Home Energy Efficiency

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ENSC – 420 – Major Project

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Executive Summary

This report sought to answer the question, "Do home energy efficiency upgrades affect the market value of a home?" A multi-tiered approach was taken to assess the impacts of upgrades on a home's market value, including: a literature review, a regional case study analysis, a survey of local Realtors, and interviews of industry experts.

The literature review consists of an extensive listing of existing home energy efficiency upgrades, an assessment of energy efficiency and market value, an evaluation of third party certification, and a listing of the barriers, benefits, and public perception related to energy efficiency upgrades.

The results of the regional case study analysis found several important facts regarding the application of energy efficiency upgrades in other jurisdictions, including the following: most regions have similar incentive programs in place; many homeowners do not remain in their homes for long enough to receive full pay-back from long-term investments; the real estate market demand for energy efficiency upgrades is low; and that there is a vicious/virtuous cycle that explains the demand and support for energy efficiency amongst homeowners, professionals, builders, and financial institutions. The vicious and virtuous cycles are positive and negative feedback loops, respectively that explain the interactions between sectors.

A survey was sent to local Realtors to determine the perception and general regard for home energy efficiency upgrades amongst Realtors and their clients. The general trend among respondents was that home energy efficiency is not an important consideration for buyers when purchasing a home; however, a small minority did attest to some value in certain energy efficiency upgrades. When asked if they perceived value in attending an educational seminar on home energy efficiency, most of the Realtors responded positively.

Three interviews were conducted with industry experts, including: the Government Relations Coordinator for the Victoria Real Estate Board; an Energy Advisor from a Victoria Energy Assessment Service Organization; and the President of Sequel Integrated Resource Management. The key findings from the interviews include, the factors associated with the success/failure of energy labelling incentive programs, the effectiveness of tailoring energy assessments to individual homeowners, the prospects of impending changes to the EnerGuide

labelling system and PAYS-BC program, the need for innovative and user friendly incentive programs, the impacts of life cycle valuation compared to traditional valuation, and the need for full-cost accounting to include the externalities associated with the benefits of home energy efficiency upgrades.

Most home energy efficiency upgrades are seen as a worthwhile investment by Energy Advisers and industry professionals. However a knowledge gap still exists between homeowners and industry professionals as people are more influenced by more aesthetic features of a home like window and kitchen upgrades. The current home energy efficient programs offered should be designed around the vicious/virtuous cycles and in collaboration with each of the cycles specific proponents. This will ensure that the virtuous cycle is achieved and the demand for home energy efficiency upgrades will increase. Although the literature suggests that energy efficient homes have the potential to be worth more, the industry professionals sampled in the Westshore area do not actively encourage energy efficient upgrades or third party certification as a selling feature. The literature also indicates that the current municipal programs are confusing to homeowners and it was suggested in the interviews that financing options need to be clearer to the homeowner.

Various recommendations were made to the project sponsor, and for future research. In regards to the sponsor, Solar Colwood should provide education seminars to homeowners and Realtors on the benefits associated with energy efficiency upgrades. It would also be worthwhile for Solar Colwood to investigate options to simplify the process (grants, permits, etc.) surrounding the implementation of home energy efficiency upgrades for homeowners and builders. Future research should investigate financing/incentive alternatives regarding home energy efficiency upgrades, including, the proposed PAYS-BC financing program, the proposed changes to the Natural Resources Canada, EnerGuide program, and Life cycle valuation. This report also recommended a more in depth, full cost accounting, listing both externalities and internalities.

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Glossary of Terms

Appraisal

> *The process of assigning value to a property (the market value) according to the estimation of an authorized or certified professional. A designated appraiser may use a number of methods to arrive at this estimation, including the cost, income, and sales comparison approaches. Also referred to as 'valuation' (Investopedia ULC, 2012).*

Barriers

> *Hindrances homeowners face when trying to undertake home energy efficient upgrades. These barriers may be both tangible and intangible ultimately leading homeowners away from home energy efficient upgrades (Field & Olewiler, 2011, p. 44).*

Benefits

> *The positive outcomes experienced by homeowners from making energy efficient upgrades to improve their overall utility (Field & Olewiler, 2011, p. 44).*

Building Envelope

> *The shape of a building as defined by the external roof and wall structures. Acts to protect the interior living space from the effects of temperature and weather (Groth, 2007).*

Comparable Home

> *A home that has recently been sold with similar land and housing data to the subject property (that which is for sale). This data includes factors such as square footage, age, style of home, as well as location, lot size, and amenities which can be used in the sales comparison approach to estimate value (Griffin, 2009, p. 14).*

Cost Approach

> *A method of valuation that takes into account the total cost of building and construction materials, minus depreciation, plus the value of property. Defined as "the cost to replace or reproduce the property being appraised" (The Appraisal Foundation, 2009).*

Drivers

> *Homeowners motivation or incentive for undertaking home energy efficient upgrades. These may also be intangible and/or tangible, which sway the homeowner to value the upgrades (Field & Olewiler, 2011, p. 5).*

Energy Advisor

> *An individual who performs an home energy assessment and assists homeowners with undertaking home energy efficient upgrades. They may provide a homeowner with a list of the most effective energy efficient upgrades that specifically relate to the interests of the homeowners (Natural Resources Canada, 2011a).*

Energy Conservation

A method of preserving energy resources through combined efforts of reduced demand and increased energy efficiency. Describes a situation in which either less energy is used to achieve the same level of work, or decreased fuel inputs are required to produce the same energy output (Kemp, 1998, p. 125).

Energy Efficiency (EE)

Typically expressed as a percentage representing the work done by a process or mechanism out of the total energy consumed by that process. The term is also applied in a less technical context in reference to the willingness of society to reduce the impacts of energy consumption on the environment (Kemp, 1998, p. 125).

Energy Efficiency Rating (EER)

A rating of only the thermal performance of a building, designed to provide accurate or standardized information about its overall energy efficiency (ABS, 2008, p. 2).

Externality

The effect or consequence that one activity has on another individual activity without being reflected in the market price (Field & Olewiler, 2011, pp. 57-62).

Greenhouse Gases (GHGs)

A group of gases including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and chlorofluorocarbons (CFCs) that absorb longwave infrared radiation and contribute to the greenhouse effect. Emission of these gases are related primarily to the use of fossil fuel and natural gas energy through increased global industrial development (Kemp, 1998, pp. 178-179).

Income Capitalization Approach

Also referred to as the 'income approach' or 'investment approach', this is a method of valuation that takes into consideration the price at acquisition and potential future benefits/discounted savings in utility of a property (Investopedia ULC, 2012).

Internality

The effects or consequences that are seen by an individual which is typically reflected in the market price (Field & Olewiler, 2011, pp. 57-62).

Market Price

In classical economics, the price at which a good or service is offered in an open market as determined by supply and demand. Market price is equal to market value only given an efficient market in equilibrium, and rational expectations on the part of the buyer and seller (Oxford Futures, Inc., 2012).

Market Price Premium

The higher price associated with a product due to its branding or labelling in comparison with competing products on the market. Price premium is a market failure that must be overcome with a change in public perception that the more expensive product offers a greater value or return on investment (Griffin, 2009, p. 11).

Market Value

According to the International Valuation Standards Committee, market value is "the estimated amount for which a property should exchange on the date of valuation between a willing buyer and a willing seller in an arm's-length transaction after proper marketing wherein the parties had each acted knowledgeable, prudently, and without compulsion" (IVSC, 2003, p. 97). The underlying value of a property may or may not be reflected in the market price.

R-Value

A rating of a given insulation's resistance to heat flow. A higher R-value indicates greater insulation effectiveness. R-values are generally expressed per inch of thickness. For example, pink fibreglass batting is typically rated as R2 - R3 per inch of thickness (Therma-Comfort-Insulation.com, 2009).

Sales Comparison

Also referred to as 'direct comparison', this is a method of valuation that establishes valuation or measurement tools for comparison across similar homes that have recently been sold (Investopedia ULC, 2012).

Service Organization (SO)

An organization that administers the energy advisements; where the Energy Advisors are employed (Natural Resources Canada, 2011d).

Third Party Certification

The verification by an independent organization that a property/household meets a set of requirements and standards to be recognized as being energy efficient. The standards that must be met may vary depending on the certification system, and can provide prospective homebuyers with an assurance of quality (Griffin, 2009, pp. 6-7).

1.0 Introduction

Considering the current real estate market, homeowners are often reluctant to invest time and resources into improving the energy efficiency of their houses if they do not plan on living there for more than a few years. This is because the perceived benefits are generally not as great as a kitchen or bathroom renovation, which are more visible and tangible means of improving property value. The result is a market failure in which the benefits to society in the form of reduced greenhouse gas (GHG) emissions and energy consumption are not recognized due to individual cost preferences.

1.1 Scope of Project

This project will focus on how home energy efficiency impacts the value of homes, the extent to which home energy efficiency ratings are a factor in the buying and selling of homes, and various methods of encouraging home energy efficiency. The project was undertaken during the 2012 school term from January to August. A literature review was completed in three main research areas: general methods for home energy efficiency improvements, home energy efficiency programs in other areas or jurisdictions, case studies analyzing home energy efficiency, and previous findings and examples of home valuations for home energy efficiency. Surveys and interviews were also conducted with real estate agents and industry professionals that addressed home energy efficiency projects in the Greater Victoria region.

1.2 Research Objectives

The objective of this project was to conduct research into various aspects of home energy efficiency, including how home energy efficiency impacts the value of homes, the extent to which home energy efficiency ratings are a factor in the buying and selling of homes, and various methods of encouraging home energy efficiency. The following research questions were developed in defining the scope of our research.

Research Questions:

1. *What are the impacts of home energy efficiency innovations on the value of properties?*
2. *What methods are other jurisdictions adopting to address the issues surrounding home energy efficiency upgrades?*

1.3 Methods

This report used a three tiered approach for answering the research questions proposed earlier in this report. The three methods used were: a literature review, survey of Realtors, and interviews of industry professionals. A detailed description of the methods used in this report is provided.

1.3.1 Document Analysis

A comprehensive literature review was undertaken using peer reviewed journals, published research studies, case studies, and websites. Research and reports related to energy efficient technologies, appraisal and property valuation systems, and consumer behaviour were analyzed in the context of our research questions. The research undertaken during the course of the literature review focused on four main areas:

- Overview of available energy efficient technologies
- Representation of energy efficiency in property valuation methods
- Correlation between certification or energy labelling and market price
- The barriers and benefits to implementing energy efficient home initiatives

The results from the literature review were then used as a comparison to the results obtained from the surveys and interviews conducted in this report.

1.3.1.1 Residential Programs and Case Studies

Residential home energy efficiency programs were investigated along with case study reports that have addressed home valuation and energy efficiency investments by homeowners.

1.3.2 Survey

A survey was created for local Realtors in the Greater Victoria region encompassing the Capitol Regional District (CRD) region to determine their position on home energy efficiency upgrades and the valuation of homes that have completed these improvements. Realtors from various companies were randomly chosen for distribution on 19 June 2012. The survey responses generated for the local Realtors is included in Appendix A of this report.

1.3.3 Interviews

Semi-structured, in-depth interviews with industry experts were completed with Jim Bennett, Government Relations Coordinator with VREB; an Energy Advisor with a local energy assessment service organization; and Chris Corps, President of Sequel Integrated Resource Management. These interviews were conducted to determine the perception of the local industries in response to home energy efficiency upgrades and the valuation of homes. A list of interview questions has been provided in Appendix B.

1.4 Solar Colwood

Solar Colwood is a community-based project initiated and managed by the City of Colwood (City of Colwood, 2011). The City of Colwood is located on Vancouver Island, west of the City of Victoria. It was incorporated in 1985 and has a population of 15,000, up 6.9 % from 2001. It lies within the Greater Victoria area and is part of the CRD. There are 5,770 private dwellings in the City of Colwood (Statistics Canada, 2010). Colwood City Council would like Solar Colwood to be a one-stop-shop for people who are inquiring about alternative energy sources. This does not only include solar energy, but other emerging technologies such as: smart-home or smart grid technologies; energy efficient/smart appliances; solar photovoltaic; geoexchange; district energy solutions; and electric vehicle charging infrastructure (City of Colwood, 2011).

The target for Solar Colwood is for the entire community of Colwood to use energy conservation practices and renewable clean energy. This is the first program in Canada that has this goal (City of Colwood, 2011). There are a number of initiatives that are offered which include: financial incentive support, clean energy options, and educating the public (City of Colwood, 2011). Of the approximately 6000 homes, Solar Colwood's first goal is trying to get 1000 homes to adopt one of these practices by 2014 (City of Colwood, 2011).

1.5 Natural Resources Canada

Natural Resources Canada (NRCan) has an initiative known as EnerGuide. EnerGuide rates the energy consumption and efficiency of: household appliances; heating equipment/cooling; ventilation; new houses; and personal vehicles. EnerGuide labels are used to compare the energy performance of different products to help

consumers make more informed buying decisions. Energy Star® labels identify major electrical appliances that meet or exceed technical specifications to ensure that they are energy efficient. These are incorporated into the EnerGuide labels. NRCan offers most of the incentives that are available in Canada for energy efficiency, including ecoENERGY Retrofit – Homes grants for improvements to heating, cooling, ventilation, and other systems (Natural Resources Canada, 2010).

2.0 Literature Review

This report was informed by research related to residential appraisal and property valuations systems, consumer behaviour, and the various barriers and benefits to homeowner implementation of energy efficient technologies. A general overview of the available technologies was also completed to provide context.

2.1 Overview of Energy Efficiency Technologies

There are four primary categories of home energy efficiency upgrade options available to homeowners: Hot Water Systems, Electrical, Building Materials, and Heating, Ventilation, and Air Conditioning (HVAC). HVAC includes the subcategory of Wood Fueled Appliances. Each category includes several options that may be installed as stand-alone upgrades, or in combination with other options. The following will summarize each of the categories and provide background information on each of the identified options within each category (City of Kingston, 2010).

2.1.1 Hot Water Systems

Hot water systems are considered to be the second-largest energy user after space heating, and can account for up to 20% of a home's energy use. (Fortis BC, 2012). There are five primary energy efficiency upgrades that pertain to hot water systems, including: High Efficiency Hot Water Tanks, On-Demand Hot Water, Solar Hot Water, Geoexchange, and Drain Water Heat Recovery (City of Kingston, 2010).

Table 1 below summarizes the advantages, disadvantages, and typical savings associated with high efficiency upgrades to Hot Water Systems. The savings associated with each technology reveal the unique nature of each specific technology. The exact savings for each will vary according to the particular configuration and installation.

Table 1. Advantages, disadvantages, and typical savings associated with high efficiency upgrades to Hot Water Systems.

	Advantages	Disadvantages	Typical Savings of High Efficiency Upgrade
HE Hot Water Tank	Instant hot water Ability to run multiple appliances concurrently	Possible flooding if tank becomes ruptured Can run out of water – set capacity	Up to 40 %[1]
On-Demand Hot Water	No floor space required Unlimited capacity	May not be able to run multiple appliances at the same time Cold water supply may take longer to heat	Up to 30 %[2]
Solar Hot Water	Free initial heating energy Some heating capacity during power outages	Does not work at night Weather dependant - can limit use	Variable[3]
Geoexchange	Can supply large amounts of hot water Water can be used as part of a Hydronic heating system	Requires geothermal installation	Up to 60 %[4]
DWHR	Maintenance-free Zero energy consumption	Requires intrusive installation	Up to 10 %[5]

[1] (Fortis BC, 2012)
[2] (Calgary Herald, 2005)
[3] (Solar BC, 2008)
[4] (Canadian GeoExchange Coalition, 2012)
[5] (SaskEnergy, n.d.)

2.1.1.1 High Efficiency (HE) Hot Water Tank

Boiler/Tank systems are the most common type of hot water heater in homes. Typically, the tanks will be lined with glass (or stainless steel for high end models), and will heat the water by electricity or by a gas-fired burner below the tank. An electric heater will have magnesium or aluminum wrapped steel anodes suspended within the tank that will heat the water. A gas-fired burner will have inlet vents for air at the bottom and an exhaust flue that will typically run through the centre of the tank to capture some of the heat from the exhaust gasses. Both heater types will contain the heated water within the storage tank, which is typically between 114 L and 283 L, with ~2.5 cm to 5 cm of insulation surrounding the tank. Both systems are controlled by a thermostat,

which ensures that the water stored within the tank is kept at the programmed temperature (Fortis BC, 2012).

High efficiency boiler/tanks are up to 40% more efficient than normal models. High efficiency models will employ several techniques to improve efficiency, including: increased insulation around the tank; heat exchangers to reduce losses; condensing heaters to collect condensation – reducing heat loss; direct-ventilation, to improve heat losses during non-heating cycles; and electronic ignition, to eliminate the use of pilot lights (Fortis BC, 2012).

2.1.1.2 On-Demand Hot Water

Instant, or on-demand, hot water heaters do not store heated water; rather, they heat the water as needed. Because the water is not stored, there are no heat losses during latent periods. Also, the reduced flow through the system can reduce energy consumption by up to 30%. These systems may be wall mounted; therefore, they do not require any floor space and are ideal for compact spaces (Fortis BC, 2012). The compact size of these units has made them a popular choice in Europe and Asia for many years (Calgary Herald, 2005).

2.1.1.3 Solar Hot Water

Solar hot water is similar to the tank system, except that water is pre-heated by solar energy. Solar collectors placed outside the home (typically on the roof), absorb energy from the sun, which is transferred to a heat exchanger via heat transfer fluid. The heat transfer fluid is used to heat water in a solar water tank, which is then added to the regular hot water storage tank, as needed. Heated water from the solar tank is used to lower the energy required to heat the water in the hot water tank by raising the initial temperature of the water. Germany had over 140,000 solar hot water units installed as of 2006 (Solar BC, 2008).

2.1.1.4 Geoexchange

Typically installed in conjunction with a geothermal heat system, most geoexchange hot water systems function similarly to solar hot water system. A desuperheater (an auxiliary heat recovery system) is installed in the heat pump unit and is

tied to the regular hot water tank inside the home. When the heap pump compressor unit is running to regulate the temperature of the home, the heated refrigerant used in the geothermal system is used to transfer heat to the hot water tank via water circulation pipes running from the heat pump to the tank. The preheated water lowers the heating requirements of the hot water tank; therefore, lowering energy used by the tank.

Some geoexchange systems are able to produce 100 % of the hot water requirements of a home by incorporating systems that are able to switch from heating or cooling of the home to heating water, as needed (Canadian GeoExchange Coalition, 2012).

2.1.1.5 Drain Water Heat Recovery (DWHR)

Once hot water has been used in a home, it is typically lost down the drain; however, with DWHR, some of the residual heat is recovered. This simple innovation uses a heat exchange system that is wrapped around the drainpipes in a home, which allows the latent heat from the drain water to be transferred to the primary hot water system. There are no moving parts in the system and it is considered to be maintenance-free (SaskEnergy, n.d.).

2.1.2 Electrical

Electrical upgrades typically fall into two categories: those that reduce electricity consumption, and those that produce electricity. Five upgrades are listed as follows: Motion Sensor Light Switches, Computerized Lighting, Compact Fluorescent Lighting (CFL) or Light-Emitting Diode (LED) Lighting, Wind Turbines, and Photovoltaics (City of Kingston, 2010).

Table 2 below summarizes the advantages, disadvantages, and typical savings associated with high efficiency upgrades to Electrical Systems. The savings associated with each technology reveal the unique nature of each specific technology. The exact savings for each will vary according to the particular configuration and installation.

Table 2. Advantages, disadvantages, and typical savings associated with high efficiency upgrades to Electrical Systems.

	Advantages	Disadvantages	Typical Savings of High Efficiency Upgrade
Motion Sensor Light Switches	Electricity use is minimized	Separate sensors are required for each light	Variable[1]
Computerized Lighting	Custom electrical use profiles are possible and can be integrated into a complete home automation system	Cost of system can be high and operation may be complicated	Variable[2]
CFL or LED Lighting	Long lifetimes mean less replacement of bulbs	Initial costs are high, potential concerns over mercury of CFLs	75 %[3]
Wind Turbines	Reduced grid dependency, and *free* (after purchase and installation) electricity	Aesthetics, initial costs, and DC to AC electrical conversion is often required	N/A
Photovoltaic	Reduced grid dependency, and *free* (after purchase and installation) electricity	Aesthetics and initial costs	N/A

[1] (Today's Circuits, 2009)
[2] (Canada Mortgage and Housing Corporation, 2012*a*)
[3] (BC Hydro, 2012)

2.1.2.1 Motion Sensor Light Switches

These light switches operate as detectors, which are able to sense human motion via infrared. Also known as Passive Infrared (PIR) sensors, the detector will switch lights on when a human is detected within the range of the sensor, and turn lights off when the infrared signature is no longer sensed. PIR sensors are commonly used as security features (Today's Circuits, 2009).

2.1.2.2 Computerized Lighting

Computerized lighting systems are often integrated with complete home automation systems; wherein, many of the functions of a home are automated and controlled via computer. There are three primary elements common to all automation systems, including: an operating system (typically a computer), device(s) being operated (lights, blinds, etc.), and the interface (button, touchpad, cell phone, etc.). A typical

lighting controller will have a controller at each light in the system, which is able to communicate (wired or wireless) with the operating system. The user is able to program the lights via the interface, often using software that will allow for many various lighting scenarios. For example, a night scenario could have all but a bathroom light turned off. A weekday morning scenario would follow this, when lights in the bedroom slowly brighten, followed by the bathroom and kitchen lights being turned on according to the programmed schedule (Canada Mortgage and Housing Corporation, 2012*a*).

2.1.2.3 CFL or LED Lighting

CFL and LED lighting are two options for replacing traditional incandescent lights with highly efficient alternatives. CFLs are small, socket ready versions of the long fluorescent light tubes that are common in many public buildings. CFLs can last for up to 10 times longer than incandescent bulbs and use ~ 75 % less energy. LEDs consist of a small array of small, individual LEDs nestled into a typical light bulb sized unit. LEDs can last for up to 25 years and can use ~ 75 % less energy than incandescent bulbs. While both lighting options are more expensive to produce and purchase, the long-term energy savings far out weigh the initial costs (BC Hydro, 2012).

2.1.2.4 Wind Turbines

While wind turbines do not lower home energy use, they do generate clean, *free* (after purchase and installation) electricity, which can offset traditional electrical requirements and costs. Similar to the large wind turbines found in large wind farms, a home wind turbine will typically be mounted high on a tower and consist of a nacelle with a bladed nosecone, which is made to rotate in the wind and turn an electrical generator. In some jurisdictions, a home wind turbine may be connected to the electrical grid so that excess, unused electricity may be sold to the utility (Canadian Wind Energy Association, 2010).

2.1.2.5 Photovoltaic

Photovoltaics (PV) are often referred to as simply *solar panels*; however, unlike solar heating units, PV converts sunlight into electrical energy. Similar to wind turbines, PV is an option to provide an energy alternative to grid electricity, often with the possibility of selling excess, unused electricity to the utility. PV systems require large

panels and arrays of PV cells to be installed in a sunny location, often on the roofs of homes (Canada Mortgage and Housing Corporation, 2012*b*).

2.1.3 Building Materials

The materials used in a home's construction are important factors in energy efficiency. Whether the materials are installed during new home construction, or if they are installed during a renovation, each of following 12 upgrades can increase a home's energy efficiency: Energy Star Rated Windows, Energy Star Rated Doors, Expanding Foam Insulation at all Windows/Doors/Small Air Spaces, Insulated Sheathing, Basement Slab Insulation, Insulated Garage and Garage Door, Enhanced Floor Insulation, Enhanced Wall Insulation, Enhanced Roof Insulation, Passive Solar Shading/Glazing, Weather-stripped/Insulated Attic Hatch, and Energy Star Appliances (City of Kingston, 2010).

Table 3 below summarizes the advantages, disadvantages, and typical savings associated with high efficiency upgrades to Building Materials. The savings associated with each technology reveal the unique nature of each specific technology. The exact savings for each will vary according to the particular configuration and installation.

Table 3. Advantages, disadvantages, and typical savings associated with high efficiency upgrades to Building Materials.

	Advantages	**Disadvantages**	**Typical Savings of High Efficiency Upgrade**
Energy Star Rated Windows	Reduction of drafts and condensation	High initial cost	7 – 12 %[1]
Energy Star Rated Doors	Reduction of drafts and condensation	High initial cost	7 – 12 %[1]
Expanding Foam Insulation at all Windows/Doors/Small Air Spaces	Simple, does not require a large investment	Aesthetics	Variable[2]
Insulated Sheathing	Very effective method of insulating walls	High initial cost and typically professionally installed	Variable, depending on R-Value[3]

Basement Slab Insulation	Very effective in cold climates	High initial cost and typically professionally installed	Variable, depending on R-Value[4]
Insulated Garage and Garage Door	Reduction is heat loss through adjoining living spaces	Potentially high initial cost	Variable, depending on extent and R-Values[3]
Enhanced Floor Insulation	Very effective	High initial cost and typically professionally installed	Variable, depending on R-Values, typically 10 – 20 %[3]
Enhanced Wall Insulation	Very effective	High initial cost and typically professionally installed	Variable, depending on R-Values[3]
Enhanced Roof Insulation	Very effective	High initial cost and typically professionally installed	Variable, depending on R-Values[3]
Passive Solar Shading/Glazing	Zero costs after implementation	Can be difficult to retrofit to existing homes	Variable, depending on techniques used[5]
Weather-stripped/Insulated Attic Hatch	Simple, effective	May not provide a noticeable benefit	Variable, depending on R-Values[3]
Energy Star® Appliances	Simple	Upfront costs may be higher than standard models	10 – 45 %[6]

[1] (Natural Resources Canada, 2011*b*)
[2] (BC Hydro, 2012*b*)
[3] (US Department of Energy, 2011)
[4] (Beausoleil-Morrison & Kemery, 2009)
[5] (Commonwealth of Australia, 2010)
[6] (Natural Resources Canada, 2011*c*)

2.1.3.1 Energy Star® Rated Windows

In Canada, the Energy Star® rating system for windows is based upon a zone map that divides the country into four zones (A – D), based on climate. Once the zone in which a home is located is identified, the appropriate Energy Star performance level is chosen. An Energy Rating or U-Factor (comparable to R-Values applied to insulation) is used to rate windows. Typically, Energy Star® windows will have multiple panes of glass and an inert gas between the panes (Natural Resources Canada, 2011*b*).

2.1.3.2 Energy Star® Rated Doors

Similar to windows, the Energy Star® rating system for doors is based upon a zone map that divides the country into four zones (A – D), based on climate. Once the zone in which a home is located is identified, the appropriate Energy Star performance level is chosen. An Energy Rating or U-Factor (comparable to R-Values applied to insulation) is used to rate doors. Typically, Energy Star® doors will have increased insulation within the core and some method of sealing the spaces between the door and the door jams (Natural Resources Canada, 2011*b*).

2.1.3.3 Expanding Foam Insulation at all Windows/Doors/Small Air Spaces

Sealing the spaces that exist at the gaps between windows, doors, and small spaces can increase the energy efficiency of a home with little investment in time and money. Using expanding foam (usually sprayed from a can) to fill the gaps can reduce drafts and lower heat loss from a home. Often, draft-proofing a home can be done by the homeowner for little cost (BC Hydro, 2012*b*).

2.1.3.4 Insulated Sheathing

Also known as foam board insulation, there are three primary types of insulated sheathing available, including: polystyrene, polyisocyanurate, and polyurethane. This type of insulation is installed on the exterior of the walls (below the cladding), and consists of foam panels that are attached to the building envelope. Foam board insulations are common in new home construction; however, older homes can be retrofitted. Retrofitting an older home would most often occur during residing or cladding the walls. Insulated sheathing comes in a variety of thicknesses, each with an associated R-Value (US Department of Energy, 2011).

2.1.3.5 Basement Slab Insulation

Because many basements slabs are poured directly onto existing substrate, some heat loss may occur through the slab via conductance. The cold floors associated with many basements are indicative of this heat loss. Often, basement slab insulation will be installed during new home construction (in cold climates); however, it is possible to retrofit existing homes. Retrofitting an older home requires removal of the existing slab,

which is replaced with insulated concrete. This type of insulation is more common in colder climates (Beausoleil-Morrison & Kemery, 2009).

2.1.3.6 Insulated Garage and Garage Door

Often, garages are not constructed as living spaces; as such, they are often not given the same insulation treatment as the rest of the home when constructed. However, adjoining walls and living spaces above garages often lose heat to the cooler garage. For this reason, insulating garages and garage doors is often seen as an effective method of improving the thermal efficiency of a home. Wall and ceiling insulation is installed similar to the methods that are used for the walls and ceilings of homes, and garage doors are available with insulated cores, similar to Energy Star® doors. Windows and draft sealing may also be upgraded in garages (US Department of Energy, 2011).

2.1.3.7 Enhanced Floor Insulation

Similar to basement slab insulation, heat loss through floors is often associated with cold floors. Insulation of floors will typically consist of installing foam board or batting to the joists beneath the floor, or insulation the crawl space beneath a home with blown insulation. For slab-on-grade homes, installation is the same as basement slab insulation (US Department of Energy, 2011).

2.1.3.8 Enhanced Wall Insulation

Exterior wall insulation is one of the most effective energy efficiency upgrades that can be applied to a home. Installation of foam board, batting, spray-foam, or loose-fill insulation can greatly increase the R-Value of a wall. Spray-foam and loose-fill insulation may be installed with minimal disturbance to the walls. To avoid drafts, it is important to ensure that the walls are air sealed prior to installation (US Department of Energy, 2011).

2.1.3.9 Enhanced Roof Insulation

Often, the most cost-effective energy efficiency upgrade on a home is roof insulation, or attic insulation. Because heat rises, the ceiling is a primary source of heat loss. Most attic spaces are open areas that are easy to retrofit with additional insulation. Batting or loose-fill blown into the attic are the most common forms of attic insulation.

One important consideration with attic insulation is to maintain air-flow and ventilation to avoid moisture problems (US Department of Energy, 2011).

2.1.3.10 Passive Solar Shading/Glazing

This is considered to be the least expensive method of heating/cooling a home once implemented. Typically, passive solar is designed into new construction; however, there are several techniques, which may be applied to existing homes. While passive solar involves many different designs and methods, several principles are common to all implementations, including: northerly orientation of daytime living areas; use of appropriate glazing on northern faces; passive shading of glass; thermal mass heat storage; insulation and draft sealing; floor plan zoning based on heating requirements; and advanced glazing solutions. The primary objective of passive solar is to maximize the heating potential of the sun during cool times, and to minimize the heating potential of the sun during warm times. This is accomplished via strategic shading and lighting, window treatments, and planning (Commonwealth of Australia, 2010).

2.1.3.11 Weather-stripped/Insulated Attic Hatch

Similar to draft sealing in other locations around the home, sealing the access to the attic can eliminate heat losses. Often, attics will be among the most insulated areas of a home; however, the air above the insulation can be very cool, and drafts may enter the home via the attic hatchway. Additionally, the attic hatch itself is often less insulated then the rest of the attic. Simply weather-stripping the access hatch and adding insulation to the attic hatch can eliminate this potential heat loss location (US Department of Energy, 2011).

2.1.3.12 Energy Star® Appliances

Upgrading household major appliances can be a simple, yet effective method of improving energy efficiency of a home. Energy Star® labelling began in 2001 in Canada, and is an effective way to determine the efficiency of an appliance. While the Energy Star® program is voluntary, most major manufacturers label appliances in the way. Savings vary depending on the appliance (Natural Resources Canada, 2011c).

2.1.4 Heating, Ventilation, and Air Conditioning (HVAC)

HVAC systems can have a large effect on the energy efficiency of a home. The upgrades listed below range from simple, easy to install systems, to complete retrofits of HVAC systems. Ten HVAC upgrades are listed below, as follows: Programmable thermostat, HVAC Zoning, High Efficiency, Sealed Combustion HVAC Unit, Ground Source Heat Pump (Geothermal), Ductless Split Heat Pump, Ductwork Sealing, Hydronic Radiant Floor Heating, HVAC Unit with Variable Fan Speed, Energy Star® Rated Ventilation Fans, and Active Heat Recovery Ventilator or Energy Recovery Ventilator (HRV or ERV) (City of Kingston, 2010).

Table 4 below summarizes the advantages, disadvantages, and typical savings associated with high efficiency upgrades to HVAC and Wood Fueled Appliances. The savings associated with each technology reveal the unique nature of each specific technology. The exact savings for each will vary according to the particular configuration and installation.

Table 4. Advantages, disadvantages, and typical savings associated with high efficiency upgrades to HVAC and Wood Fueled Appliances.

	Advantages	Disadvantages	Typical Savings of High Efficiency Upgrade
Programmable thermostat	Inexpensive and easy to install	Can be difficult to program	10 %[1]
HVAC Zoning	Effective use of existing HVAC system	Zoning may require professional setup and equipment	Up to 30 %[2]
High Efficiency, Sealed Combustion HVAC Unit	Very effective and safer than older models	High upfront costs and must be professionally installed	5 – 10 % per 5 % increase in AFUE[3]
Ground Source Heat Pump (Geothermal)	Very effective	High upfront costs and must be professionally installed	25 % - 50 %[4]
Ductless Split Heat Pump	Effective	High upfront costs and must be professionally installed	Variable[12]
Ductwork Sealing	Simple and effective	Some duct work may be difficult to access	20 %[5]

Hydronic Radiant Floor Heating	Effective and comfortable heating	Difficult to retrofit older homes	Variable[6]
HVAC Unit with Variable Fan Speed	Very effective	May not be compatible with all systems	Variable[7]
Energy Star® Rated Ventilation Fans (Bath, Range, etc.)	Simple and cost effective	Higher cost than standard models	60 %[8]
Active Heat Recovery Ventilator or Energy Recovery Ventilator (HRV or ERV)	Can provide low cost ventilation compared to other systems	Difficult to install correctly in new homes and very difficult to retrofit in older homes	Low[9]
Sealed Combustion Woodstove	Effective and safe	Wood burning appliances emit large quantities of air pollutants	Variable[10]
High Efficiency Wood/Pellet Stove	Very effective and lower operating costs	Wood burning appliances emit large quantities of air pollutants	20 - 30 %[11]
Fireplace Fan Kit	Simple (non-duct systems)	Wood burning appliances emit large quantities of air pollutants	Variable[11]

[1] (BC Hydro, n.d.)
[2] (Perfect Home HVAC Design, 2011)
[3] (US Department of Energy, 2011)
[4] (Manitoba, Innovation, Energy and Mines, n.d.)
[5] (US Environmental Protection Agency, n.d.a)
[6] (Canada Mortgage and Housing Corporation, 2012c)
[7] (Natural Resources Canada, 2011d)
[8] (US Environmental Protection Agency, n.d.b)
[9] (Green Building Advisor.com, 2010)
[10] (Green Code Pro, 2012)
[11] (US Department of Energy, 2011)
[12] (City of Colwood, 2011)

2.1.4.1 Programmable Thermostat

A smart thermostat can control the temperature of a home based on a set of instructions programmed into the unit, which are then used to turn the HVAC system on or off to maintain the temperature required for any given time. By setting the smart thermostat to warm the home when the residents are home and awake, then letting the home cool when the residents are away or sleeping, furnace cycles are reduced and energy is saved (BC Hydro, n.d.).

2.1.4.2 HVAC Zoning

Dividing a home into separate zones, based on type and frequency of use, furnace cycles may be reduced. This saves energy and helps to extend the life of the HVAC equipment. Typically, separate thermostats are installed in each zone, which allows for greater control of the temperature in each zone; therefore, greater savings overall. When used in combination with programmable thermostats, each zone may be tuned to meet the exact needs within the home and reduce energy use even further (Perfect Home HVAC Design, 2011).

2.1.4.3 High Efficiency, Sealed Combustion HVAC Unit

Upgrading an older HVAC unit with a high efficiency unit is one of the most effective energy efficiency upgrades a homeowner can make. HVAC unit efficiency is measured by *Annual Fuel Utilization Efficiency* (AFUE). Typical older systems, with continuous pilot lights and natural draft systems are rated as 68 – 72 % AFUE; whereas, a modern high-efficiency unit, with sealed combustion and condensing flue gasses will have a rating of 90 - 97 % AFUE. An additional benefit of a sealed combustion HVAC unit is the isolation of exhaust gasses. This means that there is no possibilities of furnace exhaust gasses entering the home, because the air is not heated directly by the combustion unit; rather, the air is heated by a heat-exchange system (US Department of Energy, 2011).

2.1.4.4 Ground Source Heat Pump (Geothermal)

By using the earth as a source of stored solar energy, geothermal ground source heat pumps exploit the geothermal heat gradient of the earth by using the ground below a home as a heat source in the winter and as a heat sink in the summer. In this system, a loop of heat exchanging pipe is buried in one of a variety of configurations (horizontal, vertical, open, closed, pond, etc.), and connected to a heat pump. Using minimal electricity to circulate the heat exchange fluid through the circuit, the heat pump effectively transfers the heat to or from the earth to the home (Manitoba, Innovation, Energy and Mines, n.d.).

2.1.4.5 Ductless Split Heat Pumps (DSHP)

Similar to the heat pumps related with Geoexchange (above, *2.1.1.4*), a DSHP makes use of the heating efficiencies associated with heat exchange/pump systems; however, there is no ducting requirement with this system. A DSHP is typically mounted on an interior wall of a home and will contain its own internal blower. These systems are ideal for retrofits in homes without existing ductwork, and are often used to replace electric baseboard heat (City of Colwood, 2011).

2.1.4.6 Ductwork Sealing

Most forced-air HVAC systems rely upon ductwork to transfer the heated/cooled around the home. Leaky ductwork can severely limit the efficiency of the HVAC system. Evaluating a systems air balance and repairing any leaks in the ductwork may achieve a significant savings. Ductwork sealing may also provide a safety benefit, due to the possible presence of combustion gasses in exhaust ductwork (US Environmental Protection Agency, n.d.*a*).

2.1.4.7 Hydronic Radiant Floor Heating

This system uses heated pipes installed within the floor to radiate heat from the floor to heat a home. Ancient Romans heated buildings in this manner; however, the technology fell out of favour when carpeting became popular after World War II. The heat exchange fluid in the flooring can be heated by a variety of HVAC systems. Because the heat radiates from the floor, thermostats are often set 1 – 2 degrees cooler than would be otherwise (Canada Mortgage and Housing Corporation, 2012*c*).

2.1.4.8 HVAC Unit with Variable Fan Speed

The use of a variable speed fan in HVAC systems has gained in popularity as electronic control systems have decreased in price. Varying the speed of the blower fan rather than having the fan either on at 100 % or off may realize significant savings. Often, a variable speed fan will run more often than a traditional fan; however, the fan will use less energy overall because it will be running at 50 % or less. This reduces electricity spikes at start-up and increases overall efficiency of the HVAC unit (Natural Resources Canada, 2011*d*).

2.1.4.9 Energy Star® Rated Ventilation Fans (Bath, Range, etc.)

High efficiency ventilation fans in kitchens and bathrooms can significantly reduce energy use in a home. Modern, Energy Star® rated ventilation fans have high performance motors that are quieter, and have improved fan blade design, which adds to performance and product lifespan. Often, Energy Star® rated ventilation fans will contain integral lighting options, which are also high efficiency, adding to the total benefit (US Environmental Protection Agency, n.d.*b*).

2.1.4.10 Active Heat Recovery Ventilator or Energy Recovery Ventilator (HRV or ERV)

HRV systems and ERV systems are similar in that they are both designed to ventilate a home by exchanging fresh, outside air with stale, inside air. The primary difference between the two is that an HRV recovers some of the heat before venting the exhaust air, while an ERV also adjusts the humidity of the air. HRV and ERV systems are not energy efficiency systems on their own; however, if properly installed, they can lower the heating/cooling costs of a home by allowing for balanced ventilation, with some heat recovery (Green Building Advisor.com, 2010).

2.1.5 Wood Fueled Appliances

In addition to various HVAC upgrades, improvements may be made to Wood Burning appliances for the benefit of a home's energy efficiency. Such upgrades include Sealed Combustion Woodstove, High Efficiency Wood/Pellet Stove, and Fireplace Fan Kit (City of Kingston, 2010).

2.1.5.1 Sealed Combustion Woodstove

By sealing the combustion chamber within a wood fireplace, heated air is allowed to stay in the home, losing little of the heated air out the exhaust. Most of these systems use a double walled pipe for ventilation, with the inner pipe containing exhaust and the outer pipe bringing in intake air. This preheats the combustion air, allowing for a further increase in efficiency. An additional benefit of sealed combustion is the isolation of exhaust gasses from the home (Green Code Pro, 2012).

2.1.5.2 High Efficiency Wood/Pellet Stove

Modern, high efficiency wood/pellet stoves often contain catalytic combustion components that allow for cleaner burning. Typically, combustion temperatures are high enough to burn combustible gases; therefore, resulting in less air pollutants being released to the environment. Pellet fueled stove use pellets made from wood processing waste and agricultural waste. They contain less moisture than traditional wood fuel and are less expensive to operate (US Department of Energy, 2011).

2.1.5.3 Fireplace Fan Kit

Since fireplaces and wood stoves are typically located in one room only, a fan is necessary to move the heated air around the home. These can be as simple as a heat powered fan that sits atop the stove, or they can be connected to a complete duct system that can heat the entire home (US Department of Energy, 2011).

2.2 Energy Efficiency and Market Value Appraisal

The past few decades have seen a growth in interest and research into valuation of alternative levels of energy efficiency for more accurate market appraisal of residential buildings. Generally, it is believed that given the market practice of adjusting price for differing levels of energy efficiency, the process of appraisals should be able to capture these impacts (DeLisle, 1984, pp. 41-43). Issues that arise during home valuations by a certified appraiser include whether or not an attribute should be considered, under what conditions it is considered, and how it is integrated in the estimation of a home's overall value. According to DeLisle (p. 42), research has primarily focused on the process of appraisals, but not on how valid an estimation this process yields. The ultimate goal should be framework development for the integration of research into a unified theory that appraisers may apply in the field (p. 42).

In 1977 in the United States, Hans R. Isakson determined that the majority of residential appraisers recognized the importance of energy efficient considerations in the estimation of a home's value (Levy, 1987, pp. 457-458). However, at the time it was not generally the practice to include such a consideration or make adjustments accordingly when delivering the appraisal value. These findings were due in part to two primary factors: lower efficiency homes were not found to consistently sell for lower prices, and it

was not believed that the real estate market would allow for price differences from variability in energy efficiency. These deficiencies in the measurement and valuation translated to an inaccurate representation of the true cost of a home (p. 458).

During the time of Isakson's research, estimation of discount savings in future utility bills was recognized as the most widely used method for making adjustments regarding efficiency (Levy, 1987, p. 458). Today, this is still true, as individuals are more willing to invest in technologies that they know will allow for capitalization on income. Additionally, comparative approaches may be taken by making energy efficiency measurements specific to the structure or physical features of the home (p. 459). The increased incidence of public awareness and knowledge driven by the development of the National Energy Act in 1978 also encouraged the acceptance of 'energy audits' for more accurate estimation of energy efficiency in home valuation. The Act also contributed to the development of municipal standards for energy efficiency in new buildings, and helped the development of a representative appraisal methodology for price adjustments made according to efficient features (pp. 459-460).

There is consensus among industry experts that appraisal should be objective and represent an unbiased third party prediction of the sale price of a home (DeLisle, 1984, p. 43). The setting of prices that appraisers must predict is a value of perception, and takes into consideration a number of factors about the property. Therefore in order to maintain a relative level of consistency the value assigned by an appraiser should reflect the current market perspective. To begin, there must be an understanding of the market pricing process, as well as its often informal and subjective nature. As DeLisle (pp. 45-46) explains, the appraiser must take into consideration pertinent attributes of the property such as building construction, as well as external and situational attributes like location, market structure, or financing. The recommendation of this article is that there should be periodic review procedures to account for real estate market fluctuations and technological change (p. 47).

As energy efficiency has consistently been difficult to account for in value appraisals, it has historically been excluded from the evaluation and analysis of a home. However, Hendrickson (1989, p. 25) explains that there is evidence to suggest that

energy efficiency does in fact have a measurable effect on market value. This would therefore be a strong incentive to incorporate it as a factor in the appraisal process. Two common methods of home valuations, the income capitalization and cost approach, may be limited by the fact that they are not based on current market conditions. The alternative sale comparison approach is therefore often preferred as it incorporates relevant market analysis data. What this method does is establish structure and property specific measurement tools for comparison of energy efficiency across similar homes that have recently been sold. A market valuation of the associated energy efficient features is then able to be derived. Identified limitations to this approach arise only in the event where there is insufficient information regarding energy efficiency technologies and their effect on the overall performance of a home (pp. 26-28).

One example to demonstrate this relationship is the Minnesota Energy Efficient Housing Demonstration Program, which studied the sale of 88 new homes in the Minneapolis-St. Paul area. Each home was constructed in 1981 will differing degrees of thermal integrity, as measured by a thermal integrity factor (TIF). It was found that, all other factors being equal, homes with better TIF were sold at a premium of approximately $2,510. Other studies also supported this convention; in Columbus, Ohio, an extra inch of wall and ceiling insulation raised selling price by $500, and reduction of 11,500 cubic feet/year of natural gas consumption raised selling price by $548, all other factors equal. Empirically, research has shown that homes operating at a higher efficiency sold for a higher premium. In Spokane, Washington in 1978, however, a study revealed that there was not statistically significant relationship between selling price and a home's overall energy efficiency (Hendrickson, 1989, pp. 27-28). This was proposed to be a result of the relatively low cost of energy at the time, indicating the effect of such external conditions on homeowner behaviour.

In 1998, Nevin and Watson published a study that provided evidence that energy efficient homes were assigned incremental appraisal values by residential real estate markets reflective of their annual fuel savings. This study compiled data from six case studies conducted between 1981 and 1986, and one published in 1990. Data were collected for the purpose of gaining insight into how the cost of energy and associated

efficiency could be related to residential market value. An expected capitalization rate of 4-10 % and incremental value of $10-25 assigned for every $1 annual reduction in energy bills was found. Historically, investments in energy efficient technologies such as innovative methods of heating, air conditioning, and improved insulation were marked on the basis of income capitalization. That is, the investment payback that they could offer to homeowners. This is the period of time required to achieve a return on the full cost of adoption through a reduction in fuel and utility costs (Nevin & Watson, 1998, pp. 402-404).

Regression analysis presented by Nevin and Watson (1998, pp. 406-407) suggested a significant relationship between a home's overall energy efficiency and its value on the market. Findings presented in this article are supported by other research that indicates market value premiums for energy efficient homes reflect the annual amount that would be saved on utilities/fuel consumption, discounted at the after-tax mortgage interest rate (p. 409). In 1999, Nevin, Bender, and Gazan performed regression analysis for attached and detached homes based on national and metropolitan statistical data from the American Housing Survey (AHS) to investigate the above claims made by Nevin and Watson in the October 1998 issue of *The Appraisal Journal*. On average, an increase in home value of $20 per $1 reduction in utility costs/year was observed, corresponding to a 5 % after-tax mortgage interest rate from 1991 to 1996 (Nevin, Bender, & Gazan, 1999, p. 454).

2.3 Third Party Certification and Market Value

As society's interest in sustainable development has grown over the years, green building features have become more prevalent. This trend has brought about an increasing need for the incorporation or consideration of energy efficiency in market value appraisals. Some previous studies and research suggest that a building's level of efficiency does have an impact on the selling price and perceived market value (Hendrickson, 1989; Pitts & Jackson, 2009). However, appraisal value is dependent on a number of interacting factors, among which include property type, age of home, location, and market conditions (Pitts & Jackson, 2009, p. 115). In order to assist appraisers in their evaluation, a variety of certification programs have been developed. Therefore,

literature that discussed the effect of third party energy labelling or rating systems on the value of a home was also examined.

In her article on efficiency valuation, Price-Robinson (2006, p. 14) cites an instance of one Florida appraiser increasing their estimation by $4,000 based on a high Energy Star® rating of a home. The goal of programs such as Energy Star® in the United States is to raise homeowner awareness of the importance of energy efficiency. In doing so, they hoped to encourage reduced energy consumption and mitigate GHG production. Establishing a system by which appliances and buildings can be evaluated according to energy efficiency could be an incentive to homeowners to use energy more wisely. Energy Star® and related programs also serve to provide a benchmark for energy efficiency in the construction industry. Individuals that invest in making the required and recommended improvements should be rewarded for their efforts, including the benefit of savings reflected in appraisal value (p. 15).

Similarly the Leadership in Energy and Environmental Design (LEED®) program, established by the US Green Building Council, promotes sustainable development through certification of new buildings according to a rating system (certified to platinum). In their first 10 years from 1996-January 2007, a total of 625 buildings had earned LEED® certification (Pitts & Jackson, 2008, p. 115). Since its inception in the US, LEED® has expanded from a system designed for the evaluation of new commercial developments to include specialization in: core and shell development; commercial interiors; existing buildings; neighbourhood and residential developments; and homes. LEED® Canada for Homes was launched in March of 2009 and evaluates new and existing single-family homes, as well as low- and mid-rise multifamily buildings, according to criteria in eight categories of green home building. Points are awarded based on the assessment of a designated professional that correspond to one of four levels of certification. A Certified home rating requires 45-59 points; a Silver rating requires 60-74 points; and a Gold rating requires 75-89 points. The highest level of achievement is Platinum certification, which requires 90-136 points (CaGBC, 2010).

The sales comparison approach to appraisals, described above in the previous section, may prove difficult in the case of homes certified by some third party

organization or under programs such as Energy Star® or LEED®. A problem arises in regions where few properties have earned such a rating, meaning it may not always be possible to obtain comparables. Furthermore, homes referred to as green or energy efficient on the real estate market are not necessarily associated with a certification to support this claim (Adomantis, 2010, p. 198). These properties may have all of the qualifications to obtain a recognized rating, but homeowners have simply not invested the additional time and money for certification. As a result, they may be perceived to be of a lower quality, and not be evaluated on the same merits. Regardless, lack of certification should not impact the market value determined if appraised according to the same energy efficient measurement tools.

In 2007, a study was conducted by the Australian Bureau of Statistics as commissioned by the Australian Government and the Department of the Environment, Water, Heritage and the Arts with the objective of modelling the relationship between energy efficiency rating (EER) and house prices in the Australian Capital Territory (ACT). The study examined the price of detached houses sold in the ACT in 2005 and 2006 using hedonic models in relation to land, distance, neighbourhood, social-economic, and EER data obtained from administrative sources. The results of this modelling showed that there was a statistically significant relationship (at a significance level of $\alpha = 0.01$) between house price and EER. All other housing variables being constant, the average house price of homes included in the study were observed to increase by approximately 1.23 % for every one unit increase in the EER of the building. The inclusion of additional energy efficiency-related variables, such as north-facing windows, and wall and ceiling insulation, had the effect of slightly decreasing the statistical significance of association between EER rating and house price. There are also some factors underlying EER add value to a house for reasons other than energy efficiency, such as the visible feature of double-glazed windows, utility doors, and the negative association of wall and ceiling vents in older homes (ABS, 2008, pp. 23-24).

The implicit price range of EER for a home can be determined, which provides an estimated average value added. This average increase in market value is associated with a 0.5 increase in the EER star rating (equivalent to a one unit increase in the overall

building EER). However, the study did not model how house in the ACT changed with homeowner or realtor disclosure of EER. There could be an effect in this respect as homebuyers that that are relatively uneducated about EER may perceive a house to be worth an additional 0.5-1 % of the house price given the star rating. That is, they assign a price premium based on the inherent worth associated with 'branding' by a third party certification system. Alternatively, well informed consumers, such as a contractor or builder, may not have the same perception. The listed house price should already reflect the EER-associated added value, and therefore these consumers would not place a premium on market value (ABS, 2008, p. 25).

Research related to the market performance of sustainable, energy efficient buildings generally follows either a residential or commercial tract. Another study examined new, single-family residential homes in the Pacific Northwest of the United States. This region is nationally and internationally recognized as an innovator in sustainable building and design, with a reputation for supporting sustainable living through public policy. Built Green, Earth Advantage, Energy Star®, and LEED® for Homes are among the many green building and energy certification systems available to prospective property owners. The Green Building Value Initiative (GBVI), a collaborating organization with the authors of this study, was implemented in 2007 for the purpose of demonstrating the practical value of sustainable certification for both residential and commercial properties. Their key objective was to determine whether or not building certification adds value to a property, and if so, what would be the most effective mode for communicating this information to real estate, finance, appraisal, and other professional communities (Griffin, 2009).

Griffin's report (2009) presents findings related to the residential sector in Oregon and Washington with the objective of determining the market price premium for new, single-family homes that had voluntarily been certified as sustainable by a third party organization. An analysis of certified and comparable non-certified homes was carried out, and average price difference calculated. In the Portland metro area, an average of +3-5 % sales price premium for certified homes was recorded (p.15). These homes were also found to sell an average of 18 days faster than comparable properties (p.15).

Certified homes in Seattle saw an average of +9.6 % sales price premium (p.15). However, these homes were on the market slightly longer than those in Portland, possibly due to differences in the regional housing markets. The findings of this study suggest that certified homes are worth more than their non-certified counterparts. There is also a recommendation for increased collaboration with residential appraisers, real estate brokers, homebuilders, and sustainable building advocates. Cooperation among these groups could help to resolve issues surrounding energy efficiency in home valuation, and improve communication of the potential benefits to the greater public (pp. 15-16).

2.4 Barriers, Benefits, and Public Perception

One prominent barrier to adoption was identified as homeowner reluctance due to uncertainty whether or not they would be living in their home long enough to see the energy savings that would allow for income capitalization (Nevin & Watson, 1998, p. 401). This barrier has helped to define the research questions of our project, and to direct focus onto the role that the real estate market plays in encouraging (or discouraging) the adoption of energy efficient technologies. Undertaking improvements can be further discouraged if the appraisal does not fully reflect the value of energy efficient features into the market value of the home (p. 402). This supports the need for a more comprehensive and inclusive system of residential appraisal that takes into consideration energy efficiency. At the moment, it appears that most of the added value from implementing efficient technologies is recognized following green third party certification by a recognized organization. Traditional real estate appraisal may overlook these features if there is not a corresponding certification or ranking to indicate the standards or quality of building that were met (Griffin, 2009).

Other studies conducting that have included a survey component find homeowners across social-demographic groups agreeing upon a number of barriers to adoption. These barriers include that the pay-back process takes too long, the lack of skills, information, and time available regarding installation, and uncertainty or scepticism about the potential benefits (Parker, Rowlands, & Scott, 2005, p. 183). Parker *et al.* (pp. 183-184) also found that the cost of energy efficiency upgrades was a barrier, but less so for conservative energy consumers. That is, homeowners with the drive and

ability to reduce energy consumption in order to capitalize on savings were not as likely as steady or heavy consumers to label cost as a 'very important' variable.

Those with the greatest potential to benefit from an investment in energy efficiency upgrades are residential homeowners (Parker *et al.*, 2005, p. 177). This is because renters often do not have the authority or financial capability to make significant changes to the unit. Along these same lines, length of home ownership is also identified as a variable that has an effect on perception and likelihood of adoption (Scott, Parker, & Rowlands, 2000). While the survey conducted by Parker *et al.* (p. 184) did not recognize 'planning to move within 5 years' as an important barrier (61 % of the total surveyed), this view was not held by most of the conservative consumers. The implication could be that individuals more inclined to adopt energy efficiency strategies may not do so if they plan on selling their home within the next 5 years. Therefore, the recognition of energy efficiency upgrades in the process of residential appraisal would help to overcome this perceived barrier.

There are many benefits, both social and environmental, to implementing and improving the 'greenness' of a home or property. Research also lends support for derived economic and financial benefits. The comparatively high initial costs may be recovered due to the high performance of energy efficiency technologies that lead to increased savings on energy consumption and related costs. Furthermore, government and municipal incentive programs can aid in the implementation of energy efficiency features (Pitts & Jackson, 2008, p. 116). The benefits of capturing the true value of a home by incorporating its level of energy efficiency into appraisals include: increased financial flexibility of homeowners; improved energy efficiency of new buildings and improved construction standards; and higher incidence of energy efficiency retrofitting of existing homes (Hendrickson, 1989, p. 25).

According to Pitts and Jackson, the residential market in the US has been slow in its recognition of the value added to a property as a result of energy efficiency features. Generally, the process of home buying is tied more to an emotional response rather than one that considers the logic of improved energy efficiency. The hope is that the value placed on green commercial buildings will eventually translate to better recognition of

the benefits of energy efficiency in residential buildings, especially single-family homes (Pitts & Jackson, 2008, p. 116).

The consumer and homebuilder survey conducted as part of the study on the market impacts of third party certification on residential properties also provides unique input on public perception from two distinct points of view; the general public and more informed industry experts (Griffin, 2009, pp. 17-29). Findings of the consumer survey indicated that residents value sustainable attributes, most notable energy efficiency and improved indoor air quality. Holding all other factors equal, 90 % of surveyed individuals reported that they would rather buy a certified home over a non-certified equivalent as their next residence (p.18). It was also agreed that they would pay more to remain in a sustainable home. A notable majority, 80 %, of those surveyed living in third party certified homes claimed that they would pay up to 5 % more in order to buy a certified sustainable home over a non-certified comparable (p. 17). Third party certified respondents also noted a greater incidence of reduction in utility bills over self-certified home owners, which could serve as an incentive to the adoption of energy efficient technologies (p. 18).

Findings of the homebuilder survey indicated that awareness of sustainable features had grown significantly over the five years prior to the publication of this study. This has not, however, translated to a direct effect or increase in the demand for third party certification. It was noted that it is more expensive to build homes to a certification standard than simply to code, though the price disparity is coming down; generally an increase in cost of 5-10 % is found for certified homes (Griffin, 2009, p. 24).

It is also important to consider perception and human behaviour in the context of an increasingly environmentally-aware global society. While ratified under the Kyoto Protocol, Canada was expected to reduce GHG emissions to 6 % below 1990 emission levels by the year 2012. A number of local initiatives were undertaken to help the nation reach this goal, 'highlighting the importance of cities in environmental and economic policies' (Parker *et al.*, 2005, p. 174). The Energy Research Group estimates that Canada's residential sector is responsible for approximately 17-20% of total GHG emissions, the third largest source behind industry and transportation. There is, however,

a trend of increasing residential energy efficiency leading to declining emissions over time, given the growth in demand for energy does not exceed the gains from efficiency (p. 175). Environmental action, such as voluntary participation in residential energy efficiency improvements, must be supported by an understanding of the environmental issues, knowledge of available resources, and the personal drive to bring about change.

3.0 Results and Discussion

The following results were generated during the course of the research, which incorporate discussions on the literature reviews, interviews, and surveys.

3.1 Residential Energy Efficiency Programs in Canada

In Canada there are a variety of home energy incentive programs that are used to help homeowners undertake energy efficiency upgrades to their homes. These programs are most commonly rebate systems that require homeowners to complete an application and mail in their receipts obtained from the upgrade (IndEco Strategic Consulting and Hollett & Sons Inc., 2011). This process has been known to be time consuming and most of the programs offered today require the homeowner to obtain an energy label or rating from an approved rating system. Most Canadian cities require an EnerGuide rating in order to be considered for home energy incentives.

The HAT Smart II program offered by the municipality of Medicine Hat, AB has done this and also offers a leasing opportunity through a third party company Enmax; an energy company (HAT Smart II, 2012). Other municipalities have taken it upon themselves to offer monetary incentive in combination with other Provincial and Federal grants and have stream lined the processes of obtaining the incentives for energy efficiency investments. This is evident in Toronto's Live Green campaign (City of Toronto, 2012). Closer to home, the District of Saanich offers rebates on building permits for energy efficient upgrades to homes (District of Saanich, 2012). Lastly, many municipalities around the globe are turning to municipal financing programs to help encourage homeowners to undertake home energy efficiency upgrades to their homes. The City of Ottawa is currently in the process of creating a program that is similar to the Pay As You Save® program current used in the UK. These financing alternatives are generally cost neutral to the municipality, as they are able to extend the term of the loan

and the savings obtained by the homeowner on their energy bills is greater than the payments (Ecology Ottawa, 2012). Table 5 outlines the details of the various residential programs offered by some of Canada's municipalities.

Table 5. A detailed list of the different programs that are currently used in the industry to encourage home energy efficiency investments. The municipality, program details, incentive to homeowners and key program features are outlined.

Municipality and Program Name	Program Details	Home Energy Incentives to Home Owners	Key Program Features
***Toronto, ON – Live Green Campaign**	• Provides a one-stop website for resources, rebates, tips and tools to help residents lower emissions • Part of Toronto's Climate Change, Clean Air, and Sustainable Energy Action Plan • Uses experts in many different fields to guide the program and provides funding for many different projects	• Offers rebates on top of other government rebates • Home Energy Assessments, Hot Water Tanks, and Heating and Cooling • Reduced savings on energy bills • Live Green Membership card is offered to residents to use at participating businesses; they are offered discounts and special deals	• One stop destination for residents to find information on the different energy efficient upgrades • Provides educational material, seminars and classes to residents to learn more about home energy efficiency • Information is easily accessible through their website
Ottawa, ON – Ottawa Energy Retrofit Financing Program	• This is a proposed program to help home owners save money by undertaking home energy retrofits • Would use low cost, long term financing where the annual payments are lower than the savings obtained by the homeowner • Cost neutral to the municipality • The loan is tied to the home, not the residents. • Similar to PAYS program in the	• Savings on energy bills by undertaking the retrofits • The loan is tied to the title of the house not the home owner	• Program will be able to support larger retrofits as terms can be negotiated • Financing can be shred or passed on to new owners of a home • Voluntary program; not mandated by the city

Municipality and Program Name	Program Details	Home Energy Incentives to Home Owners	Key Program Features
	UK		
District of Saanich – Green Home Building Rebate Program	• Offers rebates on building permit fees for building energy efficient homes or undertaking energy efficient upgrades	• Free solar hot water plumbing permit • 30% rebates are given to people applying for energy efficient building permits for upgrades • New homes under 2000sq.ft will receive a 50 % discount on an energy efficient home	• Makes obtaining building permits more appealing to homeowner
***Medicine Hat, AB – Hat Smart II**	• Environmental Initiative to help homeowners upgrade their homes through various rebates and grants, and provides educational resources • Existing homes are eligible for grants that upgrade furnaces, hotwater tanks and insulation – rebates range from $400 to $1000 • Residential Solar Electric Leasing or Solar System Purchasing programs incentives for adding a solar system to their house – leasing is through Enmax • New homes are eligible for incentives who are seeking an EnerGuide rating and/or third party certification	• Cost savings on installation of retrofits and on energy bills post installation for existing homes • New homes can receive monetary incentives for obtaining an EnerGuide rating and/or third party certification • Home owners have the ability to lease their roof to Enmax – an energy company – to offset the cost of installing a PV or SHWS	• Options for both new homes and retrofits

The various programs offered across Canada are fairly similar in nature offering monetary incentives or various low-cost, long-term financing options either through third party organizations or local governments. These programs are used to encourage homeowners, buyers, and sellers to increase home energy efficiency with the goal of reducing utility costs and GHG emissions. As identified by Griffin (2009), the knowledge regarding home energy efficiency and sustainable development practices has increased in recent times, although this understanding has not translated into the home energy efficiency undertakings themselves. One could speculate that the monetary and financing home energy efficiency programs currently offered by municipalities are not persuading homeowners to undertake these improvements and it is likely that an innovative strategy is required to increase home energy efficiency adoption for residential dwellings.

3.2 Case Studies

In order to determine whether energy investments impact the overall value of a home, case studies by other jurisdictions and their residents were examined to determine whether a relationship between home energy efficiency and home valuations exists. From the case studies examined there seems to be some correlative information that is apparent in the literature. To the north, the State of Alaska and the Alaska Craftsman Home Program (ACHP) have recently completed a study to determine the barriers, opportunities, and solutions for increasing the demand and value of energy efficiency investments (Hites McGee, 2012). The study identified consumer demand and education, and the current knowledge base of industry professionals regarding energy efficiency as major barriers for limiting home energy efficiency investments (Hites McGee, 2012, pp. 7-9). A similar study was undertaken in the UK – specifically England and Wales – to determine why home energy efficiency was not being valued in the home buying or selling processes (Royal Institution of Chartered Surveyors [RICS], 2010). The study identified similar barriers to the ones found in the Alaskan study and it was determined that the demand and value of energy efficiency as well as the knowledge base of industry professionals as significant barriers for limiting home energy efficiency investments (RICS, 2010, p. 4). Table 6 contains the summaries of the case studies that have been examined.

Table 6. Summaries of case studies completed by other institutions regarding home energy efficiency and the valuation of homes. The jurisdiction, details, barriers, drivers, and recommendations of their reports are highlighted below.

Jurisdiction	Details	Barriers	Drivers	Recommendations
Alaska – Alaska Craftsman Home Program Study (2012)	• Program was designed to help homeowners undertake energy efficient retrofits and obtain energy ratings • Alaska Craftsman Home Program (ACHP) identified barriers, opportunities and solutions to energy efficiency and the valuation of homes • Lowered energy costs to homeowners – in some communities were taking out a second mortgage • Homeowners will be able to reduce the homes operating costs and allocate money to other needs	• Market demand for energy efficiency • Education of consumers • Inadequate valuation tools, research, and comparisons • Energy rating accessibility • Retrofit costs • Inconsistencies with consumer incentive program • Industry professional education on energy efficiency	• Increase consumer demand for energy efficiency • Development of proper energy efficiency valuation tools for homes • Accessible and accurate energy ratings/labels	• Increased awareness of the benefits of home energy efficiency would increase market demand for investing in energy efficiency • Create a universal method/index for valuing home energy efficiency in local homes based off a local standard home – this would be used to compare the efficiency with the rating • Education is needed for industry professionals regarding energy efficiency • Make energy labels more easily attainable by the homeowner and accessible to realtors

England and Wales – Energy Efficiency and Value Project (2010)	• Undertaken by the RICS and CLG to understand why energy efficiency investments were not being valued in the home buying process • Phase 1 looked at determining the home buying and selling processes and identified the drivers and barriers associated with home energy efficiency • Phase 2 looked at how to increase the value of energy efficiency • Problems in both the US and UK were noted to be similar	• Value of energy efficiency is tied to demand – this sets up the vicious cycle (Figure 1) between all stakeholders • Barriers are more influential than the drivers of energy efficiency • Working professionals (advisors, real estate agents and appraisers) are not properly trained to promote energy efficiency to homeowners • Proper valuation tools are not currently available	• Using segmentation of the markets to increase participation – based on demographics, economic upwells and property type • Lender participation can drive participation as demand increases • Transform market into a virtuous cycle (Figure 3) – increase demand for energy efficiency	• Better understanding of the drivers for the UK market is needed to increase the value of energy efficiency • Energy labeling needs to educate homeowners on energy efficient improvements • Segmentation of property types, homeowners and economic upwells may create opportunities for energy efficiency • Compile energy efficiency data with property data to create a process of comparison for home valuations • Increase industry professional understanding of energy efficiency, associated technology and valuation

These studies, although worlds apart, identify critical barriers that are likely observed within Canada as well. The RICS (2010, p. 5) study described a "vicious cycle" shown in Figure 1, which outlined the four major stakeholders involved in the home energy efficiency market and the roles they play to drive the market conditions. When the benefits of home energy efficiency upgrades go overlooked or disregarded by homeowners, there is little incentive for industry professionals, like Realtors, to promote or suggest home energy efficiency upgrades during the home buying and selling process.

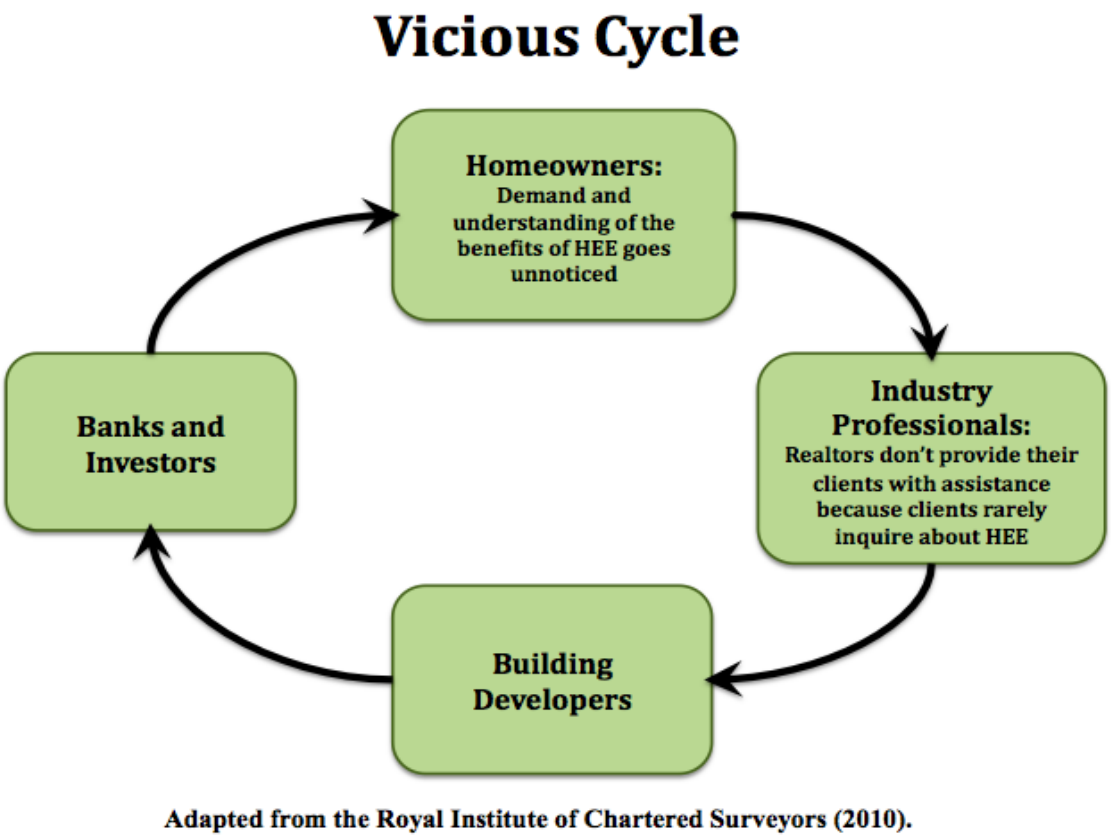

Figure 1. The vicious cycle, as adapted from the RICS (2010, p. 5), illustrates the likely demand cycle for home energy efficiency upgrades in the City of Colwood. This assumes that the lack of demand and understanding exhibited by homeowner's will sway Realtors by not actively assisting homeowners with undertaking energy efficiency upgrades during the home buying and selling process.

The studies also indicate that increased consumer demand and knowledge amongst industry professionals may be used to breakdown these barriers. When these barriers are broken down, consumer demand will ultimately drive the market in a positive direction, as the benefits and importance of home energy efficiency upgrades will have increased; although this is sometimes easier said than done. Once the demand for home energy efficiency upgrades increases, the market itself could shift from the "vicious cycle" – mentioned earlier – to a "virtuous cycle" shown in Figure 2, which was also identified in the RICS (2010, p. 14) study. If the demand from homeowners increases then industry professionals, like Realtors, may become compelled to sell and suggest home energy efficiency upgrades during the home buying and selling process. These industry experts will ultimately become more informed on the topic of home energy efficiency further supporting the cycle.

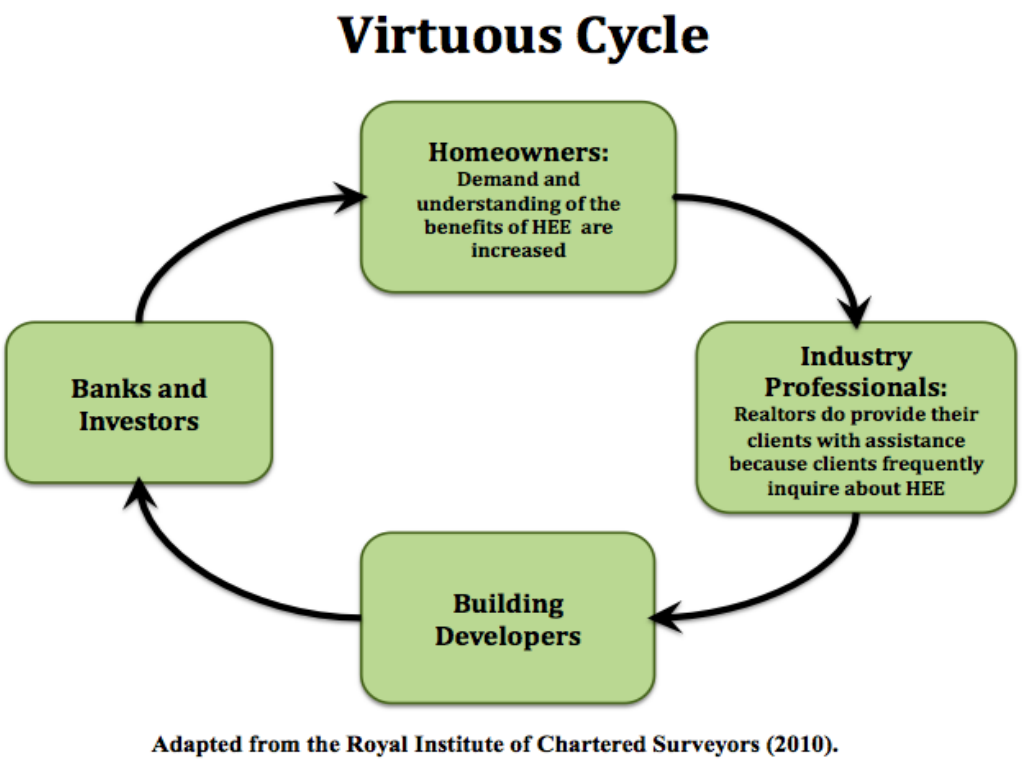

Figure 2. The virtuous cycle, as adapted from the RICS (2010, p. 14), illustrates the desirable demand cycle for home energy efficiency upgrades within the City of Colwood. The cycle assumes that the demand and understanding exhibited by homeowner's influences Realtors perception to actively assist homeowners with undertaking home energy efficiency upgrades during the home buying or selling process.

3.3 Survey

A survey of local Realtors within the CRD was e-mailed to 168 Realtors from the Westshore communities on June 19, 2012. Of the 168 individuals sampled, 11 responses were recorded over a two-week time frame, with a response rate of 6.5 %. The response to the survey was weak, which indicates a barrier when trying to undertake a research project to expand the knowledge in this field of study. The participants of the study are most likely individuals who have had some previous experience or understanding of home energy efficiency or energy labelling programs.

The results from the 11 participants in the survey were graphed using histograms and pie charts. The majority of the participants represented the Westshore communities, as indicated in Figure 3. This indicates that the information obtained from the survey was directly applicable to the City of Colwood and the entire Westshore region. The responses to the various 'Yes/No' questions posed to the Realtors are shown in Figure 4. Some interesting results were observed; the majority of respondents indicated that energy efficient upgrades are likely to increase the value of homes, yet they do not actively encourage their clients to undertake these improvements. By not encouraging their clients to undertake these improvements, the vicious cycle (Figure 1) will continue to occur because there is little incentive to complete these installations.

All of the respondents indicated that they were aware of energy labelling programs, such as EnerGuide. However, there was not consensus that labelling is a useful tool for increasing a home's overall marketability. A common misconception within the industry is that a house that scores low on a labelling system will detract from its overall value. Even though Realtors are aware of energy labelling programs, 36 % of respondents feel these labels do not contribute to the marketability of a home; 27 % are neutral, and 27 % agree that they do contribute to the marketability (Figure 5). Currently, the literature suggests that homes that receive third party certification will increase a homes value, however only if the demand for home energy efficiency is present (Pitts & Jackson, 2008).

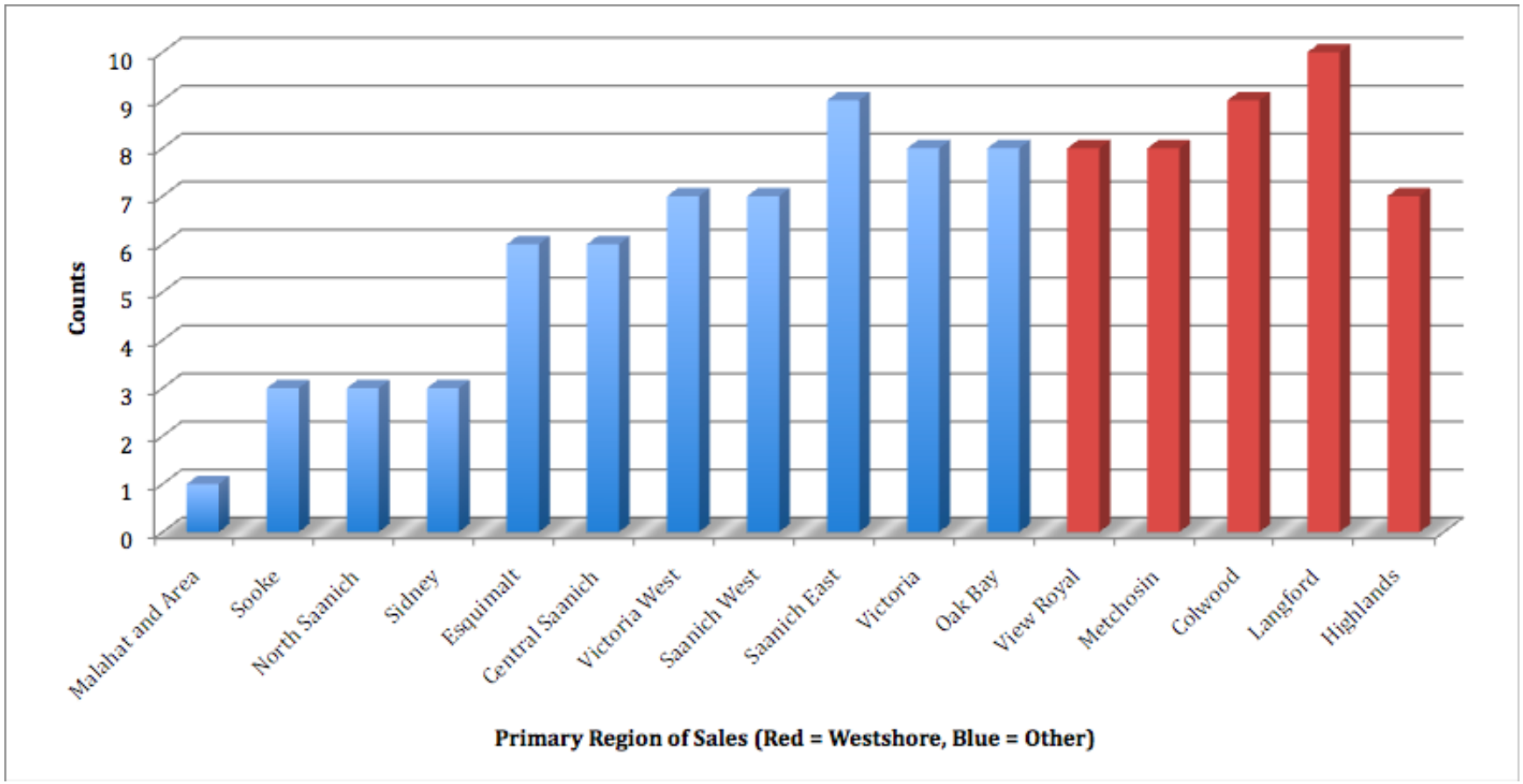

Figure 3. Histogram of the primary region of sales for the 11 Realtors surveyed. Most of the Realtors worked in multiple regions. The red bars indicate the number of Realtors that work in the Westshore region (View Royal, Metchosin, Colwood, Langford and Highlands), and the blue represents the remainder of the CRD. The majority of the Realtors tend to come from the Westshore and the survey was sent out on 19 June 2012.

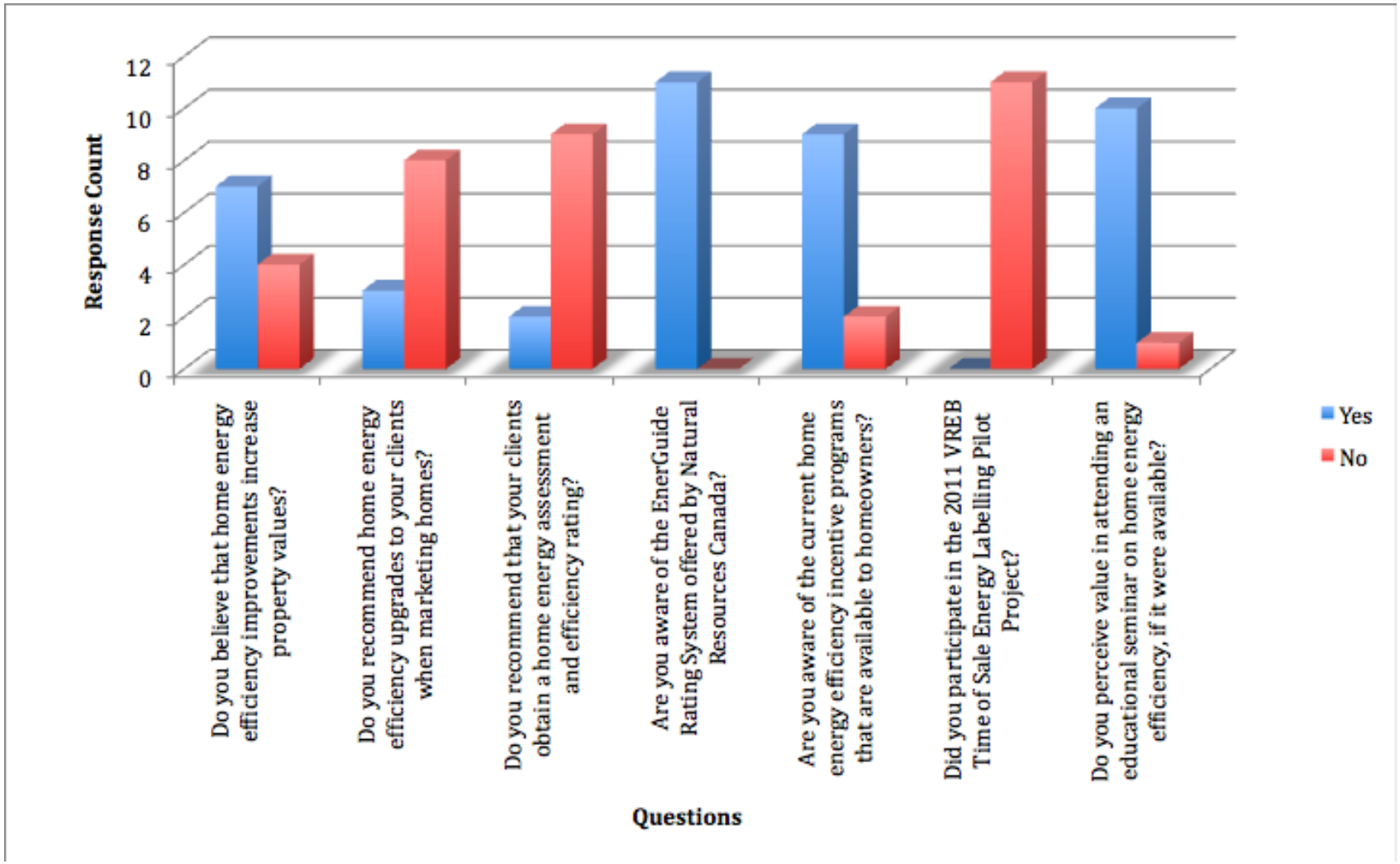

Figure 4. Histogram of the Yes/No questions posed to the Realtors in the survey that was distributed on 19 June 2012. The related questions are on the X-axis and the response count is on the Y-axis. The bars in blue represents the proportion of individuals who responded Yes, while the red is the proportion of Realtors that responded No.

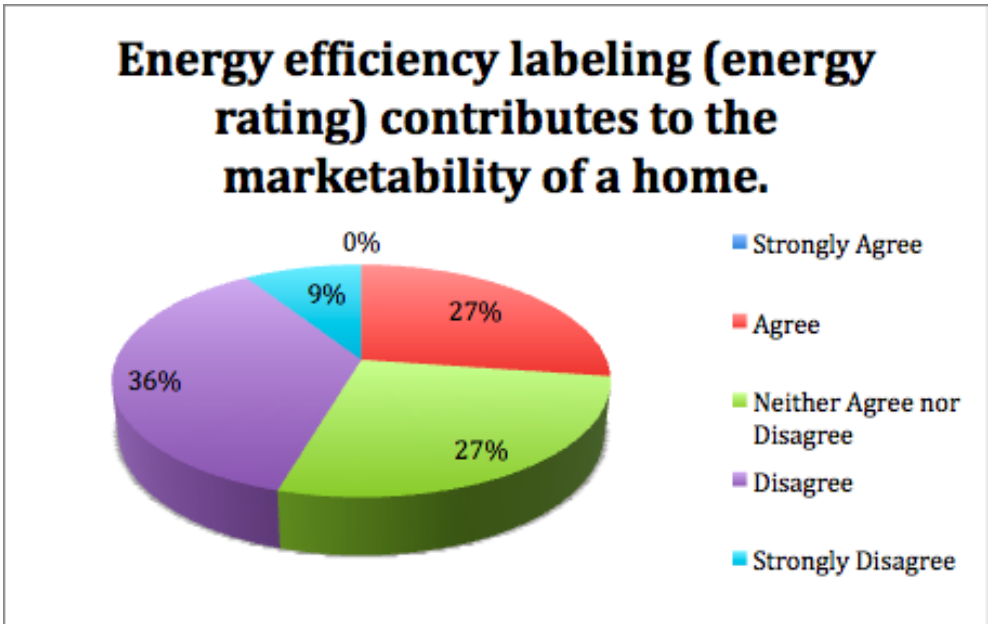

Figure 5. Pie chart displaying the responses, in percentages, to the question "Energy efficiency labelling (energy rating) contributes to the marketability of a home." The majority of the responses (36%) indicate that energy labelling is not a marketable feature of a home. The survey was distributed on 19 June 2012.

Questions were created using a Likert scale to determine Realtor's interpretation to their client's awareness of home energy efficiency. These questions and their responses can be seen in Figures 6, and 7. Not surprisingly, the Realtors indicated that energy efficiency is moderately important to their clients, however their clients rarely inquire about home energy efficiency. This provides further evidence that the demand for home energy efficiency within the Westshore area is poor. As a result of the poor demand, the vicious cycle will likely continue until homeowners understand the benefits of undertaking these upgrades. The demand for home energy efficiency was poor in the Alaska and UK markets examined in the Hites Mcgee (2012) and RICS (2010) studies, respectively, which lead to the vicious cycles.

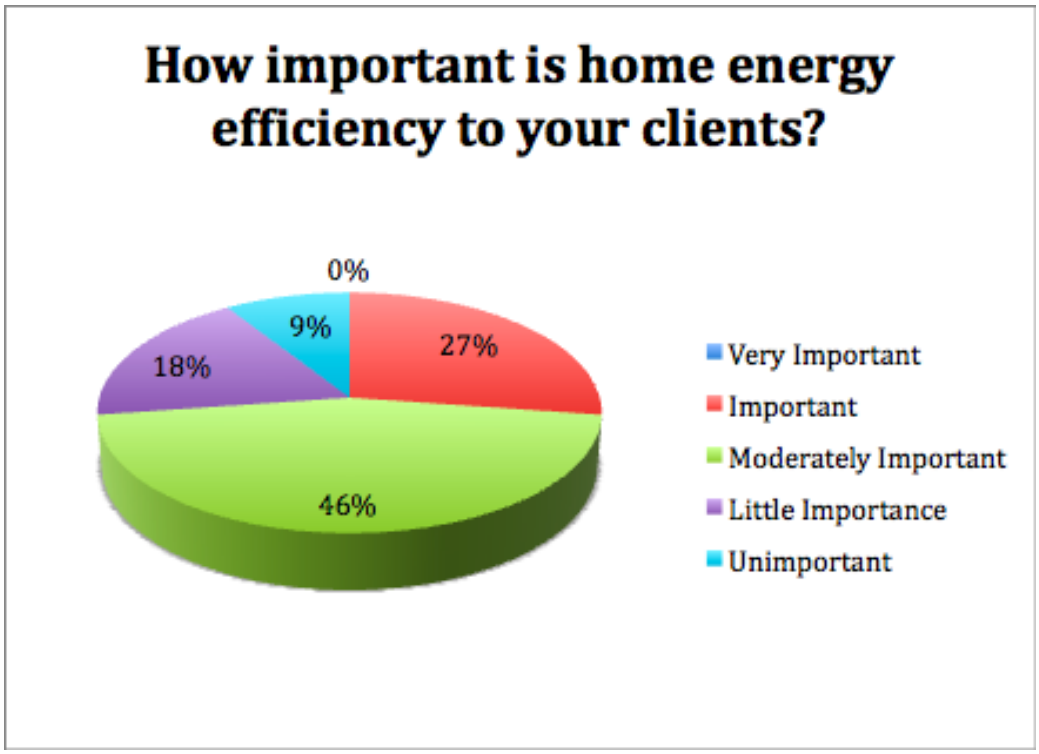

Figure 6. Pie chart displaying the responses, in percentages, to the question "How important is home energy efficiency to your clients?" The majority of the responses (46%) indicate that home energy efficiency is moderately important to their clients. The survey was distributed on 19 June 2012.

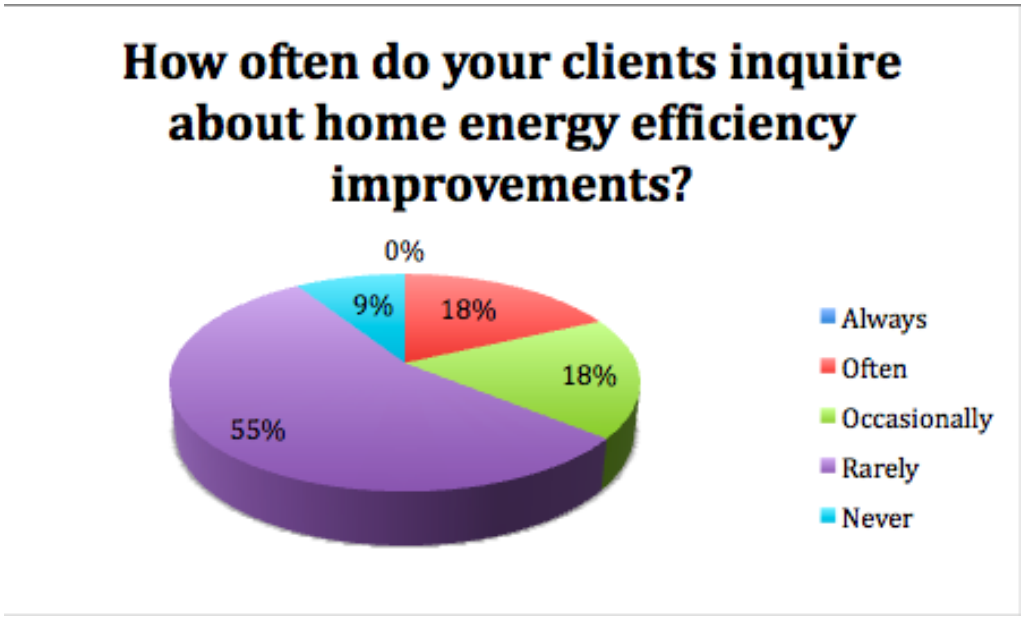

Figure 7. Pie chart displaying the responses, in percentages, to the question "How often do your clients inquire about home energy efficiency improvements?" The majority of the responses (55%) indicate that their clients rarely inquire about home energy efficiency. The survey was distributed on 19 June 2012.

Overall, the sample size and response rate to the survey was poor, which may be an indication of the current market conditions in the Westshore area and the City of Colwood. The results of the survey were generally as expected, and they were fairly consistent with the two case studies that highlighted consumer demand and knowledge of industry professionals as the main barriers for home energy efficiency upgrades in their respective markets. It would be ideal for the City of Colwood or other institutions to offer educational seminars to Realtors regarding the benefits of home energy efficiency upgrades, as their was a strong response when asked in the survey. These seminars would be helpful when promoting local programs and initiatives and would likely increase awareness amongst Realtors and homeowners throughout the home buying and selling processes.

3.4 Interviews

Interviews have been conducted with the following individuals: Jim Bennett from the Victoria Real Estate Board; an Energy Advisor from a local service organization to obtain information about their Home Energy Ratings Program; and Chris Corps from Sequel Integrated Resource Management.

3.4.1 Interview with Jim Bennett (Government Relations Coordinator, VREB)

During an interview with Jim Bennett, who is the Government Relations Coordinator at VREB, several important factors about the valuation of homes were identified. First, a pilot program in Oak Bay and Saltspring Island was initiated to encourage homeowners to get an energy assessment of their homes prior to selling, which then went on the Multiple Listing Service (MLS) as a rating. The government was pushing a mandatory program for assessments, but this program was not implemented. With the pilot program that was in place, the price of an assessment was $300 with the province subsidizing $150 through the LiveSmart program. Mr. Bennett acknowledged that there is a problem with having a mandatory program in place by mentioning that Oak Bay currently has a strong market with a high turn around, therefore the program should be mandatory because when it is optional, there does not seem to be enough time for the issue to be brought up. The issue has to be presented in a way that makes it a good

option for the seller. For example, by getting the rating done, the purchaser knows about the house and what needs to be done to move that rating up and it comes pre-packaged with eligibility for rebates. At the time of the program, Saltspring Island had a slower market with a lot of interest in the program because there was time for the Realtor to bring up the issue. Energy assessments should not be mandatory in slow, small markets with a lot of older houses because the majority of consumers are looking to tear the homes down and build new houses. The EnerGuide rating may bring the value down, which would not be good for the seller to advertize on the MLS. The thought is there, but in the opposite direction. The sellers do not want the rating to bring the price of the house down; therefore, they do not want to get the appraisal done. Another obstacle on Saltspring Island is that a lot of the houses there are summer homes and the people who own them do not live there all year round and can be hard to reach.

Phase 2 of the pilot project was to get organizations to buy in and pay for the assessments. When VREB was looking for sponsors, they found many different opportunities for sponsors to pay for them, but when the government and BC Hydro took over there was not a lot of communication about the free assessments. Communications were weak for phase 2 and it was a learning experience for what should be done. There needs to be more communication and advertisement between the Realtors and the public who are looking to sell their houses.

3.4.2 Interview with an Energy Advisor from a local Energy Assessment Service Organization

The energy advisor (who wishes to remain anonymous) spoke about why the Time of Sale pilot programs on Saltspring Island and in Oak Bay were not popular. One of the factors that affected the popularity of the program in Oak Bay was a strong real estate market which did not allow enough time for the energy assessment process to take place. Currently, there are two financing programs tied to energy assessments: one in Vancouver and one in Nelson. The one in Vancouver is not doing very well, but the one in Nelson is doing incredibly well. In Vancouver the houses are worth a lot more and the market is very short lived. They are very different markets, which affect how well they work, which is similar to the situations in Oak Bay and on Saltspring Island.

The Time of Sale program was offered during a bad time for incentives in the province, at a time with a lot of bad press about incentives. There are a lot of factors that can effect the popularity. The programs take a long time to be put into place, which can be a drawback because by the time they are ready, it may not be good timing anymore.

The number one improvement suggested by the energy advisor was insulation improvements. If the house is not well insulated, then any other improvements will not be as effective because the house will still lose heat through the building envelope. The recommendations that are given once the assessment has been done are based on where the homeowner's interests are. Those are the areas where the retrofits are emphasized the most because they are most likely to be undertaken. The other recommendations are put into the report by the service organization with the hope that if the house is sold, they will be passed on to the new owners who can implement them if they wish.

The energy advisor mentioned that there needs to be more education about the energy assessment systems. The Realtors need to be more informed about how the EnerGuide rating system works. Certain programs only finance certain retrofits that provide substantial, long-term gains; that is why they do not include windows. The easiest way to educate people about other retrofits is by beginning with window upgrades. This is because there is strong interest in that area, and other more effective ways to retrofit are not considered as often. Education is very important in moving ahead with these energy assessments and incentive programs, which can be done through educating contractors as well as the Realtors.

3.4.3 Interview with Chris Corps (Sequel Integrated Resource Management)

During the interview with Chris Corps, the President of Sequel Integrated Resource Management and a land economist, several issues pertaining to the market value of homes and their association to energy efficient upgrades were discussed. In particular, there were three key topics that will be addressed below, including: marriage value, life cycle valuation, and full-cost accounting.

The concept of marriage value is based upon the notion that compromise is at the heart of every negotiation. With respect to home energy efficiency upgrades and the

associated impact on the market value of a home, marriage value can be used to predict the added value of a given improvement when all other factors are not taken into account.

For example, if a homeowner installs an energy efficient upgrade at a cost of $10,000, the expectation is that the total increase in the value of the home should be equal to the upgrade cost. The homeowner then places his home on the market. In this scenario, it is assumed that the potential buyer also places value on the upgrade; however, assuming that the negotiations are based solely upon the upgrade value, the concept of marriage value tells us that the buyer will open the negotiation at a low, or highly discounted value for the upgrade. For this example, the opening offer would be at the listed price of the home plus $1 for the upgrade. The seller will counter with a marginally discounted counter-offer of list price plus $9,000. The negotiations will proceed until a compromise is reached; whereby, a mid-range point is settled upon so that both parties feel satisfied. In this case, the compromise would occur at the listed price of the home, plus $5,000, or 50 % of the upgrade value.

The marriage value concept therefore predicts that – all things being equal – the true value of an object will never be realized due to the nature of the negotiation process. In order for the negotiation process to be successful, both parties must compromise and allow for some give and take. For home energy efficiency upgrades - because these are often seen as add-ons to a home - they become one of many factors within the negotiation process.

Life cycle valuation is a financing option, which incorporates the long-term costs and savings into the valuation of an energy efficient upgrade. In this manner, the full savings potential and costs are accounted for.

For example, an energy efficient upgrade with an estimated lifespan of 20 years and projected savings of 10 % is installed at a total cost of $10,000. The typical method of payment would be upfront and the savings would be accrued over the next 20 years. This method would see all of the costs paid for in present day dollars; however the savings would see increases in value as inflation and energy costs rise over time. A life cycle valuation process would spread the costs of the upgrade over the lifetime of the

upgrade. By spreading the costs over the 20-year period, the payments would be based on present day dollars; whereas, the savings would increase in value as inflation and energy costs rise over time, while the payments would remain based on the original $10,000. This would maximize the return on investment, while mitigating the original impact of purchase. Traditional accounting uses the term discounted cash flow, in which all costs are calculated in present day dollars and no consideration is given for future inflation. This discounts the value of the upgrade and results in an inaccurate value calculation when attempting to assess the impact of home energy efficient upgrades on the market value of a home.

Full-cost accounting is another technique that is often misused when assessing the market value of energy efficient upgrades. Traditional accounting measures only the internalities associated with an upgrade; whereas, full-cost accounting includes all of the externalities as well. Some of the positive externalities associated with energy efficient upgrades include: lowered energy use; lowered GHG emissions; employment related to the manufacture and installation of upgrades; and unemployment related to the reduction in resource requirements.

The impact of lower energy usage has many ramifications beyond the initial costs savings achieved for the homeowner. The reduction in energy use results in reduced need for infrastructure, which in turn lowers the costs to the energy utility. The general public will therefore receive a benefit by way of lowered energy unit prices. The same potential for public benefit occurs with GHG reduction; lowered energy usage results in lowered GHG emissions, which provides benefits to the public by way of reduced climate change pressure. Additionally, employment related to technology manufacture and installation may increase employment in some sectors while reducing employment in others.

Each of the above listed externalities adds to or reduces the value of an upgrade; however, the homeowner is neither compensated nor charged for the associated external costs. In this manner there is an incomplete accounting of the value of upgrades. While full-cost accounting requires extensive research and tracking to realize the complete impact of energy efficiency upgrades, the true potential can only be understood via full-cost accounting.

Each of the three above concepts: marriage value, life cycle valuation, and full-cost accounting, are interesting in and of themselves; however, if taken together and applied alongside traditional accounting practices, the valuation of energy efficient upgrades would change from the manner currently used. The valuation of the market value of a home is often subject to various market pressures and subjectivity among Realtors. If some of the concepts listed were incorporated into the valuation strategy employed by homeowners, Realtors, home buyers, and financial institutions, a better reflection of actual value may be achieved.

According to Mr. Corps, current incentive programs and labelling programs are not achieving the desired effect of promoting home energy efficiency upgrades. Additionally, current market valuation strategies do not accurately reflect the value of energy efficiency upgrades; however, by employing some of the strategies listed above, it may be possible to increase the perceived value and therefore the marketability of the upgrades.

4.0 Conclusion and Recommendations

The objectives of this report were to address two questions regarding home energy efficiency innovations: What are the impacts of home energy efficiency innovations on the value of properties, and what methods are other jurisdictions adopting to address the issues surrounding home energy efficiency upgrades? In order to address these questions, the impacts of implementing certain green technologies on the resale or market value of a home were investigated, along with the key barriers to adoption, which prevent homeowners from capturing the potential benefits. Past and current jurisdictional programs were also discussed to examine the success and effectiveness of various methods for encouraging home energy efficiency. Original data from a survey of Realtors local to the Westshore communities, as well as semi-structured interviews with industry professionals, was analyzed to supplement the findings from a preliminary literature review.

Information on available energy efficient retrofits for homes suggest that among the most beneficial to improving overall performance and capturing possible savings are improvements to hot water systems, electricity, and building materials. Consumption of

hot water accounts for up to 20 % of a home's total energy consumption, and the installation of a high efficiency hot water tank could increase efficiency by approximately 40 %. Additionally, the use of CFL and LED lighting can lead to a 75 % reduction in energy over traditional incandescent bulbs. In building construction, better efficiency can be achieved with the use of enhanced insulation, commonly noted by industry experts as one of the best investments in terms of payback period and overall performance. Unfortunately, there still exists a gap in knowledge between the average homeowner and more informed consumers such as contractors and energy advisors. As a result, consumers and even Realtors (as indicated from the small group of respondents from the survey) perceive more visible features such as new windows or aesthetic kitchen and bathroom renovations as having greater potential for a return on investment in terms of market value increase.

As society becomes more environmentally conscious, however, individuals are gradually adopting more green and energy efficient strategies. This includes initiatives directed towards increasing residential energy efficiency not only to reduce consumption and GHG production, but to capture the associated economic benefits. A review of current residential programs and case studies suggests that an understanding of the vicious and virtuous cycles (refer to Figures 1 and 2, respectively) could be beneficial to developing a system built upon positive collaboration between real estate professionals, developers and constructors, and the banking industry. Increased demand for energy efficient features by homebuyers will prompt real estate professionals to better incorporate energy efficiency into market valuation and marketing strategies, which will encourage a higher standard in building materials and efficient design supported by increased financial investment.

Evidence cited in this report indicates that homes with energy efficient features have the potential to be appraised at a higher value than comparable properties. Cases also present data to suggest that certification of a home by third party organizations can add a market price premium as labelling can give the perception of better quality (ABS, 2008). At the moment in Victoria it appears that while industry professionals are aware of the benefits, most do not actively encourage energy efficient upgrades or recognize

them as a significant selling feature in a home. Additionally, literature suggests that grant application processes are lengthy and confusing, a potential barrier to adoption (Hites McGee, 2012). Financing options must be made easier and more attractive to homeowners, particularly to overcome the hesitation of those that may plan on selling their home within the next five years.

4.1 Recommendations for Solar Colwood

Based upon the results and conclusions of this report, the following recommendations are made to Solar Colwood:

- Provide education seminars to Realtors on the benefits associated with energy efficiency upgrades
- Provide education seminars to homeowners on the benefits associated with energy efficiency upgrades
- Investigate options to simplify the process (grants, permits, etc.) surrounding the implementation of home energy efficiency upgrades for homeowners and builders

Solar Colwood may find it beneficial to provide an education seminar to Realtors in Victoria and the surrounding area. In the survey that was completed, the majority of respondents perceived value in attending an educational seminar on home energy efficiency, if it were available. Comments were made by the Realtors that participated suggesting that, "There is still a need to raise the profile of energy efficiency. The federal and provincial programs of providing assistance to homeowners are very beneficial" (Respondent #2). Another Realtor stated, "Any seminar which educates Realtors on the efficiency of a home is a good thing, as it will help the Realtors to educate their customers, which is what I really need to enable me to promote any energy efficient programs" (Respondent #3).

Providing education to homeowners would be an opportunity for Solar Colwood to clarify many of the issues that currently surround the grant program and aid homeowners with regards to the selection of appropriate home energy efficiency upgrades. It has been identified that many homeowners find the entire energy efficiency upgrade process confusing and overwhelming. Any attempt to clarify and demystify the

grant process, the energy assessment process, energy efficiency technologies, and/or the long-term benefits of energy efficiency would likely add to the success of the Solar Colwood project.

Many builders, Realtors, and homeowners find that the process surrounding grants and approval for some of the home energy efficiency innovations can be time consuming and complex. It may be beneficial for Solar Colwood to investigate options that are used by other jurisdictions with regards to the grant and approval process.

4.2 Recommendations for Future Research

Based upon the results and conclusions of this report, the following recommendations are made for future research:

- Investigate financing/incentive alternatives regarding home energy efficiency upgrades, including:
    - the proposed PAYS-BC financing program
    - the proposed changes to the Natural Resources Canada, EnerGuide program
    - Life cycle valuation
- Investigate full cost accounting of home energy efficiency, listing both externalities and internalities

From the interviews conducted, it was found that there is no agreement about whether there should be financing programs rather than grant programs. The representative from VREB mentioned that the grant programs, such as the Natural Resources Canada EnerGuide program, are better because it is difficult to transfer the financing programs between homeowners. The representative from a local service organization said that if grant programs are done correctly, they work well, but it is difficult to properly implement a grant program. The representative from Sequel Integrated Resource Management mentioned that financing programs similar to the Life cycle valuation work much better than grant programs. Further research into these programs may clarify what works best for everyone involved to achieve the best program available.

Further research into the full-cost accounting associated with home energy efficiency would provide valuable insight into the full range of internalities/externalities that are related to the valuation and worth of the upgrades. The full extent of the costs and benefits are seldom accounted for. However, valuable knowledge could be gained from an in-depth accounting of the externalities arising from energy efficiency upgrades.

A mechanism for success needs to be created. Presently, it seems as though the Solar Colwood project is in the vicious cycle due to the lack of education about home energy efficiency from most of the parties involved. To make the project successful, the virtuous cycle should be initiated by each of the parties involved, starting with education about how energy efficiency affects the value of a home.

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Appendix A

Survey Responses

Table a-1. Realtor survey responses (11 respondents), 19 June 2012 .

Survey Question	Respondent Number										
	1	2	3	4	5	6	7	8	9	10	11
Survey Preamble	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
What is your primary region of sales?	Langford Metchosin Colwood Highlands View Royal	Victoria Saanich East Oak Bay	Victoria Victoria West Esquimalt Saanich East Saanich West Langford Metchosin Colwood Highlands Oak Bay View Royal Central Saanich	Langford Metchosin Colwood	Victoria Victoria West Saanich East Langford Metchosin Colwood Highlands Oak Bay View Royal Central Saanich	Saanich East Saanich West Langford Oak Bay	Victoria Victoria West Esquimalt Saanich East Saanich West Langford Metchosin Colwood Highlands View Royal Central Saanich	Victoria Victoria West Esquimalt Saanich East Saanich West Sooke Langford Metchosin Colwood View Royal	Victoria Victoria West Esquimalt Saanich East Saanich West Sooke Langford Metchosin Colwood Highlands Oak Bay View Royal North Saanich Sidney Central Saanich Malahat and Area	Victoria Victoria West Esquimalt Saanich East Saanich West Langford Metchosin Colwood Highlands Oak Bay View Royal North Saanich Sidney Central Saanich	Victoria Victoria West Esquimalt Saanich East Saanich West Sooke Langford Colwood Highlands Oak Bay View Royal North Saanich Sidney Central Saanich
Do you believe that home energy efficiency improvements increase property values?	No	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes
Do you recommend home energy efficiency upgrades to your clients when marketing homes?	No	Yes	No	No	No	Yes	Yes	No	No	No	No

If yes (to previous), please list examples	N/A	Insulation, Windows	N/A	N/A	N/A	Windows	Windows, Heating	N/A	N/A	N/A	N/A
Please comment on the marketability of home energy improvements compared to other home renovations (kitchens, bathrooms, etc.).	People like the energy improvements but are not willing to pay more for them.	Most consumers assume that a home has insulation, etc. They rarely ask about these improvements. Energy efficiency in Victoria hasn't yet been a major selling factor.	Not very marketable, because they are intangible (invisible so to speak), and are therefore hard for a buyer to get excited about verse items they can feel, see and touch, which usually sell a house, as people buy on emotion mostly. The energy efficiency is an added bonus.	N/A	N/A	N/A	In Victoria, energy efficiency may not rank as highly as in other areas of Canada, however it is still seen as a positive feature in the marketing of a home, especially in regards to windows (also for noise), heating system and visible insulation.	Not enough buyers place any value on home energy improvements.	As much as I love the idea of using or upgrading to environmental friendly options. I have not seen it a direct reflection in what people have been able to sell their home for. Buyers can see and touch a kitchen or bathroom renovation and make an emotional decision based on what they can see, not based on logic. Home buying decisions are based on many factors and currently if the home has environmentally friendly features is not being asked for by the buyers.	Seldom do they add more value than their respective cost. Energy efficiency upgrades should be installed for home owner enjoyment. Though they may increase value and contribute to a homes 'saleability', they do not usually offer a financial return to homeowners looking to prepare their property for sale.	Kitchen and bath updates have the highest impact on marketability and the highest ratio of payback to the seller.

How important is home energy efficiency to your clients?	Moderately Important	Moderately Important	Moderately Important	Of Little Importance	Moderately Important	Important	Important	Of Little Importance	Unimportant	Moderately Important	Important
How often do your clients inquire about home energy efficiency improvements?	Rarely	Rarely	Rarely	Rarely	Rarely	Often	Occasionally	Rarely	Never	Occasionally	Often
Do you recommend that your clients obtain a home energy assessment and efficiency rating?	No	Yes	Yes	No	No	No	No	No	No	No	No
Energy efficiency labeling (energy rating) contributes to the marketability of a home.	Disagree	Agree	Agree	Neither agree nor disagree	Neither agree nor disagree	Disagree	Neither agree nor disagree	Strongly Disagree	Disagree	Disagree	Agree
Are you aware of the EnerGuide Rating System offered by Natural Resources Canada?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Are you aware of the current home energy efficiency incentive programs that are available to homeowners ?	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
If yes (to previous), please list examples	N/A	Windows, Insulation, Heating	N/A	N/A	LED & CFC Bulbs	N/A	N/A	N/A	N/A	N/A	N/A
Did you participate in the 2011 VREB Time of Sale Energy Labelling Pilot Project?	No	No	No	No	No	No	No	No	No	No	No
Do you perceive value in attending an educational seminar on home energy efficiency, if it were available?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes

Please provide any additional comments or suggestions regarding educational seminars.	N/A	There is still a need to raise the profile of energy efficiency. The federal and provincial programs of providing assistance to homeowners are very beneficial.	Any seminar, which educates Realtors on the efficiency of a home, is a good thing, as it will help the Realtors to educate their customers, which is what I really need to enable me to promote any energy efficient programs.	When selling homes how the home looks is more important than how much energy it uses we never get asked until after they like the home.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Appendix B

Interview Consent Form

Coast-2-Coast Environmental Interview Research Consent Form

Our names are Cristy Eichmann, Dave Osguthorpe, Kristine Parrish, and Brad Pettersone, and this research project is part of the requirement for a Bachelor of Environmental Science at Royal Roads University. Our credentials with Royal Roads University can be established by telephoning Dr. Leslie King at 250-391-2511 ext. 4104.

This document constitutes an agreement to participate in our research project, the objective of which is to determine how home energy efficiency upgrades could be best reflected in the improvement of the property value of a home.

The interview will consist of open-ended questions and is foreseen to last approximately one hour. The questions will refer to the adoption of home energy efficiency upgrades. In addition to submitting our final report to Royal Roads University in partial fulfillment for a BSc degree, we will also be sharing our research findings with the Municipality of Colwood.

Information will be recorded in hand-written format and, where appropriate, summarized in the body of the final report. At no time will any specific comments be attributed to any individual unless your specific agreement has been obtained beforehand. All documentation will be kept strictly confidential. Raw data will be retained until the completion of the research project. Data pertaining to an individual who has withdrawn at any time during the research process will not be retained.

A copy of the final report will be published and archived in the RRU Library. In addition, a copy will be made available to project participants at the discretion of the project sponsor.

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 e-mail, you give free and informed consent to participate in this project.

Name: (Please Print): _____

Signed: _____

Date: _____

Appendix C

Terms of Reference

Coast-2-Coast Environmental (Team 2)
Project Agreement

Brad Pettersone
Cristy Eichmann
Dave Osguthorpe
Kevin Hope
Kristine Parrish

Project Sponsor: Dr. Charles Krusekopf
Faculty Advisor: Dr. Leslie King

Introduction

Coast-2-Coast Environmental (C2CE) has been tasked to take part in a project involving the promotion of home energy efficiency upgrades for homeowners. Over the next 8 months C2CE will work alongside project sponsor, Dr. Charles Krusekopf, and faculty advisor, Dr. Leslie King, in the completion of this project. Considering the current real estate market, homeowners are often reluctant to invest time and resources into improving the energy efficiency of their houses if they do not plan on living there for more than a few years. This is because the perceived benefits are generally not as great as a kitchen or bathroom renovation, which are more visible/tangible means of improving property value. The result is a market failure in which the benefits to society in the form of reduced GHG emissions and energy consumption are not recognized due to individual cost preferences.

C2CE will conduct research in many aspects of the home energy efficiency topic, including how home energy efficiency impacts the value of homes, how home energy efficiency and ratings tie into buying and selling a home, how to encourage the capitalization of home energy efficiency improvements, and how to encourage homeowners to complete home energy efficiency upgrades. C2CE will look at grants available for energy audits and home energy efficiency upgrades, and which of these upgrades have the biggest impact on the price of a home. Meetings with local officials from the City of Colwood and the key stakeholders from Solar Colwood will assist in the understanding of what has been done in the past and what would work going forward in this region. At the end of the project, C2CE will compile a report that demonstrates the value impact of energy efficiency upgrades, and offer recommendations based on a review of best practices in energy efficiency capitalization programs.

Research Questions and Supporting Objectives

The following research questions and supporting objectives have been identified:

Research Questions

Question 1:

What are the impacts of home energy efficiency innovations on the value of properties?

Objectives:

To review and conduct research studies to understand how home values are linked to overall home energy efficiency and how home values might be impacted by energy efficiency upgrades

Review existing real estate programs associated with energy efficiency in the Victoria area and in other jurisdictions to document program options and identify best practices

Question 2:

What methods are other jurisdictions adopting to address the issues surrounding home energy efficiency upgrades?

Objectives:

To determine areas of success/failure associated with programs adopted by other jurisdictions to encourage homeowners to improve the energy efficiency of their homes

To identify possible alternatives to existing incentives, such as on bill financing or financing linked to land taxes/title

General Approach - Method

C2CE will use a two-pronged approach to answer the research questions, including: a literature review to assess best practices regarding home value and energy efficiency innovations in other jurisdictions; and interviews and surveys to assess local programs and market conditions, the perceived impact of home energy efficiency innovations on property values, and potential barriers or opportunities for innovative new incentive programs.

Ethical Review

This project will go through the Ethical Review process prior to the start of external interviews due to the nature of the research questions, including: interviews with industry professionals; surveying local real estate agents; and interviews with local energy efficiency adopters. See attached Appendix A for a Gantt chart with the timeline.

Research Methods

To achieve the above listed objectives, the following methods will be employed:

- Literature review/Case study analysis using:
    - Published research
    - Public documents
- Interviews/Surveys of:
    - Industry professionals
    - Civic officials
- Field research at existing installations

Analysis Methods Used

- Qualitative analysis using:
    - Survey results
    - Case study analysis
- ArcGIS spatial analysis of real estate data
- Minitab statistical analysis of demographic data from previous projects/studies

Timeline

See Appendix A for the Gantt chart outlining milestones.

Communication

C2CE will maintain regular communication with the project supervisor, Dr. Leslie King, and with the project sponsor, Dr. Charles Krusekopf. Bi-weekly meetings with the project supervisor will be held. Monthly meetings with the project sponsor will be held, with the project supervisor in attendance.

One team member has been designated to represent C2CE as the main communicator. The team communicator is responsible for primary, external communications and will ensure that all team members are included in all correspondence. One team member has been assigned to update Heather Wanke on a monthly basis, with regards to team budget status. One team member has also been designated as the primary ethical review contact.

Proposed Budget

See Appendix B for the proposed budget.

Deliverables to Department

See Appendix A for the Gantt chart outlining deliverables.

Deliverables to Sponsor

An in-depth report answering all of the research questions, with a stand alone summary document for use by the City of Colwood.

Expectations of Sponsor

We expect our project sponsor, Dr. Charles Krusekopf, to guide us throughout the duration of the project and keep us within our determined scope. We expect him to remain in constant and open communication with us and be available to answer any questions we may have.

Request for Approval

Project Sponsor: Dr. Charles Krusekopf

Project Supervisor: Dr. Leslie King

Coast-2-Coast Environmental (Team 2)

Major Project Budget Proposal

Date	Description				Expenses	Funding
1-Dec-11	Admin Fee (billed at start of project)			Royal Roads University/City of Colwood		$500.00
22-Feb-12	Total Project Funding			Royal Roads University/City of Colwood		$1,000.00
Expenses:		**Mileage**	**0.45/km**	**Projected Quantity**		
Jan - Aug	Mileage - 200	200	0.45/km	20 (max) field trips of 10 km each	$90.00	
Jan - Aug	Miscellaneous Printing			50 Colour and 200 B & W	$70.00	
Jan - Aug	Purchase of documents/books			As required	$125.00	
Jan - Aug	Postage/Courier costs			As required	$65.00	
Jan - Aug	RRU Marketing Materials - Surveys			As required	$150.00	
				Total Expenses:	$500.00	
Estimated Billable Hours						
Date	**Description**	**Hours**	**Qty**	**Notes**	**Amount**	
16-Mar-12	2nd Quarter Billable Hours	200	$50.00	Terms of Reference, Ethical Review, and Presentation	$10,000.00	
8-Jun-12	3rd Quarter Billable Hours	400	$50.00	Research, Interim Report, and Presentation	$20,000.00	
31-Aug-12	4th Quarter Billable Hours	400	$50.00	Final Report and Presentation	$28,000.00	
				Total Estimated Billable Hours:	$60,000.00	

Coast-2-Coast Environmental Signatures:

Cristy Eichmann — Date: Feb 29/12

Kristine Parrish — Date: Feb 29/12

Brad Pettersone — Date: Feb 29/12

Kevin Hope — Date: Feb. 29, 2012

Dave Osguthorpe — Date: Feb 29/12

RRU Major Project Advisor:

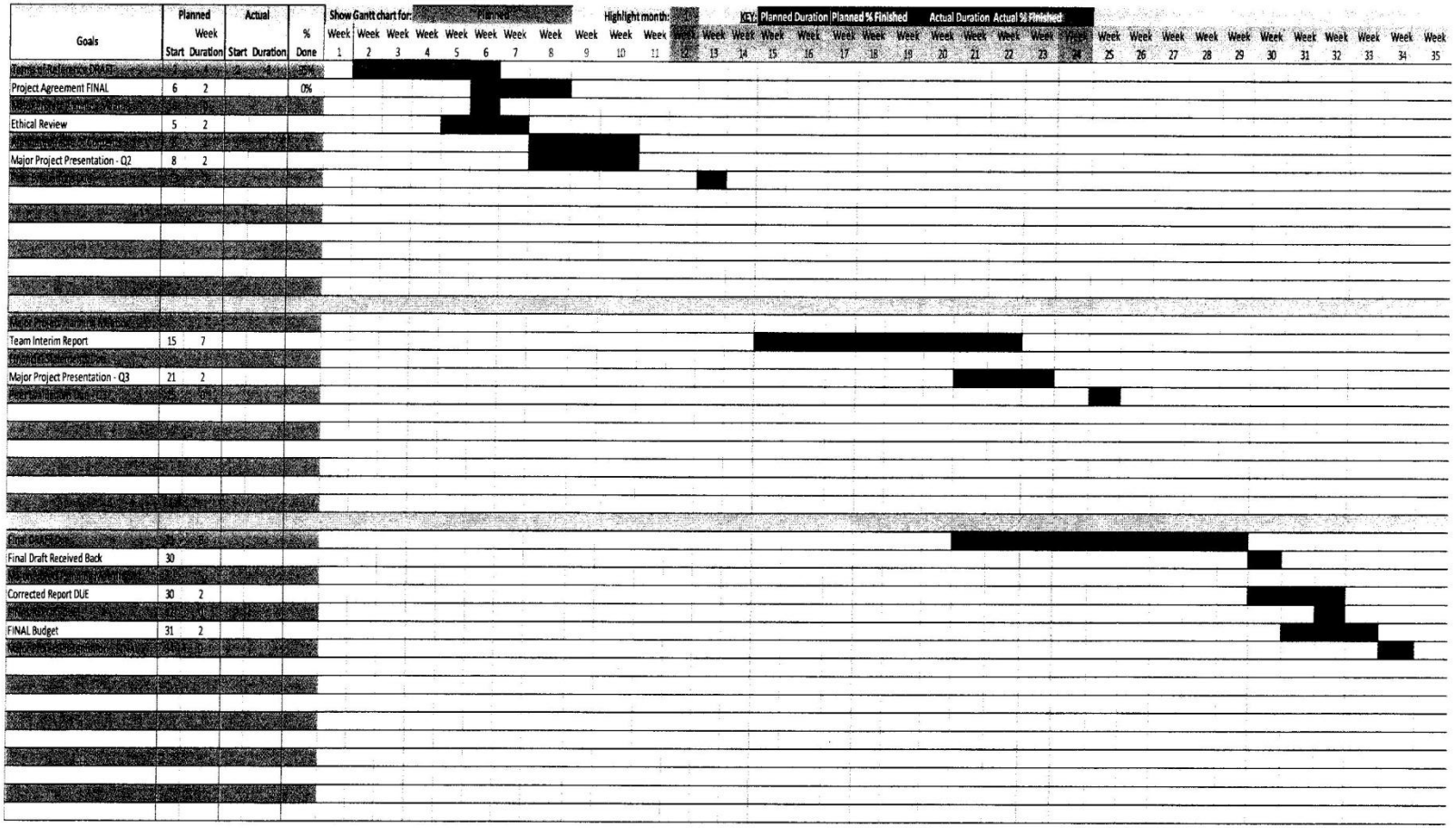
Dr. Leslie King — Date

Major Project Sponsor:

Dr. Charles Krusekopf — Date: 2.28.12

Royal Roads University/City of Colwood

2005 Sooke Road, Victoria, BC V9B 5Y2


Goals
Planned
Start
Week
Duration
Actual
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Show Gantt chart for:
Planned
Highlight month:
KEY:
Planned Duration
Planned % Finished
Actual Duration
Actual % Finished
Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Week 7
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Week 11
Week 12
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Week 20
Week 21
Week 22
Week 23
Week 24
Week 25
Week 26
Week 27
Week 28
Week 29
Week 30
Week 31
Week 32
Week 33
Week 34
Week 35
Project Agreement FINAL
6
2
0%
Ethical Review
5
2
Major Project Presentation - Q2
8
2
Team Interim Report
15
7
Major Project Presentation - Q3
21
2
Final Draft Received Back
30
Corrected Report DUE
30
2
FINAL Budget
31
2