Linking Social Housing and Energy Efficiency

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Abstract

This research explores the link between the theory, policy and practice of energy efficient social housing. The theory addresses the general question of what is energy efficient social housing and why social housing is not all energy efficient. Current policy and programs in Ontario are reviewed to discover what current incentives and opportunities there are for enhancing the energy efficiency of affordable housing. The practice is examined using three case studies of social housing in Ottawa that are energy efficient. The background theory, policy and programs, and case studies are used to make policy recommendations for achieving energy efficient social housing in Ontario. The report finishes with general conclusions of how theory, policy and practice overlap and further avenues for research on energy efficient social housing.

Executive Summary

The goal of this research is to explore how theory and policy lead to practice in energy efficient social housing. This research kills two birds with one stone by addressing the social policy issue of affordable housing and the environmental policy issue of energy conservation. Energy efficient social housing helps the environment by reducing greenhouse gas emissions and helps low-income households by lowering energy and transportation costs. The objective is to explore the link between theory of affordable energy efficient housing, policy and programs for achieving energy efficient housing and practice of actual energy efficient social housing.

Some energy efficient features are contained with the building envelope including high-tech appliances, lighting and heating systems. Other ways of increasing the energy efficiency of homes is to build in higher density, mixed land use neighbourhoods where there is public transit. Household transportation is often not considered in affordable housing or energy efficient housing, yet personal vehicles cost thousands of dollars a year to own, operate and maintain and contribute to over half of all greenhouse gases emitted from housing. Achieving energy efficient social housing is difficult because energy efficient housing general costs more to build than traditional housing. There are a number of solutions to overcoming the barriers to creating energy efficient social housing in policy, grant and incentive programs, and planning regulations.

Three social housing projects in Ottawa, Ontario are case studies for the practice of energy efficient affordable housing. The main motivation behind the Conservation Co-operative was to create environmental housing with low energy use. The Blue Heron Co-op incorporated energy efficient features to benefit the residents over the long term. The forthcoming Beaver Barracks project will be energy efficient and affordable due to demands from the City. All three projects have a combination of different features that make it energy efficient. The most influential policy for the projects is the Canada Ontario Affordable Housing funding. Energy efficient policies play a very small role. The main challenges are funding constraints and problems with operation of high tech energy efficient features. All three projects are successful because they were built or will be built in the next few years.

This report makes a number of policy recommendations Based on the theory, existing policy and programs, and case studies of energy efficient social housing. (1) Align affordable housing and energy conservation policies because there is a direct link between the cost of energy and housing. (2) Earmark funding for energy efficiency to affordable housing developers to cover the premium cost of construction. (3) Streamline programs for energy conservation in housing to make them more accessible to affordable housing providers and low-income households. (4) Enhance the flexibility of funding programs to allow developers to include energy efficient features. (5) Include household transportation, density and land use in the evaluation of energy efficiency because transportation uses such a large amount of energy compared to other household uses and density and land use impact transportation options. (6) Learn what policies and what features are both energy and cost efficient by conducting research on existing energy efficient social housing projects and use the results to inform policy.

1. Introduction

Energy efficient social housing benefits low-income households by reducing energy bills and the environment by reducing greenhouse gas emissions. It creates a thread through policy issues of energy conservation and affordable housing. Energy efficient social housing helps the lowest income population in Ontario by reducing utility bills and transportation costs so that those households can better afford the necessities of life. Local social housing providers already know the benefits of energy efficient measures and a few have already included them in social housing projects. There are three social housing projects in Ottawa that are promoted as energy efficient. These projects prove that social housing can be energy efficient and demonstrate how energy efficient social housing projects can be achieved.

The overall goal of this research is to understand how current theory and policy lead to the practice of energy efficient social housing. There are four objectives to this research that fall under the main goal. (1) Understand the theory behind energy efficient social housing. (2) Explore existing policy to see how it impacts affordable housing and energy conservation. (3) Discover how energy efficient social housing projects have been achieved. (4) See how the theory, policy, and practice relate.

1.1 Problem Definition

The purpose of increasing the efficiency of energy use is to decrease the overall amount of energy consumption. *Energy efficiency* achieves the same output with less energy. One of the reasons that rising energy consumption has become a problem in Canada is the production of greenhouse gases. *Greenhouse gases* are gases that absorb infrared radiation in the atmosphere and trap heat in the atmosphere, which cause air temperatures to rise. Greenhouse gases emitted by human activities include carbon dioxide, methane, and nitrous oxide. The use of fossil fuels is known to produce greenhouse gas emissions that contribute to global climate change. Given the policy nature of this research and the study area, this report adopts the current stance of the Government of Canada that greenhouse gases contribute to climate change (as published by Natural Resources Canada, 2007). Greenhouse gas emissions continue to increase in Canada (Environment Canada, 2005).

Households and personal transportation are significant sources of greenhouse gases. The residential sector consumes 17 percent of energy in Canada and produces approximately 16 percent of the national greenhouses gases (CMHC, 2007d; NRTEE, 2003). Energy use in residential buildings has actually decreased over the last few years because of innovation in building design, heating systems, lighting, and appliances technology (Rudlin, Falk, & URBED (Urban and Economic Development) Ltd., 1999). Conversely, energy use from passenger transportation are continuing to rise (NRTEE, 2003). The transportation sector consumes 28 percent of energy and produces approximately 34 percent of greenhouse gases, of which, cars and light trucks use the greatest share (NRTEE, 2003). Transportation is of particular concern because it primarily uses energy from fossil fuels, while energy for buildings may come from hydroelectricity or solar power (NRTEE, 2003). Personal transportation is linked with household energy use because the location of homes and the distance between home, work, and other destinations influences the length of commute. The longer the commute, the more energy

is required to reach destinations. More than half of all greenhouse gases emitted from households come from personal transportation (CMHC, 2005b).

There are many people in Ontario who cannot afford to own, rent, or run a home. According to the CMHC, *affordable housing* is when a household spends less than 30 percent of its income on adequate shelter (see definition for *adequate housing* in glossary) (CMHC, 2007a). Housing that costs more than this is not affordable. *Social housing* is accommodation subsidized by a government or a community group for households that cannot afford shelter at average market rents. Rent for units in social housing projects is allocated as average-market rent, below-market, or rent-geared-to-income. *Average-market* units are open to anyone and are not subsidized. Households must apply for *below-market* units where the rent is fixed at a portion of the average-market rate (such as 70 percent). If households qualify for *rent-geared-to-income*, rent is set at 30 percent of the household income. There are currently over 700,000 people living in approximately 250,000 units of social housing throughout the province of Ontario and the number of low-income households that require assistance is only increasing (SHSC, 2006b). There are thousands of families that need help to afford decent shelter.

One of the reasons housing is becoming less affordable is the rising cost of energy. The cost of housing comprises the cost of energy that is required to build, operate and maintain a home. Increasing energy costs in Ontario are making housing more expensive. In 2006, electricity costs increased by as much as 10 percent in Ontario (SHSC, 2006b). Low-income households that pay a higher percent of their income on utilities feel this increase more than higher income households. According to Statistics Canada, households in the lowest income quintile spend 12 percent of their income on utilities compared to the average household, which spends only 3 percent (CHRA, 2005). The term *Energy Poverty* has been coined to describe the situation when households cannot afford to heat and light their homes (SHSC, 2006b). As prices of energy continue to rise, it will become harder for low-income households to cover utility costs.

There are a few emergency relief programs in Ontario to combat energy poverty. The goals of these programs or funds are to help low-income households in crisis situations to cover utility arrears, security deposits and reconnection costs (SHSC, 2006b). There is an Emergency Energy Fund and an Ontario Home Electricity Relief Fund. It is expected that 1.5 million families and individuals will be eligible for the program. This funding is very important to helping households through the toughest parts of the year, but it does not provide long-term assistance. Often households are only eligible for the program once and the funding may only be available for a year at a time.

Environmental regulations and programs are designed for moderate and high-income persons that can afford home upgrades and renovations. Sustainable living and energy efficient housing are considered a luxury. Programs are designed to provide grants and incentives for households that are willing and able to invest in energy efficient features for their homes. Low-income households usually do not have access to capital to cover the initial costs of participation in the programs. In a way this style of programs asks moderate and high-income households to do their part in lowering energy consumption, while overlooking energy consumption by low-income households. At the same time, it is only the households who can afford the initial investment that will reap the benefits of reduced costs associated with energy conservation. This research

describes how ways of lowering energy consumption are incorporated into affordable housing so that the low-income households can also benefit from reduced costs, yet not have the burden of the initial investment. Stringent environmental regulations unfairly burden low-income persons. For example, environmentalists advocate for higher taxes on gasoline to discourage driving. Moderate and high-income persons can afford the raised tax so it may not influence their decisions. Low-income persons are most likely to drive out of necessity because the cost is already a deterrent to driving a car and the increased tax simply puts more pressure on their finances.

Environmental and social policies are not always compatible because of the priorities of each issue. Social policies focus on the short term immediate needs of low-income households for adequate shelter. Environmental policies focus on the long-term impact on the environment of greenhouse gas emissions and climate change. In the case of social housing, the objective is to spend money on immediate results such as more dwelling units. The objective of energy conservation policy is to spend money now to reduce the impact of climate change for generations to come. This research tries to show how energy conservation and affordable housing policy can complement each other. Energy conservation saves low-income households money in energy bills and affordable housing can be designed to reduce greenhouse gas emissions. This research adds to the current discussion on environmental justice, a movement that is trying to bring together social and environmental goals.

1.2 Purpose of the Research

The combination of social housing and energy conservation is a timely policy topic. In 2005, the Canadian Housing and Renewal Association held a symposium addressing the need for a low-income energy-efficiency strategy for low-income Canadians. In 2006, Social Housing Services Corporation of Ontario developed a program called the Green Light Initiative to assist low-income households in energy-efficiency upgrades. And in 2007, Canada Mortgage and Housing Corporation released the *2007 Canadian Housing Observer,* which emphasizes the role of housing in lowering greenhouse gases.

Three levels of government, federal, provincial, and municipal, in Canada promote energy conservation and affordable housing. The Government of Canada and the Ontario Government both promote energy conservation to reduce the impact of greenhouse gas emissions on climate change (CMHC, 2007d; Ministry of Energy, 2007a). According to provincial policy, the Ontario Government is committed to ensuring the existence of affordable housing in the province (Ministry of Municipal Affairs and Housing, 2007a). Federal and provincial housing organizations are stressing the link between housing and energy through policy and programs, as discussed in Section 3.2. Municipalities are responsible for encouraging affordable housing and include housing and energy conservation goals in official plans.

1.3 Structure of the Report

There are two major components of this research report. The first appears in Section 3 and provides the theoretical and policy background for energy efficient social housing in Ontario. It outlines the ways that housing can be energy and cost efficient in Section 3.1. The features described in this section are used to describe how the actual social housing projects are energy efficient. Section 3.2 describes the barriers to realizing energy efficient social housing. General barriers and opportunities are discussed with specific references to policy and programs in Ontario.

The second major component is the case study and the focus of this research that appears in Section 4. This section begins with an introduction to social housing in the City of Ottawa to provide context in Section 4.1. For each case study in Section 4.2 to 4.4, an overview, a discussion of energy efficient features, the policy and planning behind the project, and challenges and successes of the project are described. This section finishes with a number of lessons drawn from the case studies. The report concludes with policy implications for realizing energy efficient social housing in Ontario and Canada in Section 5 and overall conclusions from the research in Section 6.

2. Methodology

The research uses a literature and policy review and three case studies. The form of analysis is qualitative. A literature review of the theory, barriers and solutions behind energy efficiency and cost efficiency in housing is used to understand why and how housing can be energy efficient. A policy review reveals government policies and programs for housing and energy available to social housing in the City of Ottawa. The case studies provide three different examples of energy efficient social housing that were achieved.

There were two main selection criteria for the case studies. First, the targeted tenant population had to have low to moderate incomes. Second, the project had to be promoted as energy efficient by the municipality, the property manager or the developer. The three case studies used are the Conservation Co-operative, the Blue Heron Co-operative, and the Beaver Barracks project. The Conservation Co-op was completed in 1995 and the Blue Heron Co-op was completed in 2006. The Beaver Barracks project is currently in the design stage and is expected to be complete in a few years time. An overview of each project is provided in the case study section.

The case study research involved field observation and interviews with key informants. Field observation included visiting the sites and taking photographs for the purpose of observing the site design and neighbourhoods. The majority of information on the case studies came from semi-structured interviews with key informants. Key informants were chosen based on their official public roles and by snowball sampling. At least one interview was completed for each case study. The key question for the case studies is how the planning policies and programs for social housing and energy efficiency have been implemented. It is important to know how the building and site are energy efficient, what policies or programs were used, and what difficulties and successes there were during the process.

The study area for the case studies and policy review is Ottawa, Ontario. This study area was chosen because it is a large city within Ontario and results from the study will be applicable to other municipalities in the province as they all fall under the same provincial policy and planning system. The study area is well known to the researcher, as it is her hometown. Ottawa is the fourth largest city in Canada and the capital city of the country. There is a significant need for affordable housing in Ottawa. There are over 22,000 units of social housing across the City, yet households can still wait up to five years for social housing in Ottawa (City of Ottawa, 2007e).

This research pertains to theoretical discussions of sustainability and environmental justice that are not discussed in the report. Affordable housing should be considered integral to a sustainable city. The discussion of environmental justice is now addressing how low-income persons are being excluded from environmental programs and argues that social justice be added to the wider concept of environmental justice for policy purposes (Sandler & Pezzullo, 2007). The scope of the report does not allow for further articulation of this the relationship of affordable housing to sustainable development and environmental justice.

3. Energy Efficient Social Housing

This section provides background for energy efficient social housing that is pertinent for understanding the case studies. The information presented here is taken mostly from the literature and policy review. It is important to understand that there is no strict form of energy efficient housing. Different features may be more or less applicable for each particular project. The same thing is true for the development of housing. For each particular project there are a number of barriers and solutions that can be used to achieve a desirable energy efficient project in the end. The features and barriers and solutions presented here are general and based on theory.

3.1 Features

It is helpful to understand what and how housing is energy efficient. What types of features and design are highly efficient? This background is necessary for understanding how the case studies are energy efficient compared to traditional design. There are a variety of features that increase the efficiency of housing. These features can be grouped into the following categories: housing construction; appliances and lighting; building envelope; household transportation; and density and land use. Most people think of heating systems or appliances when they hear "energy efficiency," yet energy consumption is not only contained within the home. Energy is consumed when homes are built and when people travel to and from their homes. For each category, the method or features of energy conservation and cost are described in this section. These categories provide a checklist of ways that housing can be energy efficient that are used to explain how the three case studies are energy efficient in Section 4.

3.1.1 Housing Construction

Energy consumption should be considered throughout the process of housing construction. There are a few ways to save energy in this phase. The initial construction of housing can be more energy efficient by using materials that are close to the site and not transporting materials long distances. The transportation of heavy materials requires a significant amount of energy and money. The economy of scale and type of units being built can save a further 5 to 10 percent on construction costs (CMHC, 2007f). Economy of scale simply means that the more units being built the more the cost per unit is reduced. The type of unit impact costs because a unit in an apartment building or even a rowhouse is less expensive to build than a single family home. Energy can also be reduced through efficient infrastructure. The building of new housing is more energy efficient if it makes use of existing infrastructure, such as roads and sewers, instead of having to build new infrastructure (CMHC, 2007f).

3.1.2 Appliances and Lighting

Appliances and lighting designed to be energy efficient are widely available. Lighting alone accounts for 15 percent of energy consumed in the home (CMHC, 2007e). Items that are typically included in rental housing, such as a fridge, range, and overhead lighting can all be highly energy efficient and save utility costs for tenants. In Canada, appliances receive an EnerGuide rating to allow customers to compare products. There is also an international symbol, ENERGY STAR, to mark products that are energy efficient. Energy efficient appliances are usually more costly to purchase, but often recoup the extra cost in the continued energy savings in 5 to 10 years (CMHC, 2007e).

3.1.3 Heating and Cooling

Almost 30 percent of energy consumption is for heating and cooling of homes (see Figure 1) (CMHC, 2007c). Natural energy sources can be used to heat and cool. Cross ventilation uses wind to move air. Some energy supply and hot water systems are more efficient than others and can significantly lower heating costs. A high-efficiency heating system combined with natural heating and cooling features can be effective at reducing energy consumption.

3.1.4 Building Envelope

The building envelope impacts how much energy is lost. A tight building envelope reduces heat loss and thus increases the efficiency of heating systems. The building envelope includes insulation of walls and ceilings and windows and doors. The housing typology contributes to the efficiency of the building envelope. Rowhouses are more energy efficient than single detached dwellings because heat loss is limited to only two exterior walls or three walls for an end unit (Fletcher Marsden, Smolders, Tomich, Canada Mortgage and Housing Corporation., & Dillon Consulting., 2000). Multi-unit buildings are more energy efficient than rowhouses as heat loss is further limited. Single-family detached dwellings are the least efficient of all housing types. Unfortunately, single-family detached houses make up more that half of the current occupied housing stock in Canada (CMHC, 2007c).

3.1.5 Household Transportation

As discussed above, passenger transportation accounts for a significant portion of energy consumption, see Figure 1. One way of reducing this portion of energy consumption is to provide transportation options other than private automobiles. This includes providing walking and cycling paths and public transit, which use much less energy than personal automobiles. Residents can save money by not having to own a car in order to reach employment areas. "The average annual cost to own and operate a car in Canada is over $9,000. If you can eliminate the need for a second car, drive less or avoid having a car at all, that's money in your pocket" (CMHC, 2005b). Homebuyers do not often consider the expense of owning and operating a vehicle, yet it is directly influenced by the location of housing (Dillon Consulting Limited, IBI Group, Sustainable Edge, & Metropole Consultants, 2005).

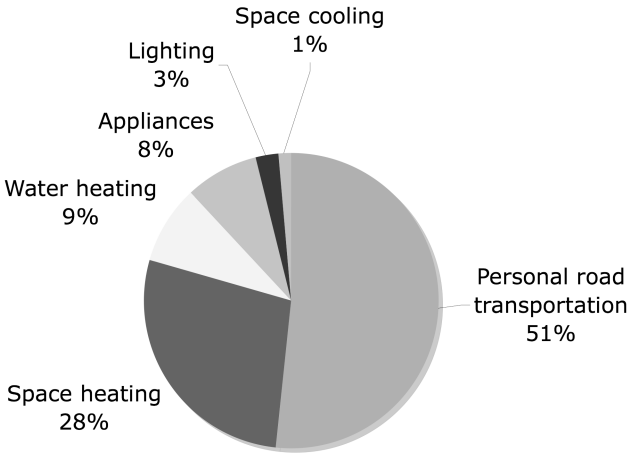

Figure 1. Contribution of Transportation to Household Greenhouse Gas Emissions, 2005. Source: (CMHC, 2007c) from © Natural Resources Canada (2005).

3.1.6 Density and Land Use

Residential density is an important consideration in energy efficient housing. *Density* is a measure of the number of dwelling units per area. For example, a neighbourhood of semidetached houses has a density of approximately 35 dwelling units per hectare (Friedman, 2005). Research has found that high density neighbourhoods in central areas are approximately 50 percent more cost efficient than low density neighbourhoods on the periphery (Dillon Consulting Limited et al., 2005). Households in higher density areas have lower costs because the costs of land, infrastructure and services are shared among more households (CMHC, 2007f; Dillon Consulting Limited et al., 2005). Density also allows for the viability of transit systems and a diversity of services (Larice & Macdonald, 2007). A minimum residential density of 37 housing units per hectare are needed to support a bus service (CMHC, 2007c).

The land use surrounding housing influences the amount of energy needed to reach employment and essential services. A mix of different land uses allows for residential, commercial, institutional, and possibly light industrial uses to be within the same neighbourhood. Such a mix of uses allows people to live close to work, grocery stores, daycares and other services. Residents can then walk, cycle, or take a short transit trip to reach their destination. Consequently, car trips and commuting distances are reduced lowering energy consumption and greenhouse gases from personal transportation.

There are many ways to design buildings to be energy efficient. It is also important to remember that energy consumption is not limited to within the walls of a home, but extends to the neighbourhood as well. High density, mixed-use areas are more efficient than low-density residential areas. According to the CMHC, "greenhouse gases from weekday passenger travel generated by people living in mixed-use, pedestrian and transit-friendly neighbourhoods near the urban core are about 1/3 of those by people living in dispersed, strictly residential neighbourhoods on the urban fringe" (CMHC, 2005b). In fact, the CMHC has identified sustainable homes in high density neighbourhoods that have public transit as "key to reducing the housing sector's impact on the environment and lowering greenhouse gas emissions" (CMHC, October 22, 2007).

The benefits of saving energy for low-income persons seem obvious. There are a number of barriers to implementing energy efficient measures into homes, especially when the priority is to keep homes affordable. These barriers are described in the next section.

3.2 Barriers and Solutions

The realization of energy efficient social housing is not straightforward. There are a number of barriers in the development process that fall in the areas of housing policy, research, initial investment costs, complex programs, land value, and planning regulations and processes. In this section, each of the barriers is explained and a number of solutions are proposed. The barriers and solutions are taken from the literature and policy review. When possible, specific barriers and solutions present in Ottawa, Ontario are used, as this is the area of the case studies in the following section. Tables 1 and 2 at the end of this section list the specific policies and programs according to level of government that are referenced in this discussion. There is another table that lists all the legislation that is behind many of the provincial and municipal programs that appears in Appendix A for reference.

The fictitious story of Joe Development is told to reveal these barriers and give the reader a general understanding of the process for developing social housing. Each time Joe hits a barrier or obstacle there is (#) in the text that corresponds to section that describes that barrier in detail. Here is Joe's story:

A successful housing developer, Joe's Development Corporation decided to build a new social housing project that would be highly energy efficient. Joe had never built social housing before but had recently read a publication describing the need for more subsidized housing in the city. He felt that this project was a chance to give back to the community and was a good advertisement for his company that was trying to specialize in sustainable housing.

First, Joe looked into how social housing is developed in the municipality to understand how to go about the project. He was shocked to find that there was no national affordable housing policy in Canada (3.2.1) and that all responsibility for social housing was now held by the City of Ottawa, as a local service manager. Fortunately he found that the federal government had made an agreement with the Province of Ontario so there was funding available for new housing.

Next, he did some research on ways to make housing energy efficient (3.2.2). He knew that unlike his other clients, low-income tenants would not be able to pay the premium price for high tech energy efficient features. He found that most energy efficient measures would cost more than traditional ways of construction and design (3.2.3). So he looked for grant and incentive programs that could help cover the costs of including energy efficient features. He spent weeks searching for programs and became very confused due to the amount of different programs and their requirements (3.2.4).

From his research, Joe realized that one of the best ways of making housing energy efficient was by building it at a location that was well serviced by public transit, close to amenities, and did not need extensive new infrastructure. So his next step was to find a plot of land to build on. He found a number of potential plots, but most were expensive because of the desirability and high demand for the land (3.2.5).

Once Joe finally procured a site for his project, he began the process of applying for building permits from the City. There were a number of planning regulations that had to be changed in order to make the project viable such as reduce the parking standards (3.2.6). The planning process took so long that Joe began to worry about the rising cost of lumber and how much money he was losing just waiting for his permit (3.2.7). There were so many obstacles in the way of Joe developing an energy efficient social housing project that by the end he decided that he would never build social housing again unless the process became much simpler.

Joe identified seven different barriers to developing social housing in Ontario. Fortunately governments are working towards overcoming these challenges. The following sections described the barriers Joe faced and different ways he could have overcome them.

3.2.1 Housing Policy

A general barrier to the development of social housing in Canada is the lack of a national housing policy. A national policy assigns different aspects of social housing to the three levels of government in Canada (SHSC, 2006b). There has been no national affordable housing policy since the 1990s. After its height in the 1960s, federal involvement in affordable housing began to decline in the 1970s when social housing was discredited in the public opinion. In 1973, Federal government involvement was dispersed to non-profit and co-op housing programs (Hulchanski, 2002). Housing programs survived until the Mulroney Conservatives came to power in the mid-1980s. Programs were allowed to die a slow death by simply not increasing funding in an era of high inflation that made it almost impossible to build affordable housing (Hulchanski, 2002; Trotscha, 2007). Programs were cancelled altogether in 1993 (Hulchanski, 2002; Trotscha, 2007).

The federal government's solution to having no national housing policy or programs was to devolve all responsibility for social housing to the provinces. In 1999, the CMHC and the Ministry of Municipal Affairs and Housing (MMAH) signed a Federal Provincial Social Housing Agreement that dissolved all responsibility for management and operation of social housing to the provinces. In 2000, the responsibility for social housing in Ontario was subsequently passed to consolidated service managers under the *Social Housing Reform Act 2000*. Now social housing is the responsibility of local governments.

Despite not having a national affordable housing policy, there is funding available for the creation of new social housing. After years of no funding for affordable housing, the Harper Conservative Government wrote a check for $1.4 billion for affordable housing to the provinces in 2006 (Peters, Cooper, & Hallam, 2006; Trotscha, 2007). The share for the Province of Ontario was $392 million and that same amount of funding was passed on to the social housing service managers throughout the province (ONPHA, 2007; Peters et al., 2006). The most recent federal and provincial government agreement on affordable housing was signed on April 29, 2005 and helped bring the total federal, provincial and municipal government funding for affordable housing to $734 million in Ontario (Ministry of Municipal Affairs and Housing, 2007c). Funding from the federal government affords opportunities for social housing.

It is worth looking at provincial policy because policy and legislation for social housing now happens at this level. The Provincial Policy Statement is issued under the Planning Act and concerns land use planning and development related to the province. Section 1.4, Housing, found in the Provincial Policy Statement, 2005, addresses housing needs for the province. Within this section, the province recognizes the need to promote density for the efficient use of infrastructure and the support of alternative modes of transportation as well as the role of intensification to minimize housing cost (Ministry of Municipal Affairs and Housing, 2005). The Policy Statement shows that the theory behind energy efficient housing is being translated into policy. It highlights the importance of density to efficient use of infrastructure and provision of public transit. It continues to link compact urban form with housing affordability. The provincial policy statement acknowledges the link between housing and energy. Provincial policy does not always filter down to practice.

According to the Provincial Policy Statement, planning authorities have the responsibility of establishing minimum housing targets for low and moderate income households (Ministry of Municipal Affairs and Housing, 2005). For example, the City of Ottawa's housing target, in accordance with the Provincial Policy Statement, is to create 500 new units of affordable housing a year (Sayah, 2007). Unfortunately, in the past few years only 200 to 300 units have been built per year. The city can only encourage housing to be built and has not met this target in the past few years. The achievable goal for the upcoming year, 2008, is 400 units. It is important to understand that this is only a target, not a commitment to provide the amount of housing needed.

Although there is not a solution for Joe's Development to address the lack of national housing policy, there is an opportunity here for the developer to work in closer unison with the local service manager. Developers like Joe can tap into the funding from the Canada Ontario Affordable Housing Program. The Provincial Policy Statement encourages the type of building that Joe is planning and his development can actually help meet affordable housing targets.

3.2.2 Education and Training

A general barrier to energy efficient social housing is a lack of education or training. Without the understanding of energy efficient features, housing developers may not consider the long-term savings for residents and the environment. If the value is not clear, there is no motivation to exert the extra effort in design and construction that is required to incorporate special energy efficient features.

The solution for this barrier is to provide free and easy access to information on this topic. The federal housing corporation, CMHC, recognizes that designing energy efficient housing requires additional education and training for architects, contractors and building operators (CMHC, 2007b). So, CMHC provides information designed for consumers and housing industry professionals and community groups. "The builder is the final decision-maker in the home building industry and is ultimately responsible for the implementation of new ideas in housing development" (Friedman, Canada Mortgage and Housing Corporation, & McGill University Affordable Homes Program, 1993). Research and education for developers is a step towards overcoming barriers to creating energy efficient social housing.

Much of the information that Joe needs to design and construct a sustainable building can be found on the CMHC website. A number of publications and web pages have information on what energy efficient features to include and their payback value. The website also has a number of case studies that provide real examples of sustainable housing that Joe can learn from.

3.2.3 Preliminary Costs

The preliminary costs of development and renovation are often higher in energy efficient buildings than in traditional construction. Energy efficient building can cost as much as 10 percent more than conventional construction (CMHC, 2007b). The emphasis in social housing is often to keep construction costs as low as possible to keep the cost low for potential residents or the social housing provider. There is often little consideration for ongoing costs (SHSC, 2006b), yet many energy efficient measures can make housing more affordable in the end and the initial cost may be recouped in 5 to 8 years (CMHC, 2007b). For social housing, energy efficient measures need to be selected carefully to justify the expense (CMHC, 2007b). Even then social housing providers usually have tight budgets and may not have the financial capability of adding energy efficient measures in construction or in retrofitting existing buildings.

The federal and provincial governments provide different grants and incentive programs to help cover the initial costs of higher energy efficient features. A program specifically for upgrading appliances in affordable housing to highly energy efficient ones finished in the autumn of 2007. The AHP Energy efficiency Program was created under the Canada-Ontario Affordable Housing program (Ministry of Municipal Affairs and Housing, 2007b). The most prominent program offered by the federal government for upgrading the energy efficiency of homes is called ecoENERGY Grant and Incentive Program established in April 2007.

The ecoENERGY program replaces another called EnerGuide for Houses Retrofit Incentive Program that was cancelled in May of 2006 (NRCan, 2007b). The EnerGuide for Houses program was successful because over 270,000 property owners have participated in the program, including 89 different non-profit and co-op housing groups (Deschesne, 2007; NRCan, 2007a). On average, under EnerGuide for Houses, the energy savings for participating dwellings is approximately 2.5 tons per house per year and overall energy consumption was reduced by a minimum of 20 percent for each household (Deschesne, 2007). Social housing providers and residents can participate under the current ecoENERGY Retrofit program. This is the only federal program that provides grants and incentives for social housing. Housing providers that own residential buildings that qualify for the program "are eligible for up to $500,000 over the life of the four-year program ending March 31, 2011" (NRCan, 2007b). Under the new program, the grant is based on specific renovations or actions instead of on the overall performance rating. So it is easier for participants to predict the amount of the grant they will receive making it easier to determine what features to invest in (Deschesne, 2007). This is crucial for households on a tight budget. Households can determine what renovations have the highest payback and can strategically invest in those renovations. The catch for this program is that it is only available for buildings under three stories with a footprint of less than 600 square metres (NRCan, 2007a).

In Ontario, the Province will match the grant awarded under ecoENERGY Retrofit (Deschesne, 2007). The complementary program is called Home Energy Retrofit Program (Ministry of

Energy, 2007c). The qualifications for the Home Energy Retrofit Program are exactly the same as the ecoENERGY Retrofit program (Deschesne, 2007). Households may be awarded a maximum of $5000 from each program for a total of $10,000 (Ministry of Energy, 2007c). Although $10,000 seems like a significant amount of money, it only covers a portion of renovations and upgrades. A much larger amount of money is spent before homeowners receive the maximum grant allowance.

One way of overcoming the initial cost of energy efficient homes for homebuyers is green mortgages. Canada Mortgage and Housing Corporation (CMHC) administrates mortgage programs that are designed to help households choose to buy an energy efficient home or upgrade the energy efficiency of their current home. Energy efficient mortgages take into account the higher purchasing price of a home with energy efficient measures and the lower monthly utility expenses so that households may qualify for a greater loan (NRTEE, 2003). The purpose of the energy efficient mortgage is to provide households with the initial capital that is required to undergo renovations or to cover the higher costs of purchasing a home that is more energy efficient. The theory is that the initial cost will be recouped and money will be saved over the long-term operation of a home.

Joe can only receive a grant from the ecoENERGY program if he builds a low-rise apartment building. If he chooses to build a larger building because the economy of scales lowers the cost per unit, the building no longer applies for the program or the related Home Energy Retrofit Program. He can apply for an energy efficient mortgage from CMHC, but he will then have to carry the larger mortgage. The initial cost to include energy efficient features in the building is a major barrier for Joe Blow Development.

3.2.4 Complex Funding Programs

The assortment of policy and programs for energy and housing are scattered and complex for residents and housing providers to navigate. Tables 1 and 2 list the many national and provincial programs that are available to reduce energy consumption in social housing. The time spent just accessing the limited funding available from each of the programs increases the costs for affordable housing developers (Davis, 1995).

Social Housing Services Corporation (SHSC) began the Green Light Initiative (GLI) in 2006. The objective of the GLI is to promote conservation of energy and water to reduce utility costs and greenhouse gas emissions (SHSC, 2007b). The GLI brings together multiple organizations, tools, and services to provide a one-stop application process for program and incentives for energy efficient measures specifically for the social housing community. Governments and utility companies offer programs and incentives in the province. The full development of the GLI includes an entire energy management plan for social housing in Ontario (SHSC, 2006a). So far there has been above expected interest in the program and over 180 buildings and 12,000 units of social housing are now involved (Dufton, 2007). SHSC estimates that over 6,000 tones of greenhouse gases have been saved (SHSC, 2007a).

Table 1. Current National Programs for Social Housing and Energy Conservation, Autumn 2007

Title of the Program	Significance to Social Housing
ecoENERGY Retrofit Grants and Incentives	Administered by the federal Office of Energy Efficiency, this program offers grants and incentives for home owners to upgrade the energy efficiency of their homes.
Model National Energy Code of Canada for Buildings (MNECB) 1997	The MNECB is a building code for energy-efficiency in buildings that are three or more stories and considers cost-efficiency in conjunction with minimum levels of energy efficiency (NRCan, 2007c). The innovative element of the MNECB is the three different ways of complying with the code: buildings can either follow prescriptive, trade-off or performance measurements, which allows for flexibility (NRCan, 2007c). The provinces of Ontario has adopted the MNECB as building regulations fall under provincial jurisdiction (NRCan, 2007c).
Energy Efficient Mortgage	CMHC offers "a 10% CMHC mortgage loan insurance premium refund and extended amortization periods of up to 40 years without surcharge when you use CMHC insured financing to purchase an energy-efficient home or make energy-saving renovations" (CMHC, 2007d).
Affordability and Choice Today (ACT) Grants	ACT is a collaborative effort of CMHC, FCM, Canadian Home Builders' Association, and Canadian Housing and Renewal Association. ACT provides grants to address regulatory issues or barriers in the provision of affordable housing in Canada. Grants are worth up to $5,000 for organizations that wish "to improve housing affordability and choice" (ACT, 2007). Types of regulatory issues include "land use planning, residential building codes, zoning, residential regulations, the development approvals process and building permit procedures, provincial or territorial legislation, redevelopment financing, etc" (ACT, 2007). The purpose of the grant is to cover costs of sessions, meetings, guest presenters, logistics, facilitators, presentations, workshops, documents, monitoring and more that are necessary to implementing the regulation solution (ACT, 2007).
Green Municipal Fund (GMF)	Cities can also apply for funding from the Federation of Canadian Municipalities' (FCM) Green Municipal Fund (GMF). The GMF contains $550 million from the Government of Canada and is managed by the Centre for Sustainable Community Development (FCM, 2007). "The Fund provides low-interest loans and grants, builds capacity, and shares knowledge to support municipal governments and their partners in developing communities that are more environmentally, socially and economically sustainable" (FCM, 2007). Funding is meant to cover capital infrastructure projects such as brownfields, energy, planning, transportation, waste and water (FCM, 2007). FCM focuses on projects that demonstrate municipal leadership and that can be replicated in other cities (FCM, 2007).

Source: Author, 2007.

Table 2. Current Provincial Programs for Social Housing and Energy Conservation, Autumn 2007

Title of the Program	Significance to Social Housing
Home Energy Retrofit Program	The qualifications for the Home Energy Retrofit Program are exactly the same as the ecoENERGY Retrofit program (Deschesne, 2007).
AHP-Energy Efficiency Program	Joint initiative of the Ministry of Municipal Affairs and Housing (MMAH), the Ontario Power Authority (OPA), and Natural Resources Canada (NRCan) (Ministry of Municipal Affairs and Housing, 2007b). The goal of the program is to save energy in affordable housing units (Ministry of Municipal Affairs and Housing, 2007b). The program provides "financial incentives, in the form of a rebate, to upgrade from a regular appliance to an energy efficient one, and training and education designed to promote energy-efficient practices for affordable housing residents, building operators, service managers and housing providers" (Ministry of Municipal Affairs and Housing, 2007b).
Green Light Initiative	The objective of the GLI is to promote conservation of energy and water to reduce utility costs and GHG emissions (SHSC, 2007b). The GLI brings together multiple organizations, tools, and services to provide a one-stop application process for program and incentives for energy-efficient measures specifically for the social housing community (SHSC, 2007b).
Low-Income Conservation and Demand Management Program	Ontario Power Authority's Conservation Bureau's Low-Income Conservation and Demand Management Program aims to "to reduce electricity consumption in this sector by 100 megawatts (MW), the amount used by about 33,000 homes. The program is targeting 750,000 low-income units across the province, including social housing" (SHSC, 2006b).
Powerwise	Offered in Ottawa by HydroOttawa and the Ministry of Energy helps households save energy through small initiatives.
Winter Warmth Fund	There is a program offered by Enbridge, a natural gas provider, to assist households who are unable to cover their bills.
Ontario Home Electricity Relief	Program that is meant to cover increased electricity costs for low-income households for 2006 (SHSC, 2006b). Households may be granted a payment of up to $120 for Ontario Income Tax after completing the Property and Sales Tax Credit (SHSC, 2006b).
Emergency Energy Fund	Provide money to cover utility arrears, security deposits and reconnection costs (SHSC, 2006b). Households can only receive this assistance once (SHSC, 2006b). The program began in 2004 and in the first year helped over 2,700 households with an average of $467 (SHSC, 2006b).

Source: Author, 2007.

The GLI program can help Joe plan his development. By registering for the program, SHSC will identify programs that are applicable to his project saving time and money for Joe. Hopefully, the GLI will produce funding or grants that Joe can use in the project. It can also help forecast long-term savings for the building and residents that Joe can use to promote the project.

3.2.5 Cost of Land

The value of land is a barrier for procuring energy efficient locations. There is high demand for higher density, mixed-use locations because they are close to amenities and services. When the demand is high so is the cost of the land.

Intensification development is an opportunity for housing to be built on land in desirable locations. *Intensification* is the addition of buildings to built up areas on vacant lots or on previously developed land. Previously developed land, referred to as *brownfields*, may be available at cheaper costs for affordable housing developers. As part of the City of Ottawa's social housing program, Action Ottawa, the City maintains a Housing First Policy. This policy "ensures that surplus City land or proceeds from the sale of land are made available to build affordable housing" (City of Ottawa, 2007b). This policy can be effective in securing energy efficient locations for social housing because the high cost of land is overcome. Two of the social housing projects in the case studies, the Conservation Co-op and the Beaver Barracks project, have desirable locations because the land was previously developed and was under City control. The City was able to designate these land parcels for affordable housing and provide the land to the developers for next to nothing.

Municipalities can apply for funding from the Federation of Canadian Municipalities' (FCM) Green Municipal Fund (GMF) for sustainable infrastructure projects. The GMF contains $550 million from the Government of Canada and is managed by the Centre for Sustainable Community Development (FCM, 2007). "The Fund provides low-interest loans and grants, builds capacity, and shares knowledge to support municipal governments and their partners in developing communities that are more environmentally, socially and economically sustainable" (FCM, 2007). Funding is meant to cover capital infrastructure projects such as brownfields, energy, planning, transportation, waste and water (FCM, 2007). FCM focuses on projects that demonstrate municipal leadership and that can be replicated in other cities (FCM, 2007). The City of Ottawa has applied for funding from the GMF to help with the Beaver Barracks project that is in the design stage as of November 2007. Funding of this sort can help overcome the high costs of land at efficient locations.

Another type of green mortgage, location efficient mortgages take transportation costs into consideration. Choosing a home that is well serviced by transit and has options for walking and cycling can relieve a homeowner of the costs of car ownership. Homebuyers that choose a home at an efficient location may qualify for a higher amount of principal (NRTEE, 2003). The higher principal may allow a homebuyer to purchase a home in a dense, mixed-use area instead of in a new suburb on an undeveloped greenfield site. The purpose of green mortgages is to give people the choice to live an energy efficient lifestyle. Lenders in a few cities in the United States offer location efficient mortgages.

Joe realizes how valuable an energy efficient location is to the viability of his project and is aware of the expense of centrally located land. Joe can talk with the municipality to determine the possibility of securing land through a program like Action Ottawa and the Housing First policy in Ottawa that designates land for affordable housing. Subsidized land is Joes best hope for building at an energy efficient location. Without a subsidy, Joe will most likely build on inexpensive land far from the city centre and possibly on previously undeveloped land.

3.2.6 Planning Regulations

The planning tools that municipalities use to control land use can limit or encourage affordable housing. For example, official plans and related zoning bylaws can limit housing by setting high minimum parking space standards and can encourage affordable housing by reducing those standards so that residents are not forced to pay for expensive parking spaces they do not need. Parking requirements for high-density areas are expensive to meet especially in the form of underground parking (CMHC, 2007f). Another example of a regulation barrier is the use of development charges. Ontario municipalities use development charges or levies to cover the financial impact on municipally operated infrastructure such as roads, transit and schools (NRTEE, 2003). The current structure for development levies in Ontario does not encourage affordable housing because fees are based on an average cost per dwelling, not the actual corresponding costs in infrastructure (NRTEE, 2003). So a single-family dwelling on a 30 metre lot is charged the same as a rowhouse on a 10 metre lot even though the single-family dwelling requires longer roads and sewers. A change in this fee structure would have more efficient housing, such as rowhouses, paying less than single-family dwellings that are highly inefficient.

There are opportunities to overcome regulation barriers. In the case of development charges, municipalities can alter them. With accordance to the provincial Planning Act and Development Charges Act, the City of Ottawa has an incentives bylaws that allows them to reduce or exempt developers from development costs as well as make property tax exemptions, release land for below market value and waive building permit fees (Sayah, 2007). Waiving development levies or fees can decrease costs for social housing developers and thus make the housing more affordable (Alexander & Tomalty, 2002; CMHC, 2007f).

Another interesting planning regulation barrier are building codes, especially when building codes are used to promote energy efficiency. Regulation on energy efficiency can increase the overall energy efficiency in the province, but can burden low-income households more than moderate and high-income households. For example, a building code can compel housing developers to build more efficient housing, which helps energy conservation. Unfortunately, in many cases this increases the cost of building to the developer and those costs are passed onto the residents. In Ontario, the most recent Building Code was created in 2006 with a plan to integrate energy efficient building measures into the code over time (Ministry of Municipal Affairs and Housing, 2006). Many of the measures are based on the Model National Energy Code of Canada for Buildings 1997 (MNECB) developed by the Government of Canada to address concerns of energy consumption (NRCan, 2007c). The MNECB is a step towards more stringent energy efficient buildings, but simply adjusting the building code can place a further expense on housing developers, which in turns increases the cost of housing.

Joe needs to discuss his plan for social housing with the housing developers at the municipality. Hopefully the City can help Joe with his plan be accommodating his design by adapting planning regulations and waiving a number of planning fees to reduce Joe's overall cost. The City will most likely want to help Joe because of the need for additional affordable housing.

3.2.7 Planning Process

There are barriers in the planning process to building affordable housing. The length of the development process can increase costs for developers as development applications are reviewed. These costs are due to fees for consultants and architects, etc. In some cases, even the price of lumber can rise significantly while a developer is waiting for a building permit.

There are many ways of solving planning process barriers. One method is to reduce the time involved in development approval and permit applications. Together, Affordability and Choice Today (ACT) and the City of Ottawa have done just that. ACT is working towards solving regulatory issues or barriers in the provision of affordable housing in Canada by offering grants to organizations that wish "to improve housing affordability and choice" (ACT, 2007). The City of Ottawa used an ACT grant to develop a One-Stop Development Information and Applications Centre (Energy Pathways Inc., 1995). The streamlined development approval process in Ottawa integrates the infrastructure and planning approval process (Sayah, 2007). "Through several initiatives the project has improved the standard of service to the public, thereby substantially reducing the number of complaints received about building permit delays" (Energy Pathways Inc., 1995). This process has helped reduce the process time for applications and thus improved overall housing development in the city.

The streamlined process helps Joe and does not require extra effort or information on his behalf. When Joe goes to apply for his building permits, the process will be smoother and faster. The streamlined process benefits all developers and the municipality by saving time.

3.2.8 Remaining Challenges

Barriers to energy efficient social housing happen at many stages of development. Fortunately, the barriers to developing energy efficient housing and social housing are well known and governments and other organizations are doing their best to overcome these barriers. There are a few criticisms of the current programs available to increase energy efficiency in homes: solutions do not directly address the problems, there is a lack of integration between programs, the initial costs of participation are high, and the focus is on homeowners.

It is interesting to note that many of the solutions do not solve the real problem, but they try to overcome it in some way, often with funding. For example, the waiving of development cost charges in the planning system does not address the fundamental flaw in the way the costs are evaluated in the first place. The fundamental flaw is that low efficiency developments such as low-density single-family detached housing are favoured over high efficiency development such as higher density row housing. An example of a program trying to address the fundamental problems is the grant system offered by ACT to overcome regulatory barriers. The grant used by the City of Ottawa streamlined the entire development process to make the process of

development applications more efficient so developers all benefit and save money helping to make housing more affordable throughout the city.

The existing policy is complex and programs are scattered throughout levels of governments, utility providers, and non-profit organizations. Each level of government provides different aspects of housing. The federal government offers information to lower level governments. The main role of the federal government, while lacking an affordable housing policy, is education and funding for affordable housing and programs for increasing energy efficiency in homes. The Province plays a prominent role in social housing. The provincial government creates legislation on the responsibility, creation and maintenance of social housing. It also provides a number of programs to reduce energy use. The role of the municipality in social housing is mostly in planning. The municipal government deals directly with housing developers to encourage provision of affordable housing to meet the City's housing targets. It is important that each level of government plays their role and communicates with other levels and departments. It seems there is not enough communication on this subject because programs to lower energy consumption are scattered. The GLI program by SHSC shows recognition of the complexity of available programs and the need for better integration. A national policy would promote better alignment among the programs at different levels of government (NRTEE, 2003).

Unfortunately, the majority of programs offered in Ontario require an initial investment in retrofitting and upgrading homes so that households save money in the long-term, perhaps after five years of utility bills (CMHC, 2007e). Thus, programs such as ecoENERGY are really aimed at medium- and high-income households that can afford to pay the initial costs. Low-income households, who may see the greatest impact of the financial benefit of energy efficient dwellings, do not have access to capital to cover the initial investment costs. Developers of social housing have similar concerns because they want to keep costs low so that units are affordable to residents and so they can provide housing for the most households possible.

The vast majority of households in core housing need are renters (CMHC, 2007c) and thus are excluded from the policies for energy conservation that are tied to home ownership. Programs such as the ecoENERGY Retrofit program and green mortgages are designed for homeowners. So it is up to the housing providers or developers to tap into programs that are reserved for homeowners.

The energy efficient features and barriers to their implementation discussed in this section are general ideas and are based on collective experience and research from a literature and policy review. After establishing the possible barriers and solutions that a fictitious housing developer (like Joe) might experience, three real case studies of energy efficient social housing projects are presented. The case studies show how different combinations of energy efficient features, policies, and programs are used in real social housing projects. They also show specific challenges that are experienced.

4. Case Studies

Housing is now very much a concern of municipalities. This research focuses on how one municipality, the City of Ottawa, is trying to promote and realize energy efficient social housing. Government commitment to affordable housing and energy conservation and the existing policy can be seen in built projects. The three social housing projects included in this research are presented here in chronological order of date completed to follow the progression of policy. The location of the three projects in relationship to downtown Ottawa are shown in Figure 2. A brief overview of each project is given. The energy efficient measures in the project are then described. Energy efficient measures are listed under the grouping of features provided in Section 3.1 that described how housing can be energy efficient in housing construction, appliances and lighting, heating and cooling, the building envelope, household transportation, and density and land use. Based on discussion with housing developers and property managers, the challenges that each project experienced are discussed. To conclude each case study the success of the project is illustrated. Success is measured based on a number of factors including the resulting energy consumption and cost savings for residents. Information for social housing in Ottawa is provided here as context for the case studies.

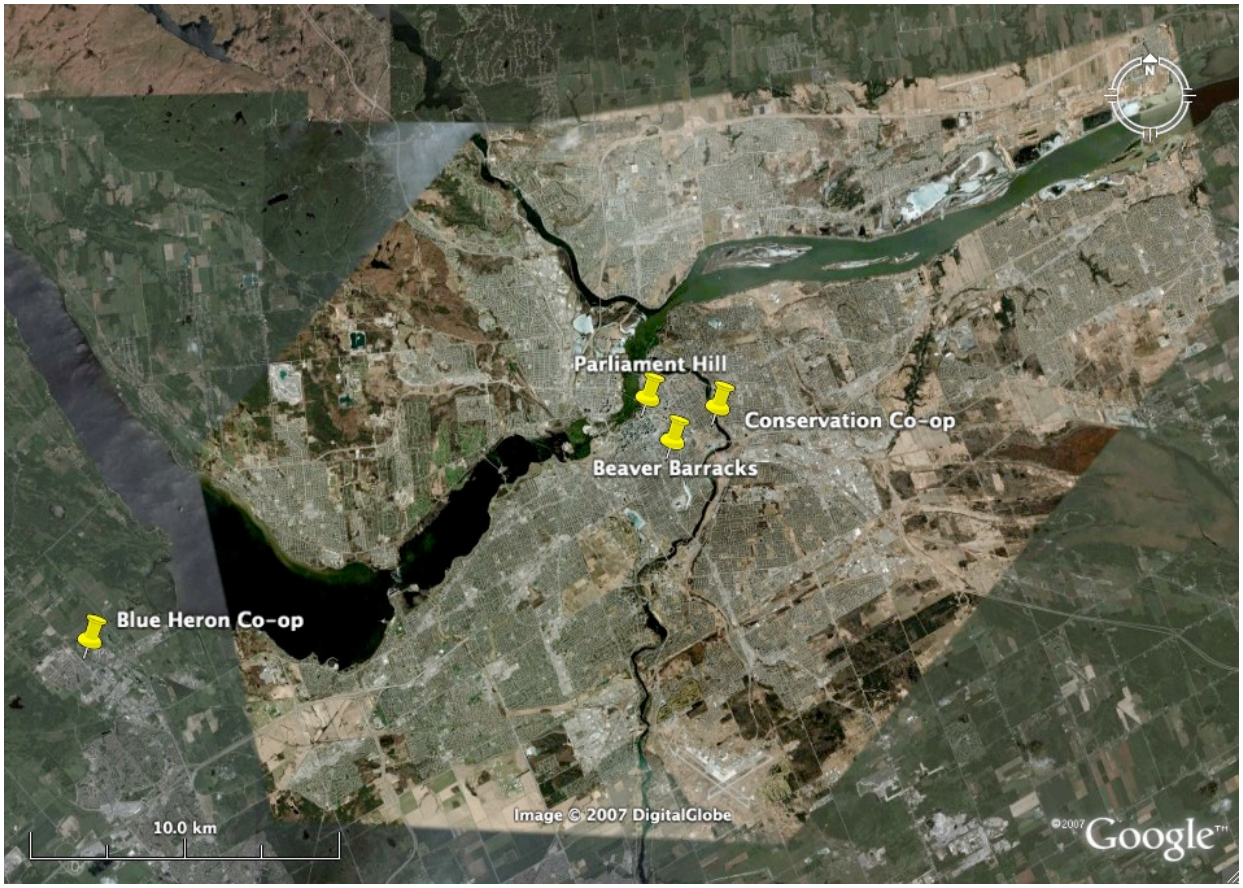

Figure 2. Locations of the three case studies in the region of Ottawa. Parliament Hill is shown to indicate the centre of downtown Ottawa.

Source: Google Earth, 2007.

Two of the case studies are co-operatives and one is a non-profit. Residents themselves manage co-operative housing through a co-op board. Monthly fees are set based on the operational costs of the building. Often a portion of the units in a co-op are subsidized by governments so that qualified residents only pay 30 percent of their before tax income on housing. The third case study is a private non-profit managed by a community housing provider, Centretown Citizens Ottawa Corporation. Non-profits provide affordable rental accommodation often with a combination of average-market, below-market and subsidized units.

4.1 City of Ottawa

Ottawa's municipal government is interested in increasing affordable housing options and reducing greenhouse gases in the city. The municipal government sees the value of the connection of energy conservation and affordable housing:

> Because of the limited ability of low-income people to afford rising utility costs, and the City of Ottawa's commitment to reducing greenhouse gas emissions, the City encourages all proponents to incorporate energy efficiency measures for the design, construction, and operation of the project (City of Ottawa, 2007d)

The City intends to be a leader in energy conservation, land use, alternate transportation use, and other environment fields (City of Ottawa, 2007a). It is important to have the commitment from the municipality because the City has a number of tools to help affordable housing developers.

Policies for energy conservation and affordable housing are addressed in two separate plans by the City of Ottawa. The Climate Change and Air Quality Plan aims to reduce greenhouse gases and other pollutants from the air (City of Ottawa, 2007c). The plan to reduce greenhouse gases in the City is by reducing energy consumption in buildings, transportation and waste. The Affordable Housing Strategy for the City is contained with the Human Services Plan. The Affordable Housing Strategy guides housing initiatives for the city. Action Ottawa is a key program for social housing within the Affordable Housing Strategy. It provides municipal services for housing developers and provides the funding for below-market rent units and housing subsidies (Social Housing Registry of Ottawa, 2007). It also deals with physical resources; for example, under Action Ottawa the municipality can offer surplus land in exchange for the provision of affordable housing (City of Ottawa, 2007c). The City also maintains a Housing First Policy that designates surplus municipal owned land or the revenue from the land to affordable housing as discussed in Section 3.2.5 (City of Ottawa, 2007b). The Housing First Policy and Action Ottawa helped the Beaver Barracks project obtain its efficient location.

Social housing is administered through a municipal housing corporation, cooperatives and non-profits. Under the Social Housing Reform Act, the City of Ottawa became a Consolidated Municipal Service Manager making the City responsible for social housing in the area. There are over 22,000 units of social housing across the City managed by 56 non-profit housing providers (City of Ottawa, 2007e). Under the Business Corporation Act, the City of Ottawa incorporated a non-profit housing corporation, the Ottawa Community Housing Corporation (OCHC), which operates the majority of social housing in the city. OCHC currently owns 14,000 units (Sayah, 2007). The largest non-profit housing provider in Ottawa is Centretown Citizens Ottawa Corporation (CCOC), which operates 1,300 units in the city (CCOC, 2007c).

Despite the vast amount of housing that exists, there is still a wait list of 10,000 households that qualify and are waiting for affordable housing (Rupert, 2007). The average wait time for rent-geared-to-income housing in Ottawa is 4.5 years (Peters et al., 2006), although households can wait up to five years (City of Ottawa, 2007e). In other service manager areas, households can wait anywhere from to three to ten years (Peters et al., 2006). The Social Housing Registry, a non-profit, administers the centralized waiting list for rent-geared-to-income and below market rent social housing in the city (Social Housing Registry of Ottawa, 2007).

According to Sayah (2007), the City is flexible with development proposals for accommodating green building and energy efficient design and features. The city encourages sustainable design, but does not intend to force energy efficiency on all housing developers. As will be shown with the Beaver Barracks project, the city is pushing for green building features for proposals when it is deemed appropriate. The city is now trying to use life-cycling costing of projects to determine what are the realistic payback periods and benefits of energy efficient housing. The city is closely watching and learning from the experience of the recent Blue Heron Co-op and the Beaver Barracks project that are included as case studies below.

In the past decade, there has been little new social housing constructed. The majority of social housing units in Ottawa need repairs just to bring units up to building codes (Sayah, 2007). This is an opportune time to upgrade the energy-efficiency of units that need renovations.

4.2 Conservation Co-operative

The Conservation Co-operative is located in Strathcona Heights, a central neighbourhood in Ottawa. The neighbourhood is well established and contains mostly residential single-family homes and low-rise apartment buildings, which can be seen in Figure 3. There are a few commercial services on main streets. The Co-op is located in the southeast of the neighbourhood and is close to the recreation paths along the Rideau River. The project was completed and occupied in 1995. The four storey multi-unit apartment building forms a u-shape around a shared courtyard and garden. The main entrance is shown in Figure 4. It contains 84 units with a mix of one, two, three, and four-bedroom units. It is meant to provide housing that is affordable to low and moderate-income households. An overview of the project is provided in Table 3. The driving force behind the project was a group of community members that were interested in the environment and formed the co-op board in 1994. The goal established by the board "was to create a sustainable community, integrating environmental, social and economical considerations" (Green Building Council, 1998). For this project, energy-efficiency was a goal in and of itself (CMHC, 2007b).

Figure 3. Conservation Co-op Site.
Source: Google Earth, 2007.

Table 3. Conservation Co-operative Project Information

Property Owner and Manager	Conservation Co-operative Homes Inc
Location	Strathcona Heights, Ottawa, Ontario
Date of Initiation	Spring 1994
Date of Completion	November 1995
Number of Units	84, typically 216 persons
Unit Type	11 one-bedrooms 53 two-bedrooms 18 three-bedrooms 2 four-bedrooms
Target Occupant	Low and moderate-income households 4 accessible units
Housing Typology	Multi-family apartment
Construction	Warlyn Construction
Architect	Cole & Associate Architects
Financing Sources	Ontario Ministry of Housing, MUP grant City of Ottawa, City Living
Information Sources	(CMHC, 2007b; Green Building Council, 1998; O'Neill Cole, 2007)

Source: Author, 2007.

Figure 4. Conservation Co-op Entrance.
Source: Author, October 2007.

Figure 5. Conservation Co-op Garden Gate.
Source: Author, October 2007.

Figure 6. Conservation Co-op Balconies.
Source: Author, October 2007.

Figure 7. Conservation Co-op Parking Lot.
Source: Author, October 2007.

4.2.1 Energy Efficient Features

The Conservation Co-op building, site and location are all energy efficient. The features included in the final design had to be cost efficient as well as energy efficient. Each feature was evaluated using life cycle costing (O'Neill Cole, 2007). "The Conservation Co-op was able to use energy efficient products that still remained within the social housing construction budget guidelines even with some higher emplacement costs" (CMHC, 2007b). The funding guidelines demanded that construction not cost more than $645 per meter squared (Briggs, 1999). The features included are listed below.

Housing Construction:

- The Conservation Co-op is built on a previously developed brownfield site.
- The prior building was demolished and when possible the materials were reused in the project or recycled (O'Neill Cole, 2007).

Appliances and Lighting:

- All the units have energy efficient appliances and lighting.
- Common space has energy efficient light fixtures and site lighting is powered by photovoltaic lighting. Photovoltaic lighting converts solar energy into electricity to provide light.

Heating and Cooling:

- There are individual metered gas units that are high-efficiency for hot water and hydronic space heating (Green Building Council, 1998).
- Occupants are individually billed so that they pay directly for their consumption (Green Building Council, 1998).
- The high efficiency heating system is complimented with further energy efficiency design for heating. The site is designed to gain maximum passive solar energy in winter and shaded from sun in summer (Green Building Council, 1998).
- "Heat recovery ventilators and a balanced ventilation system for each individual unit was chosen over the traditional air supply from a pressurized corridor and exhaustion through kitchen and bathroom fans because individual unit systems offer superior efficiency" (CMHC, 2007b).
- The design tried to allow for cross-ventilation in as many units as possible (O'Neill Cole, 2007).

Building Envelope

- The building envelope is designed to trap heat in the winter and release heat in the summer.
- Windows are double-glazed, argon filled, lowE to reduce heat loss (Hill & CMHC, 2001). Insulation level in walls and roof are higher than required by code (RSI 4.93 for walls, RSI 7.04 for roof) (Hill & CMHC, 2001).

- Balconies in the Co-op are separate structures from the main building so that radiant heat is not lost from the floor in wintertime (Green Building Council, 1998; Hill & CMHC, 2001). "Balconies can be inefficient because they are an extension of the floor slab, allowing for radiant heat loss through the floor to the outdoors" (CMHC, 2007b). The balconies for the Conservation Co-op are shown in Figure 6.
- "To block unwanted heat in the summertime, there are fin-walls and sunscreens on the balconies" (CMHC, 2007b).

Household Transportation

- The site design encourages energy efficient modes of transportation.
- The only parking available is eight surface spaces (O'Neill Cole, 2007). Only eight parking spaces were required to meet the strict parking zoning regulations set by the City because the property was treated as a single property (O'Neill Cole, 2007). This saved the Co-op a substantial sum because underground parking spaces cost approximately $20,000 per space (O'Neill Cole, 2007). The eight spaces could easily be accommodated for at surface (see Figure 3 and 7).
- Two of the surface spots are reserved for cars owned by co-op board members. These two cars are available for all residents to use for special trips (O'Neill Cole, 2007).
- Only street parking is available for visitor parking.
- Ramps led to secure underground parking for up to 240 bicycles, which allows for everyone in the Co-op to store a bicycle (O'Neill Cole, 2007).
- There is a bus stop just outside the main door of the building.

Density and Land Use

- Although much of the neighbourhood is single-family detached dwellings, there are a number of low-rise apartment buildings like the Conservation Co-op on the one street that increases the density of the neighbourhood, see Figure 3.
- There are a number of services nearby. The University of Ottawa and an elementary school are located within a few blocks. Downtown Ottawa and the Byward Market are within two kilometres.
- The courtyard provides garden space and compost containers for local food production. Local food production actually saves energy because food does not need to be transported by trucks. It also provides food security for residents. See a view of the garden gate in Figure 5.

The Conservation Co-op included a variety of energy efficient features. In fact, the design for the Co-op also includes many other environmental features that are not pertinent to this report. The building has a combination of high and low tech features such as high tech heating systems and low tech design for natural cross ventilation. The site also includes energy efficient features to support an environmental lifestyle such as the bicycle parking and limited parking spots. Although the community is moderate to low density, its proximity to downtown allows for easy access to public transit and services.

4.2.2 Policy and Planning

The Conservation Co-op was accomplished by an inspired board and funding from the Ontario Ministry of Housing social housing funding (O'Neill Cole, 2007). The Conservation Co-op was founded by a group of community members that came together to look at housing options. The Co-op worked closely with the project architect to determine what features would be included in the design. Over about eight months, board members met with the architect in the evenings for consultation (O'Neill Cole, 2007). They needed to identify features that paid off, followed the principles of the project, and they needed to establish guidelines for living in the dwellings (O'Neill Cole, 2007). Fortunately, the architect had experience working with social housing budget constraints. Cole & Associates Architects had built two previous buildings under the same funding so were aware of the tight financial constraints (O'Neill Cole, 2007). Architects performed life cycle costing to determine the pay-off of different energy efficient features. Only features that were affordable and energy efficient were included because of cost limitations (Green Building Council, 1998; O'Neill Cole, 2007).

One of the first tasks of the Co-op board was to procure a site for the project. The group noticed a site where a social housing project built in the 1940s or 1950s, but was in severe need of renovation or demolition (O'Neill Cole, 2007). That site was obtained from the City of Ottawa through a program called City Living (O'Neill Cole, 2007). The land was available for low-income housing and was leased to the Co-op for $1 for 99 years (O'Neill Cole, 2007).

4.2.3 Challenges

There were many challenges in developing the Conservation Co-op. The challenge from the start was to include energy efficient features within tight budget constraints (O'Neill Cole, 2007). The Ministry of Housing funding was extremely strict and limits spending by cost per square footage. The design process would have been easier with more flexibility (O'Neill Cole, 2007). If it had been more flexible, more amenities, such as wider balconies and planters on all balconies and cross ventilation in all units, could have been provided (O'Neill Cole, 2007).

It was also difficult to get the City to agree to issues around parking and servicing, such as providing individual meters and including a grey water system (O'Neill Cole, 2007). The Ministry of Housing was skeptical of many of the features, such as the gas heat and heat recovery ventilators (HRV) because they had not been done before. They had to be convinced to take risks (O'Neill Cole, 2007).

Further challenges were experienced once the Co-op was occupied. At first, the building manager was very knowledgeable about the different elements and functions of the energy efficient features (O'Neill Cole, 2007). Then there was a fast turnover of building managers and much of that knowledge was lost (O'Neill Cole, 2007). The experimental grey water system had to be abandoned because the maintenance person had no training for the system and did not know how to deal with it (Carr, 2007).

The project required tenants to buy into the concept of environmental living that requires certain effort on of behalf of residents. One example is of a family that moved into one of the few units

that faces northeast and is generally cooler than most units. The family insisted on keeping the temperature in the unit at 32˚C, which made the parquet floor pop (O'Neill Cole, 2007). There were also problems with the floors warping when people did not use the suggested cleaning products (O'Neill Cole, 2007). Even though there were challenges and problems with the project, it can still be deemed a success.

4.2.4 Successes

The project is successful because it has provided an example of what can be done. The project has been used by CMHC as an example of energy efficient housing (CMHC, 2007b). The project received an award from the Green Building Council (Green Building Council, 1998). It also provided research for a CMHC study of grey water systems (Green Building Council, 1998). A CMHC researcher argues that the project is successful because it brought together many environmental practices and could be replicated (Hill & CMHC, 2001).

The project was also a financial success. A CMHC evaluation found that the pay-back period for the collection of energy efficient measures was ten years (Hill & CMHC, 2001). Residents have low monthly energy costs, which are encouraged because residents pay their own utilities. “Co-op members have reported that on sunny days in the winter, even when it is minus 20 degrees Celsius, the apartment remains around plus 17°C without turning on the heat” (Hill & CMHC, 2001). The result of the Co-op Board’s initiative is energy efficient and affordable housing units.

4.3 Blue Heron Co-operative

When the Blue Heron Co-operative was completed in 2006, it was the first co-op built in Ontario since 1996. The Co-op was built in the former city of Kanata. The project is made up of a multi-family apartment building and townhouses shown in Figures 9, 10 and 11. It is located on a major road in a residential area. The site, at the time of construction, can be seen in Figure 8. The average market rent for a two-bedroom unit in the Blue Heron Co-op is approximately $920 and the below market rent is 70 percent of average market rent at $644 (Trotscha, 2007). Table 4 provides a summary of information for the project.

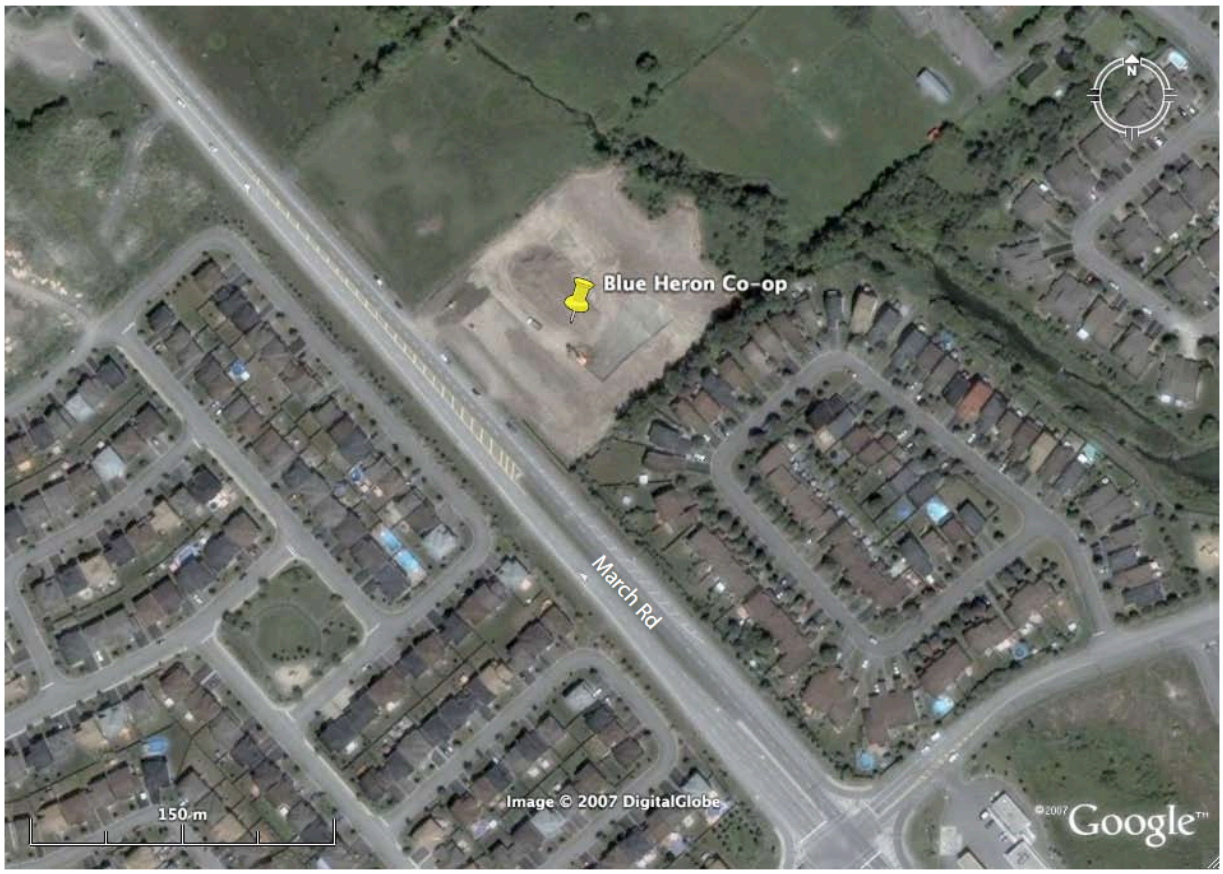

Figure 8. Blue Heron Co-op Site.
The image shows the site during the initial phase of construction.
Source: Google Earth, 2007.

Figure 9. Blue Heron Co-op Multi-Unit Apartment Building.
Source: Author, October 2007.

Figure 10. Blue Heron Co-op Townhouses.
Source: Author, October 2007.

Table 4. Blue Heron Co-operative Project Information

Property Owner and Manager	Blue Heron Co-operative Homes Inc
Location	Kanata, Ottawa, Ontario
Date of Initiation	Co-op formed in 1999
Date of Completion	September 2006
Number of Units	83
Unit Type	8 bachelors 25 one-bedrooms 25 two-bedrooms 22 three-bedrooms 3 four-bedrooms
Target Occupant	Low and moderate-income households 14 average market rent 48 below average market rent 21 rent supplement units
Housing Typology	Multi-family apartment and townhouses
Architect	Christopher Simmonds
Financing Sources	Canada-Ontario Funding Action Ottawa City of Ottawa
Information Sources	(Bainbridge, 2007; CMHC, 2005a; Thibert, 2007; Trotscha, 2007)

Source: Author, 2007.

Figure 11. Blue Heron Co-op Natural Drainage.
Source: Author, October 2007.

Figure 12. Blue Heron Co-op Greenfield Site.
Source: Author, October 2007.

4.3.1 Energy Efficient Features

The Blue Heron Co-operative has energy efficient appliances, lighting, and heating systems. It is not located on an efficient site. It is built on a greenfield, see Figure 8, far from downtown and essential services.

Housing Construction

- The economy of scale allowed for the inclusion of a common space, meeting room and office in the apartment building, although it was difficult and it would have been much easier to build three apartments.

Appliances and Lighting

- All units have compact fluorescent lamp (CFL) bulbs and ENERGY STAR fridges (Trotscha, 2007). Compact fluorescent bulbs use less energy and last longer than traditional incandescent lamps. Compact fluorescent bulbs save greenhouse gases. The price of these lamps is higher, but cost is recouped through energy savings and the life of the bulb itself.
- The laundry room uses low water and energy use Heubsch appliances.
- The clothes dryers are gas and there are fewer dryers than washing machines to encourage residents to hang dry clothes.
- Common spaces have high efficiency exit signs (LEDs) that cost about $5 a year to operate, as opposed to compact fluorescent bulbs at $25 a year and incandescent bulbs at $47 a year (Trotscha, 2007). Flat plate technologies are even more efficient at $0.50 a year, but they are not legal in Canada because they only provide green light and are not approved by the fire martial in Ontario.

Heating and Cooling

- There is a highly efficient heat pump and water loop heating and cooling system that uses the east/west site orientation to save a further 35 percent in energy consumption (Simmonds, 2007).
- There is central air conditioning for all units (Trotscha, 2007).
- There is a heat exchange unit for hot/cold water (Trotscha, 2007).
- There are low flush toilets and flow restriction on all taps (Trotscha, 2007).

Building Envelope

- The building structure is also energy efficient. One interesting feature is the use of steel studs in the building structure. Wood studs are traditionally used and steel studs are uncommon. Steel is used because it is a reusable resource and has a structural quality (Trotscha, 2007). The steel can serve as a cold bridge, so wall insulation is outside of the studs.
- The balconies are separate structures so radiant heat is not lost as in the Conservation Co-op (Trotscha, 2007).

- The housing typologies are efficient and include a row-rise apartment building shown in Figure 9 and townhouses shown in Figure 10.

Household Transportation

- Parking is not limited. There are 99 surface parking spots so each household can own a car (Trotscha, 2007).
- Access to public transportation is limited and time efficient access to downtown at peak times involves a rural express bus pass, which is quite expensive.

Density and Land Use

- The site includes natural draining systems that flow into a natural stream as shown in Figure 11 (Trotscha, 2007).
- The surrounding area is low density, see Figure 8. There are 500 new housing units planned to be built within one kilometre of the co-op, which will include market-rate single-family and semi-detached units (Trotscha, 2007). This will help to increase the density of the area, but it will most likely still be considered too low for efficient transit service.
- A new school will follow the residential development (Trotscha, 2007).
- The area is mostly residential, although there is a bit of commercial on March Road.

The overall energy efficiency of the Blue Heron Co-op is probably quite low when household transportation and infrastructure are considered. The project itself is of moderate density, but it sits in a community of low density and is surrounding by greenfields (see Figure 8 and 12). Transit service is poor and potential new development will probably not be high enough density to increase the efficiency of the service. It is impressive to see how many energy efficient features were included in a project when the impact on the environment was not a high priority for the Board.

4.3.2 Policy and Planning

The Blue Heron Co-op was the first co-op to be built in ten years. The Co-op Board was formed by people who were concerned about affordable housing options in the region. The main goal was to secure affordable housing in Kanata (Thibert, 2007). The Board formed in 1999, but did not procure a site until 2004.

The site belonged to an Anglican Church. The Church and the associated graveyard are located on the edge of the property. The site is located on the far side of the property and was once used as grazing land for the Minister's horse (Trotscha, 2007). A property adjacent to the Co-op is still used for grazing horses. The Co-op Board responded to a Request for Proposals from the Anglican Church. The Church was searching for a new use of the land that would provide supplementary income. The Co-op was a more attractive proposal than commercial uses because of the value of affordable housing to the community. The site is leased from an Anglican Church for $5,000 per month.

The Co-op received funding from the Harper Government (Trotscha, 2007). Funding from the Canada-Ontario Affordable Housing program was $2,075,000 or $25,000 per unit. Seed funding of $5,500 came from CMHC. The Province provided only $332,000 due to the financial situation of the government recovering from the Harris era. Funding from the City of Ottawa through Action Ottawa was $1,550,000. The municipality also forgave costs of planning approvals, building permit fees, development charges, and parkland levy fees for a total of $962,000.

It is interesting to note that NRCan encouraged the Co-op to apply for energy conservation grants (Trotscha, 2007). So the time was taken to apply for the grants for a possibility of $25,500, but the Co-op received no grant at all in the end. The project consultant is unaware of why their application was denied.

4.3.3 Challenges

There were unique challenges that had to do with the high-tech features. There were difficulties with operating the computer system that manages the heating and cooling (Trotscha, 2007). There were mechanical failures that were not easily fixed. The HRV systems were not operating smoothly. Three have broken down since the opening of the building in 2006, one within the first week of operation.

Co-operative housing itself presents a challenge for people who are adjusting to the co-operative style of living. Only three residents at the Blue Heron Co-op had lived in a co-op situation previously (Bainbridge, 2007). On top of that, residents of Blue Heron Co-op must also adjust to living environmentally. The property manager is often the person dealing with issues in the period of adjustment. For example, the property manager is often called on to explain the purpose and operation of the programmable thermostats. So the property manager needs to have special knowledge of the energy efficient features. Some operation is beyond the capability of the professional property manager. The property manager has had a number of problems dealing with residents. One challenge for the residents was with the hydro bills. Residents received bills in October 2007 that were larger than they expected. This may be due to the non-standardized billing periods that hydro uses. The property manager is going to compare the operating costs with similar co-ops, Thompson (that has a boiler) and Eagle (that has natural gas), to better understand the impact of the energy efficient features on the residents. Fortunately, the property manager was hired on before the project was even completed and has previous experience working in six co-ops. Property managers in the area get together to discuss problems and share lessons.

The finances were also a challenge for this project. The project budget is still a problem. The consultancy group has had to waive its fees of $20,000 twice to help balance the budget (Trotscha, 2007). The project consultant believes that townhouses will no longer be built under social housing funding because they are too large and expensive. The townhouses in the Blue Heron Co-op cost approximately $240,000 to construct. Due to challenges with the maintenance of certain systems, the consultant and property manager agree that the cost of a specialized maintenance worker needs to be incorporated into budgets.

4.3.4 Successes

The Blue Heron Co-op is a success simply because it was built. It signifies a turning point in affordable housing construction after a decade of no new building. Although the housing has not been occupied for very long, it is already providing lessons to the development community. A similar project is currently being constructed based on the Blue Heron model. The 63 unit McLean Co-op is being built in the Gloucester-Southgate Ward of Ottawa by the same architect as the Blue Heron Co-op. In 2006, the architect received the award for Best Project in the Sustainable/Green Housing Category for the Ottawa-Carleton Home Builders' Association (OCHBA) Awards (Simmonds, 2007).

4.4 Beaver Barracks Project

The Beaver Barracks project is an infill project in Centretown, Ottawa. The site has been vacant for years and was recently designated by the City for affordable housing (see Figure 13 and 16). The City accepted the proposal from Centretown Citizens Ottawa Corporation (CCOC) to develop the site. CCOC is currently is the design stage of the project. The construction has not yet begun and occupancy is not expected until the autumn of 2009. The entire project is anticipated to be affordable. It will include a range of units rented at below market rate, rent-geared to income, and for low-income households (Rupert, 2007). The goal of the project is to first provide additional affordable housing in a central location and second demonstrate how environmental features can work for low-income households (CCOC, 2007b). CCOC states the following vision for the project:

> The project will set a new standard for affordable and livable communities for households of all income levels. The project will be a green gateway to Ottawa demonstrating the high-performance buildings can be attractive, accessible and affordable - important components of an ecological oasis in the heart of the city (CCOC, 2007b)

Both CCOC and the City of Ottawa are dedicated to making the Beaver Barracks project a model for future development in the City. A summary of the project is provided in Table 5.

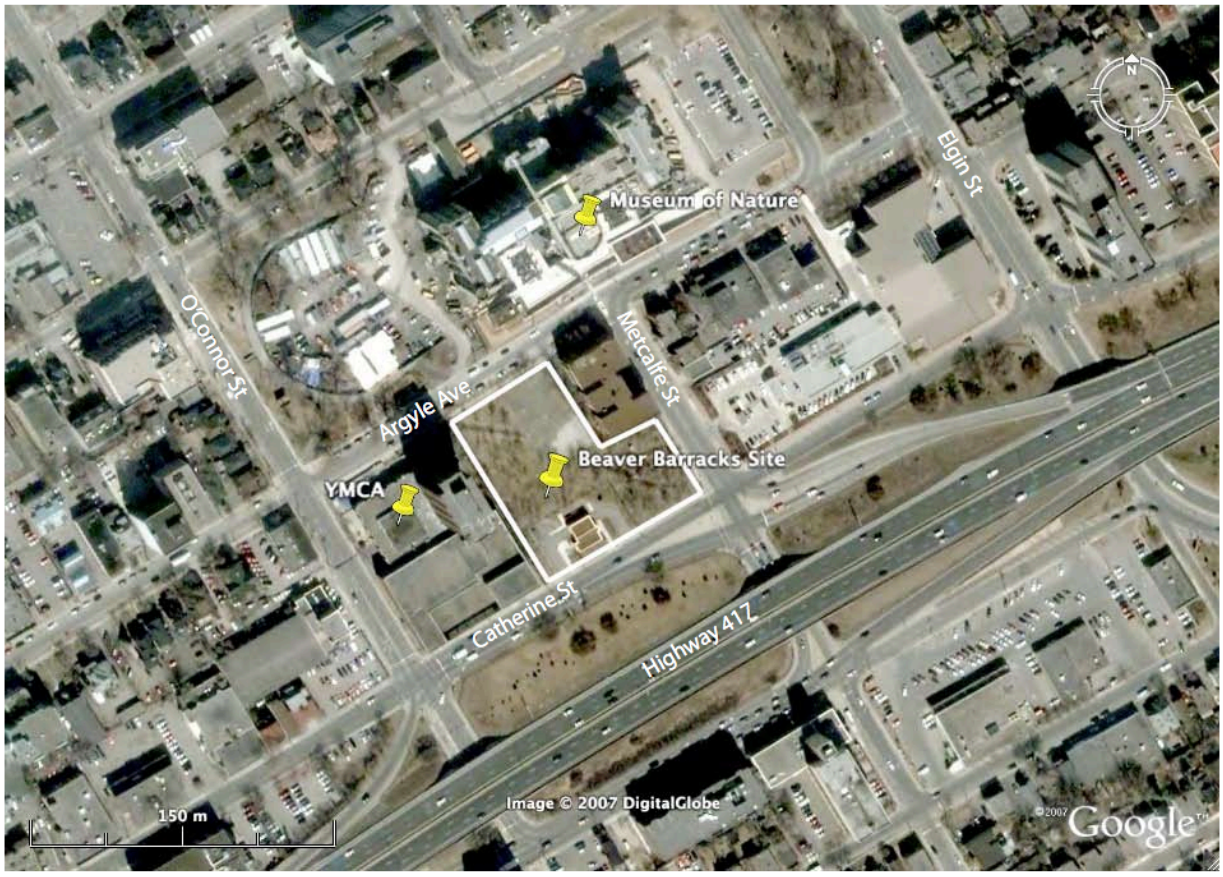

Figure 13. Future site of the Beaver Barracks project.
Source: Google Earth, 2007.

Table 5. Beaver Barracks Project Information.

Property Owner and Manager	Centretown Citizens Ottawa Corporation (CCOC)
Location	Centretown, Ottawa, Ontario
Date of Initiation	Spring 2007
Date of Completion	Estimated Autumn 2009
Number of Units	195 planned
Unit Type	61 bachelors 62 one-bedrooms 54 two-bedrooms 18 three-bedrooms (20 accessible)
Target Occupant	Low, moderate-income households 48 Average market rent (AVR) 114 Below (70%) AVR 15 Below (50%) AVR 12 ODSP units 6 Ontario Works units
Housing Typology	Multi-family apartments, townhouses and stacked townhouses
Architect	Barry J. Hobin and Associates
Financing Sources	Canada-Ontario Funding Action Ottawa, City of Ottawa Conventional First Mortgage Second Mortgage from Grey Sisters
Information Sources	(Carr, 2007; CCOC, 2007a, 2007b; CCOC & CCHC, 2007; Sayah, 2007)

Source: Author, 2007.

Figure 14. Museum of Nature from Metcalfe St, neighbour to Beaver Barracks Site.

Source: Author, October 2007.

Figure 15. BUGS Community Garden on the Beaver Barracks Site.

Source: Author, October 2007.

Figure 16. Beaver Barracks Site from Argyle Ave.

Source: Author, October 2007.

Figure 17. Beaver Barracks Site and the YMCA from Metcalfe St.

Source: Author, October 2007.

4.4.1 Energy efficient Features

CCOC is looking to integrate as many energy efficient features as possible into the design. They have established Leadership in Energy and Environmental Design (LEED) Silver as a minimum target, although they will not seek certification for the building (Carr, 2007; CCOC, 2007b). The LEED building rating system provides a set of standards for environmentally friendly construction. The LEED rating system is currently well recognized in the development industry. Unfortunately, it is expensive for a building to obtain official accreditation so affordable housing developers often use the system solely as a checklist for development.

Housing Construction

- The project will be built on a previously developed brownfield site.
- The capital budget includes a 5 percent construction premium to account for the extra costs of sustainable features (CCOC, 2007b).

Appliances and Lighting

- Features to be included are low energy lighting and appliances (CCOC, 2007b).

Heating and Cooling

- They are researching the possibility of central heating and geothermal energy from ground source heat pumps (Carr, 2007; CCOC, 2007b).
- Solar energy may be collected from flat rooftops and solar domestic hot water systems may be used (CCOC, 2007b).
- Electricity and thermal energy costs are billed to units to encourage tenants to reduce utility costs and reward conservation (CCOC, 2007b).

Building Envelope

- Features to be included are high levels of insulation and high performance windows (CCOC, 2007b).
- Proposed buildings are energy efficient typologies including a 7.5 storey and a 4.5 storey apartment building and a number of stacked townhouses.

Household Transportation

- The unit to parking ratio required by zoning is 50 percent, although parking needs for residents will probably be less than 45 percent (Carr, 2007). Excess spaces can be leased to neighbours (Carr, 2007).
- Residents will have access to shared vehicles through the local car share company, Vrtucar (Carr, 2007).
- There are many bus routes that frequently pass by the site.
- It is located just north of the major highway (the Queensway) that runs east to west across the city, see Figure 13.

- Conventional bicycle parking is to be provided (Carr, 2007).

Density and Land Use

- The community is moderate to high density. The project will blend well with the existing building heights and increase the density of the neighbourhood. The neighbouring buildings are between two and six storeys. There is also the high-rise YMCA tower (see Figure 17).
- The site is centrally located and is surrounded by a mix of land uses shown in Figure 13. To the north is the Canadian Museum of Nature (see Figure 14). To the west is the downtown YMCA that provides recreational facilities and a daycare. To the west are a heritage apartment building and the Ottawa Policy Headquarters.
- There is a community garden project currently using the vacant site (see Figure 15). The garden will be moved, but will be incorporated into the new site design. Community gardens provide local food production as discussed above with the Conservation Co-op.

The site itself makes the Beaver Barracks project energy efficient before the building is even constructed. The community is high density, with a wide mix of uses and frequent public transit. Residents will be able to tap into services that already exist. The proposed design will further enhance energy efficiency by using efficient housing typologies and incorporating energy efficient lighting, appliances and other features whenever economically viable.

4.4.2 Policy and Planning

The initiative for the Beaver Barracks project comes from the City of Ottawa and CCOC. The Request for proposals (RFP) from the City states the first priority for the site as affordability and the second as sustainability (Carr, 2007). The RFP is specific to the site and so many energy efficient features can be considered because the site is large enough that the economy of scale comes into play. The initiative for energy-efficiency came from City through its RFP, although CCOC would have done it anyways.

The reasons that CCOC's proposal was selected was because they proposed to build almost twice as many affordable units as the other proposals and because of their experience in the community (Sayah, 2007). According to a City Housing Developer, CCOC is not afraid of green building features and is more willing than private developers to include environment features such as green roofs. Their experience has led them to be the second largest housing provider in the city and to be an excellent model for housing provision.

CCOC is learning from other organizations and projects. They are looking at the experience of the Blue Heron Co-op, the Conservation Co-op and its grey water system. They are also learning from international projects such as Trolley Square in Cambridge, MA, USA. For this project, an operational manual for tenants and one for staff was developed to deal with the sustainable features of the project (Carr, 2007). Lessons taken from other projects can help overcome challenges such as the ones experienced in the Conservation Co-op and the Blue Heron Co-op.

The brownfield was the site of the old army barracks, Beaver Barracks, which had been torn down in 1990. The land was given to the City through a transfer of lands with the federal

government. The land was targeted for affordable housing by the City (Carr, 2007). The land will be given to CCOC at $1 as part of the development project.

Funding is being provided for 100 of the units. The federal and provincial governments are providing $7 million in Canada-Ontario Affordable Housing Program Funding (Rupert, 2007). The Beaver Barracks project is the only project eligible for this round of funding from the federal and provincial government (Rupert, 2007). Funding from the City of Ottawa is $30,000 per unit for a total of $3 million. Under the Action Ottawa program, the City is providing $3 million of funding and the land for $1 (Carr, 2007). The funding from Action Ottawa has made energy-efficiency and affordability targets more stringent. The City is also waiving development charges, planning fees, parkland levies, and school board fees for a savings of approximately $1.5 million.

The remaining 95 or so units will be funded by CCOC. "The corporation's executive co-ordinator said they were able to finance the extra 95 units by taking a $10 million mortgage, because interest rates are low and revenue from the building is expected to be steady" (Rupert, 2007). The loan is made possible because of low interest, long-term financing from the Grey Sisters of the Immaculate Conception. They intend to lend $1.5 million, $800,000 for phase one (195 units) and $700,000 for phase two Catherine Street rental project (Carr, 2007). CCOC has used this financing twice before. CCOC will also use some of its own equity; approximately $200,000 for phase one, and an equal amount for phase 2.

CCOC and the City of Ottawa are exploring additional funding opportunities. CCOC is applying for incentives for the energy efficient features. They are still looking for ways to finance a geothermal heating system. They are also reviewing "utility model options for third party financing and operation" (CCOC, 2007b). The City of Ottawa has applied for sustainable infrastructure funding from the Green Municipal Funding from FCM and is now waiting for a decision (Sayah, 2007). As this project is still in the design stage, there are opportunities to explore other avenues for funding.

4.4.3 Challenges

The restrictions on the Canada-Ontario Affordable Housing program funding greatly limits how housing is built, so it is difficult to fund the energy efficient features which cost extra (Carr, 2007). CCOC may experience challenges in developing and managing this housing project because this is the largest building they have done. The next largest is 100 units at 415 Gilmour. Carr claims it would be good to have a national housing program and a national energy-efficiency program that were aligned.

4.4.4 Successes

As the Beaver Barracks project is not yet built, its success cannot be determined. There is hope from CCOC and the city that Beaver Barracks will provide a new standard for housing in Ottawa. Another new standard for energy efficient social housing in Ontario is the Regent Park project by Toronto Community Housing that is aiming for LEED Silver certification (Carr, 2007). Beaver Barracks may be a new model for other groups to follow or learn from. It is also a learning opportunity for the building sector in Ottawa (Sayah, 2007). The real success of Beaver Barracks will be based on energy conservation and saved costs for residents.

4.5 Lessons from Case Studies

The case studies prove that it is possible to build social housing that is cost and energy efficient. From these projects, a set of lessons can be learned on the challenges and possibilities that affordable housing providers are experiencing. Together with the barriers and solutions taken from the literature and policy, Section 3.3, policy makers and affordable housing providers can learn from experience and overcome the barriers that still exist for energy efficient social housing. The lessons from the case studies are:

Lesson One: Funding is complicated
Funding is one of the greatest opportunities and challenges for social housing. Without funding, these social housing projects would not be built. One of the difficulties for the City is the limited funding, tight timelines and restrictions placed on affordable housing spending (Sayah, 2007). For example, affordable housing units built under the Canada-Ontario Affordable Housing program must be constructed for under $75,000 (Ministry of Municipal Affairs and Housing, 2007c). Such strict guidelines make it difficult for housing providers to design housing to include energy efficient features that cost more to build, yet save residents costs. More flexible funding parameters would allow for the maneuverability that is necessary for accommodating energy efficient features.

Additional funding for energy efficient measures is not standard in housing projects. The architect for the Conservation Co-op, the consultant for the Blue Heron Co-op, the housing developer of the Beaver Barracks project and the housing developer at the City, all look for additional funding for sustainable design features, such as measures to improve energy-efficiency. The additional funding is hard to find and even harder to get. The Blue Heron Co-op applied for grants, yet did not receive them. The complex system is time consuming and not rewarding for developers of social housing because money is limited and money is lost from wasted time. Funding used for energy efficient features comes from housing funding, not energy programs. The three projects discussed in this report used social housing funding to include energy efficient features. Very little funding came from energy conservation programs.

It takes a lot of work on the part of housing developers in the City to finance energy efficient measures within those guidelines. Some organizations even apply for predevelopment funding for environmental studies and consultants to look at the value of energy efficient features in their particular project (Sayah, 2007). The advantage of the funding restrictions is that it forces careful consideration of what energy efficient measures to include based on their cost efficiency. The observation of the three projects is a valuable opportunity to monitor success and cost efficiency.

Lesson Two: Subsidized land secures energy efficient locations
Securing land to build social housing on is one of the largest hurdles for developers. There were no alternative sites possible for the three case studies so housing was built where land was available rather than the most desirable place. The two projects that received land for $1 for long-term leases were built on land in higher density areas, surrounded by a mix of land uses and access to transit. Residents living in these buildings could walk to downtown employment and activities. The Blue Heron Co-op was built in Kanata on land rented for thousands of dollars and

is far from services including transit. The policy and programs for designating urban land for social housing are effective for increasing energy efficiency.

Lesson Three: Communication at the local level leads to solutions
The motivation for including energy efficient measures is from local housing professionals in the city and not necessarily because of government policy. Local housing professionals in Ottawa share information and ideas with each other. They are learning from other projects in the community as well as projects in other cities. Overall, the people involved seem hopeful that the City is on the right track and moving forward to a more sustainable vision. It is appropriate that the local service managers are responsible for social housing because they have the closest contact with housing developers and have intimate knowledge of their region.

Lesson Four: Energy efficiency goes beyond initial design and construction
Extra considerations beyond the design and construction of the project are necessary for energy efficient social housing. This includes the proper training and education of property managers and maintenance staff. It also extends to the residents. Energy-efficiency is not just about design; it is part of a lifestyle. Residents of energy efficient buildings, sites, and locations must buy into a sustainable lifestyle. They are required to use particular cleaning projects and alternative modes of transit.

Lesson Five: High tech features are problematic
The three social housing projects presented were not completely successful. There were problems with high–tech features in both built projects. While in theory, energy efficient social housing is logical; in practice there are still a number of hurdles as developers experiment with different features. For now, it seems that the energy efficient measures that are the most successful are low tech and easy for residents to live with.

Lesson Six: Affordability is the number one priority
The priority for social housing is still affordability. Sustainability is still thought to be a luxury. The City of Ottawa is keen to move towards more sustainable housing, but funding is so limited that energy efficient features are not justifiable. The City would rather build ten more units or renovate existing units to bring them up to code then to pursue energy efficient measures or retrofits.

5. Policy Recommendations

What do the results of the case studies mean for policy in Ottawa, in Ontario and in Canada?

One: Align energy conservation and social housing policy
The combination of energy conservation and social housing policy makes sense. These policies ought to be intrinsically aligned, as energy costs ought not to be considered separately from affordable housing. Aligning the two can increase our efficiency and ability to deal with both challenges.

Two: Allocate funds to cover the 5 to 10 percent premium cost of construction
The number one priority for affordable housing developers is affordability and so more housing funding will be used to create more units, not increase energy efficiency. The federal government has already budgeted money for improving energy efficiency in the country. Some of this funding could be allocated to builders of affordable housing to cover the 5 to 10 percent premium cost of construction to render the building energy efficient or to procure an energy efficient location. This energy efficient funding would be linked with the funding from federal provincial social housing agreements.

Three: Streamline and clarify grant and incentive programs
Grant and incentive programs need to be streamlined at all levels and between all levels. Incentive programs need to be clarified so that funding can be incorporated into housing providers' budgets. The new ecoENERGY program and Green Light Initiative are moving in this direction.

Four: Concentrate programs at local level
Policy initiatives should be focused on the local level because there is good communication within the local housing industry, and housing developers know the areas more intimately than policy makers and so they know what works in their areas and what the local challenges are.

Five: Make funding more flexible
Funding restrictions need to be examined to provide more flexibility in spending. Flexibility allows developers the leeway they require to render buildings more energy efficient. For example, funding could be used to cover the extra of cost of energy efficient features at the beginning of the project or training manuals for property managers and residents.

Six: Affordable life includes housing, energy, and transportation
Affordable housing should include all costs associated with housing including the cost of energy in utility bills and the cost of transportation.

Seven: Household energy efficiency includes transportation, density and land use
Policy for energy-efficiency is often contained in the building envelope and features within the home. It needs to extend beyond the walls of the home in order to be effective. Should a single family detached dwelling located on a greenfield be considered energy efficient because it has highly efficient lighting and appliances? Personal transportation is of particular concern because of its contribution to greenhouse gas emissions from households and this can be influenced using energy efficient locations and site design. Policy needs to take a more holistic view of energy efficient housing to make a real impact on greenhouse gas emissions and climate change.

Eight: Learn by monitoring existing projects
Monitoring of existing energy efficient social housing can establish the environmental and economic value of different features. Life cycle costing is a valuable tool because it addresses the long-term impact of features to determine what is worthwhile investing in at the beginning of the project. In order to determine the actual impact of energy efficient features, CMHC could sponsor a demonstration for affordable energy efficient housing, similar to the Equilibrium Housing Demonstration Initiative recently completed and featured in the *Canadian Housing Observer 2007*.

Nine: Increase funding for social housing
There is not enough funding for social housing in Ontario. There are thousands of households waiting for years for subsidized housing. Without additional funding, very few new homes will be built and only dedicated housing providers will include energy efficient features. Funding is also needed for upgrading and retrofitting existing housing stock because so many social housing units are in need of repairs. The price of energy will continue to increase making housing even more unaffordable. Energy efficient social housing can provide affordable housing over the long-term to low-income households.

6. Conclusion

Social housing and energy efficiency are linked because together they help low-income households and reduce greenhouse gases. The theory of energy conservation and social housing is linked to policy and practice. The policy reflects the theoretical assumption that energy efficiency saves money for residents in the long-term. Practitioners, in this case local housing developers, are aware of the theory as well and try to incorporate energy efficient features into social housing projects when it is economically feasible to do so. Although, theory is linked to policy and practice, there is a definite gap is between policy and practice. Only affordable and social housing policy and programs are used to achieve higher energy efficiency in projects. Programs to improve energy conservation were not used by the housing developers in the case studies. Attention needs to be paid to the application of energy conservation policy for housing developers and low-income households and their strict financial constraints.

The theory and practice of energy efficient social housing show that each project has a different combination of energy efficient features that is specific to the project site. Energy efficiency is achieved in many different ways and is not a one size fits all model. Energy efficiency in housing should not be considered separately from the energy efficiency of the neighbourhood. Efficient density, land use and public transit can save significant amounts of both energy and money compared to smaller scale renovations such as windows.

The theoretical connection between affordable housing and energy efficiency is mirrored in policy for residential energy conservation. There are many policies and programs that promote affordable housing and energy conservation. Many of them explicitly state the link between energy and cost savings. Unfortunately the related programs do not directly address the barriers that exist for affordable housing developers.

Local housing developers and providers are well aware of the savings created by energy efficiency and the potential importance of these savings to low-income households that occupy social housing. The three case studies, Conservation Co-op, Blue Heron Co-op and Beaver Barracks, are examples of how energy efficient social housing can be achieved. These projects are models that policy makers, planners and developers can look to in order to understand the changes to realizing energy efficient social housing. Due to funding constraints and lack of a clearly defined policy seeking to address both issues together there are very few such units that have been built and few have received retrofits.

There are a number of avenues of further research of the relationship between energy conservation and affordable housing. More research is needed into the financial aspects the efficiency features such as initial costs, payback and long-term savings. Research into streamlining the policies between national, provincial and municipal levels could prove beneficial. Studying funding structures that allow more flexibility in spending by the developers who know the local issues could improve the impact of funds. When research and policy makers are discussing the vision of a new national housing policy, the conversation should include each of these issues in order to ensure the intersection of the dual challenges of energy efficiency and affordable housing that have been proven to be inextricably linked.

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Appendix A: Provincial Legislation

Table 6. Provincial Legislation for Social Housing and Energy Conservation

Title of the Act, Year	Significance to Social Housing
Assessment Act, 1990	Enables municipalities to tax each class of property differently (Starr & Pacini, 2001). Affordable housing can be set in a low tax property class or municipalities can exempt affordable housing form property tax (Starr & Pacini, 2001).
Building Code Act, 1992	Sets out health and safety standards for buildings in Ontario.
Business Corporations Act, 1990	Enables municipalities to create non-profit housing corporations (Starr & Pacini, 2001). Under this Act, all ownership of public housing is transferred to municipalities' housing corporations (Starr & Pacini, 2001).
Development Charges Act, 1997	This Act gives municipalities the authority to charge development fees to cover municipal service costs (Starr & Pacini, 2001). Municipalities determine the amount of the fee if any and what exemptions are allowed (Starr & Pacini, 2001). Reducing or waiving fees can stimulate affordable housing.
Energy-Efficiency Act, 1990	"The Ontario Energy Efficiency Act establishes energy efficiency standards for a wide range of energy-using products, with the objective of eliminating the least energy-efficient products from the Ontario marketplace. The resultant energy savings are translated into lower utility bills for the consumer" (Ministry of Energy, 2007b).
Energy Conservation Responsibility Act, 2006	This Act states out guidelines for energy conservation. It includes the proposal to implement smart meters in all homes in Ontario by 2010 to monitor energy use and conservation (Ministry of Energy, 2007b).
Municipal Act, 2001	This Act lays out the authority and responsibilities of municipalities. "The Municipal Act provides the legislative authority for municipalities in a number of areas relevant to meeting affordable housing needs" (Starr & Pacini, 2001).
Planning Act, 1990	This Act gives municipalities powers to prepare official plans and zoning bylaws related to land use and development (Starr & Pacini, 2001). For example, section 37 authorizes municipalities to exchange height and density bonuses for public benefits such as affordable housing (Starr & Pacini, 2001).
Social Housing Reform Act, 2000	Under this Act, responsibility for administration, ownership, and operation of social housing is transferred from Ontario Housing Corporation (OHC) to municipal Consolidated Municipal Service Managers (CMSM) and District Social Services Administration Board (DSSABs) (Starr & Pacini, 2001).

Source: Author, 2007.