey was prepared for the residents of a Latvian apartment building to inquire into their interest and concerns regarding energy efficiency renovations. Researchers then used their findings to tailor the project to reflect these concerns as well as to create specifically directed reporting measures.
    - Basically, in this example: the project organizers asked the target group what they were interested in and tailored their reporting messages to address those interests.
- This section of the website outlines the key to effective communication with your target group as being understanding that they:
    - Think about energy use a lot less than you do
    - Have a different level of understanding regarding energy use
    - Have different needs and interests than you do
    - Represent a range of people with diverse needs, resources and motivations

(MECHanisms, n.d.)

MECHanisms. (n.d.). Retrieved July 5, 2011, from MECHanisms Make Energy Change Happen Toolkit: http://mechanisms.energychange.info/home

Source	One Change Project Porchlight	**Date Reviewed**	March 29,2011
Subject	Reporting of Clean Energy/Energy Conservation		
Reference/URL	http://www.projectporchlight.com/		
Findings			

Community Engagement

- Use existing community leaders to connect with the community as a whole; a sort of role model approach; a social marketing campaign
- An interactive Google map is presented on their website, which allows other individuals to view those homes that are participating in the project; serves to develop self-regulation, "keeping up with the Jones"
- Social media links are provided, including Facebook, Twitter, StumbleUpon, Digg.com and YouTube
- Email sign-up and photo gallery (where participants can post their own photos) are also used
- Partnered with BC Hydro PowerSmart and EnCana to give away free CFL bulbs door-to-door and through community events

Measurement of Reporting to various audiences can be accomplished through the use of social media sites capable of tracking visitors; knowledge level of the visitors can be assessed by the nature of the specific information that they request. For example, views of the website, map etc. can be used to assess general interest, while actual requests for information are indicative of a higher level of interest/knowledge.

(Project Porchlight, 2010)

Project Porchlight. (2010). Retrieved March 29, 2011, from Project Porchlight: http://www.projectporchlight.com/

Source	SolarBC	**Date Reviewed**	July 5, 2011
Subject	Reporting Practices		
Reference/URL	www.solarbc.ca		
Findings			

- Solar BC operates web site containing a number of different levels of reporting:
    - In their Media Centre, an annual report and summary of that report is available for viewing; this report is likely targeted towards other communities and academic audiences due to the technical nature of some of its language and includes detailed information on:
        - Scope of the project,
        - Energy savings from installation,
        - Training of new installers and tracking that training as a method of measuring economic benefit
        - How SolarBC targets marketing to different groups: school aged children, homeowners and institutions.
    - A searchable Google map of installations is also available; each installation can be examined for a number of factors including type of system installed and links to solar communities are also available.
    - A link to the solar champions section of the site is available. In this section, homeowners that have installed a SHW system as part of the project share their experiences. This section is a particularly effective method of reporting, as it allows potential participates to relate directly with a real person, who has had a positive experience with the project. This approach of reporting/marketing is a similar to "word of mouth" advertising of the past but on a much larger scale (i.e. - all internet users have access to the site).
    - Associated news stories and events are also displayed allowing visitors to direct their experience to the information that most interests them creating a personal experience.
    - A link to a Facebook page is also presented, allowing site visitors to connect with other likeminded individuals.
        - The language and content of individual Facebook pages can be tailored to a specific audience
    - Links to other features are also presented including BC Sustainable Energy Association and an e-newsletter sign-up

(SolarBC, 2008)

SolarBC. (2008). Retrieved July 5, 2011, from SolarBC: www.solarbc.ca

Source	TopRank Online Marketing Blog	**Date Reviewed**	July 12, 2011
Subject	5 Ingredients for a Perfect Twitter Marketing Recipe		
Reference/URL	http://www.toprankblog.com/2010/01/twitter-marketing-strategy/		
Findings			

The website summarizes 5 ways to create a perfect Twitter Marketing Campaign.

1) Post relevant, informative content

Such things as info on upcoming events, interesting statistics from press releases may be useful for promoting your business.

2) Post relevant informative content that is not necessarily yours

Sharing content from outside sources may also be beneficial. It allows readers to stay up to date with content that is related to yours, while also drawing attention to you.

3) Post product offers and promotions

Information regarding coupons, incentives and sales can allow followers to respond quickly.

4) Customer Service

Allows a business to ask question about client satisfaction, while also allowing followers to post questions and concerns.

5) Retweets

A retweet is when you post the same tweet as other that you feel will be useful to your followers. It allows you to increase your following and have your content retweeted.

(TopRank Online Marketing, n.d.)

TopRank Online Marketing. (n.d.). *5 Ingredients for a Perfect Twitter Marketing Recipe*. Retrieved July 12, 2011, from Top Rank: Online Marketing Blog: http://www.toprankblog.com/2010/01/twitter-marketing-strategy/

Source	Twitter	**Date Reviewed**	July 12, 2011
Subject	Twitter for Businesses		
Reference/URL	http://business.twitter.com/		
Findings			

Twitter has a section in their about us page specifically geared towards getting businesses to use twitter for marketing. They provide the basics, ways to optimize your activity, and also ways to start advertising. Under advertising there is some information on analytics. Twitter allows businesses to track impressions, retweets, clicks, replies and followers in real time. It also provides a timeline of activity that provides an all encompassing look at your twitter activity.

Twitter is also a free application that allows for current and instant updates directly to followers mobile phones.

(twitter, 2011)

twitter. (2011). *Twitter for Business*. Retrieved July 12, 2011, from Twitter: http://business.twitter.com/

Appendix 9.6

Signed Letters of Consent

Andrew Moore, T'Sou-ke First Nation

If you remember way back, we came to visit you regarding the solar thermal installations. I would just like to know if we can get consent from you to mention our trip in our report, as well as the information you had given us throughout the tour.

For consent, all you would need to do is email us back and say its ok to mention the trip in our report!
Also, if you had any other questions or anything regarding our project, or anything we have learned, feel free to ask.

Thank you,

Jeff Greene
PurSun Solutions
pursunsolutions@gmail.com

On Wed, Feb 2, 2011 at 10:29 AM, Andrew Moore <andrew@tsoukenation.com> wrote:
- Show quoted text -

Reply Forward

Andrew Moore to me show details May 11 (1 day ago) Reply

Hi Jeff,
Feel free to mention T'Sou-ke in your report.
I look forward to hearing how your project is proceeding.
Best wishes
Andrew

Bob Davidson, Fortis BC

BSC ENSC Team 4 to Bob show details 9:15 AM (4 hours ago) Reply

Hi Bob,

I was just wondering if you had gotten a chance to sign the letter of consent?

Thanks,

Erin Greenhough

- Show quoted text -

Reply Forward

Davidson, Bob to me show details 12:36 PM (48 minutes ago) Reply

Hey Erin,

The scanner is giving me grief. Your letter says that I can provide my consent by email. If that is the case ...

I have read the letter, and you have my consent.

Thanks

Bob Davidson

bob davidson | community energy solutions manager
604.312.0166 | bob.davidson@fortisbc.com
www.fortisbc.com
FORTIS BC

Dr. Chris Ling, Royal Roads University

BSC ENSC Team 4 to Chris

show details Apr 5 Reply

Hi Dr. Ling,

As part of our ethical review and in reference to our meeting today, we have attached a research consent form to this email. If you choose to sign it, we can get a copy from you on Tuesday, April 12, or we can come to your office to pick it up. There is also the option of replying electronically and we can just print out the email as a record. Thank you,

Courtney

- Show quoted text -

Research_Consent_Form.doc
31K View Download

Reply Forward

Chris Ling to me

show details Apr 5 Reply

I consent

Best wishes
Chris
- Show quoted text -
--
- Show quoted text -

Reply Forward

Marlene Lagoa, Township of Esquimalt

Research_Consent_Form[1].doc
27K

Marlene Lagoa <marlene.lagoa@esquimalt.ca> **Tue, May 10, 2011 at 8:23 AM**
To: BSC ENSC Team 4 <pursunsolutions@gmail.com>

Hello Krystal,

I'm happy to give you my consent to use our telephone conversation for your research. I would be interested in obtaining a final copy of the report upon completion.

Thank you,

Marlene Lagoa
Sustainability Coordinator
Corporate Services
Township of Esquimalt
Phone: 1-250-414-7114

www.esquimalt.ca

From: BSC ENSC Team 4 [mailto:pursunsolutions@gmail.com]
Sent: May 9, 2011 21:38
To: Marlene Lagoa
Subject: Solar Colwood Interview - Consent Form

RESEARCH CONSENT FORM

Our names are Erin Greenhough, Courtney Howes, Krystal Handley, Jeff Greene, and Jordan Kummerfield, and this research project is part of the requirement for a BSc in Environmental Science, in the School of Environment and Sustainability at Royal Roads University. Our credentials with Royal Roads University can be established by telephoning Dr. Audrey Dallimore at 250-391-2580 or by email at Audrey.Dallimore@royalroads.ca.

This document constitutes an agreement to participate in our research project, the objective of which to get information about how to conduct a baseline assessment to measure changes in energy usage and greenhouse gas emissions associated with the installation of solar thermal hot water systems, determine the best methods for measuring economic benefits and social diffusion associated with the life of the Solar Colwood project, as well as determining the best methods of reporting the progress of the project to public, government, and academic audiences.

The research will consist of open-ended questions and is foreseen to last less than an hour. The foreseen questions will refer to solar thermal heating systems. In addition to submitting our final report to Royal Roads University in partial fulfillment for BSc degrees, we will also be sharing our research findings with the Municipality of Colwood. We may also use this data for our work portfolios.

Information will be recorded in hand-written format and, where appropriate, summarized, in the body of the final report. With your permission, we would like to attribute your comments to you in our report.

All documentation will be kept strictly confidential. Raw data will be retained until after convocation after which all raw data will be held in the Office of Sustainability at Royal Roads University.

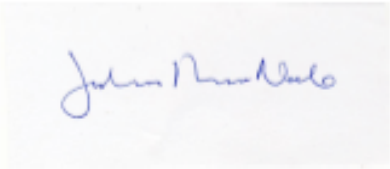
Data will not be retained pertaining to an individual who has withdrawn at any time.

The research will be public once the final document has been compiled. A copy will be provided to research participated upon request.

You are not compelled to participate in this research project. If you do choose to participate, you are free to withdraw at any time without prejudice. Similarly, if you choose not to participate in this research project, this information will also be maintained in confidence.

By signing this letter, or by replying to this email, you give free and informed consent to participate in this project.

Name: (Please Print): _____Josha MacNab_____



Signed: _____

Date: _____April 5, 2011_____

Travis Streb, BC Hydro

RESEARCH CONSENT FORM

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By signing this letter, or by replying to this email, you give free and informed consent to participate in this project.

Name: (Please Print): TONIS STREB

Signed: _____

Date: APRIL 28/2011