RETROFITS FOR THE FUTURE:

AFFORDABLE HOUSING AND ENERGY EFFICIENCY PROGRAMS IN CANADA

Sasha Tsenkova

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CHAPTER 1 ENERGY EFFICIENCY RETROFITS AND POLICY SOLUTIONS FOR SUSTAINABLE SOCIAL HOUSING

1.1 RESEARCH OBJECTIVES AND METHODOLOGY

This research project responds to global and local imperatives for reducing the energy consumption through sustainable refurbishment of existing housing. Energy savings in the built environment have a high priority on political and scientific agendas due to their potential to improve the security of the energy supply, reduce greenhouse gas (GHG) emissions and respond to climate change imperatives (Engelund & Wittchen, 2008; Itard & Klunder, 2007). In Canada, housing accounts for 17% of secondary energy use and 16% of GHG emissions, with over 80% of residential energy use related to space and hot water heating (Natural Resources Canada, 2006). While experimental technologies in new housing and LEED certified buildings have demonstrated a potential 40% reduction in energy consumption, impact remains limited due to the pilot nature of these projects (CMHC, 2008). New supply adds less than 1.5% to the housing stock on an annual basis. Within this context, sustainable transformation of existing housing constitutes an extensive societal challenge and is of great importance for the reduction of environmental impacts caused by the use of non-renewable energy sources (Hamilton et al. 2010).

Support for comprehensive energy retrofits in the built environment is gaining popularity across Canada (Fuller, 2009). The federal government has recently launched policy initiatives supporting energy efficiency retrofits in social housing in an effort to create green jobs and provide an efficient response to climate change.[1] Within the context of this new political commitment to energy efficiency improvement in the social housing sector, this research project focuses on the following objectives:

- To review national and provincial policies and programs to implement energy efficiency retrofits in social housing;
- To identify preferred investment strategies and policy responses by different social housing providers—public, private non-profit and community (cooperative);
- To evaluate the results achieved in several domains: economic/financial, social, technical/technological and environmental through an in-depth analysis of select case studies.

The research will investigate the implementation of energy efficiency programs in the housing sector with a particular focus on the investment decisions and choices made by

[1] The 2009 *The Renewable Energy Initiative* provides $70 million for energy efficiency upgrades to existing and new social housing. *Canada's Economic Action Plan* provides $850 million for the renovation and retrofit of existing social housing over two years, with another $2 billion for new and existing social housing.

social housing organisations. The geographic focus is limited to three provinces where federal programs have been complemented by provincial ones since 2009.[2] Such synergies are expected to generate more robust results and implementation practices, particularly in Toronto, Vancouver and Calgary, where preliminary research indicates that there is a concentration of these types of innovative and experimental projects.

This research is exploratory in nature and is designed to provide the first systematic evaluation of energy efficiency residential programs in Canada using an interdisciplinary framework of analysis. The general hypothesis advanced in this research is that a more supportive policy framework for energy efficient transformation of social housing will yield better results. Furthermore, the institutional culture, market share, commitment to sustainability and ability to innovate of social housing providers will put them in a better position to implement innovative strategies for energy efficiency retrofits in their portfolio. The main research questions are:

- What policy instruments support energy efficiency improvements in the social housing sector in British Colombia, Ontario and Alberta?
- How are these policies and programs implemented by different types of social housing providers?
- What types of energy efficient retrofits are the preferred choice, and why?

Analytical Framework

The research draws on network theory and its application to comparative analysis of the operation of social housing actors (see Van Bortel and Elsinga, 2007; Van Bortel and Mullins, 2009). The emphasis is on mutually dependent actors—governments, social housing providers, resident associations, housing industry institutions—with none of them dominant in the process of policy formulation and implementation (Kickert, Klijn & Koppenjan, 1997; Lowndes & Skelcher, 1998). The analytical framework applied to this research views the investment strategies of social housing providers as contextually dependent on the policy environment in which they operate. The policy environment is deconstructed through analysis of a range of policy instruments (regulatory, fiscal and financial) to determine the main factors affecting the types of retrofits implemented and investment priorities.

Furthermore, investment strategies are defined by the nature of social housing organisations operating between state, market and civil society. Brandsen *et al*. (2005) distinguish between state-led (public), market-led (private non-profit) and community-led housing organisations. Research indicates that state-led housing organisations, such as municipal providers, might be relatively easy for governments to influence to invest in the energy efficiency of their housing stock through bureaucratic mechanisms (Gruis and Nieboer, 2004). Market and community-led organisations, however, may require

[2] In Ontario, $704 million is channelled into the repair and energy efficiency retrofits of social housing. In British Columbia, the implementation of *Livegreen: A Housing Sustainability Action Plan* includes the retrofitting of more than 7,500 social housing facilities, while in Alberta, *The Affordable Housing Program* provides $90 million to social housing organisations for building and renovating energy efficient homes.

different approaches—stimulation programmes including financial, regulatory and communicative measures—to be persuaded. Market-led, non-profit housing organisations are sensitive to the return on investment and could be reluctant to invest in the energy efficiency of their stock if it cannot be recovered by an increase in rental income (Gruis, Tsenkova and Nieboer, 2009). In addition to position in the state-market-society triangle, other factors may influence the willingness and ability of organizations to invest in energy efficiency, such as the size, knowledge and skills within the organisation, available financial resources and the market position of its housing stock (Engelund & Wittchen, 2008).

The analytical model employed in the research project centres on links between policy objectives, policy instruments—regulatory, fiscal and institutional—and implementation choices by social housing providers. The primary research will explore investment decisions at the project level by different types of social housing organisations—public, private non-profit and cooperative. The two programs under Canada's Economic Action Plan—managed by the provinces and by Canada Mortgage and Housing Corporation—will be reviewed separately to capture important differences in their institutional model, funding criteria and results achieved. At the project level, attention will be paid to outcomes related to types of energy retrofits carried out, building envelope improvements, costs, energy savings and affordability (types of energy efficiency measures), financial risks and cost recovery (see Beerepoot, 2007; Fuller, 2009; Mlecnik, Visscher & van Hal, 2010). The profiling of these project-based outcomes will be integrated in a broad comparative evaluation of CEAP program long-term results focused on efficiency and effectiveness. Given the small sample of case study projects, these conclusions will utilise findings from the literature review, comments from key informants and personal observations. The efficiency of results will be reviewed with reference to relevance of objectives, institutional arrangements and the quality of program design and implementation. The efficiency is particularly important as it evaluates the achievement of objectives with optimal use of resources and the overall impact over the social housing sector (see Tsenkova 2006, 20011). The effectiveness of CEAP program will be reviewed with a reference to project achievements, quality of the retrofits and energy savings.

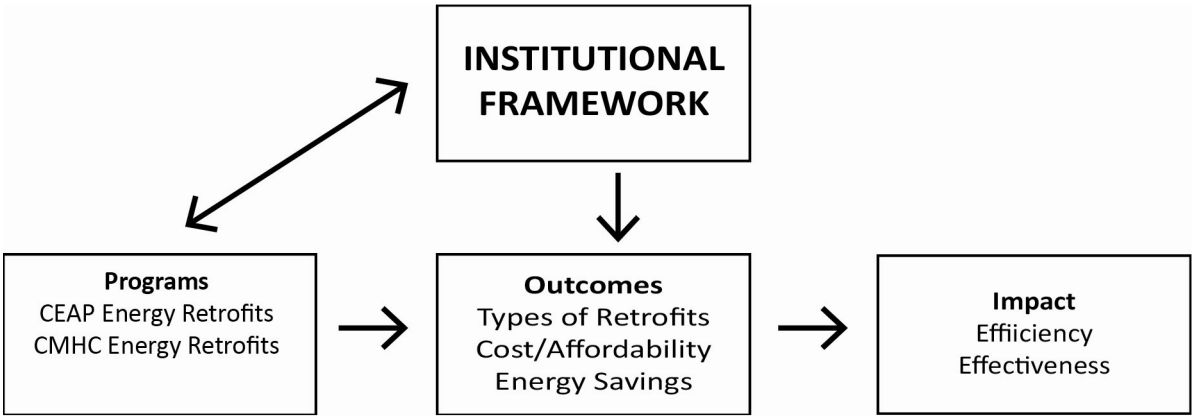


FIGURE 1 Analytical Framework.

Research Methodology

The research is structured in two parts, and employed both qualitative and quantitative techniques.

Review of the Literature. First, policy instruments at the national and provincial level were explored more broadly through a review of the literature: monographs on social housing, officially published documents on energy efficiency policies, reports, and working paper series. This phase included the development of survey instruments and tools (templates) for comparative assessment of energy efficiency improvements in social housing.

Surveys and Field Work. Second, the collection of quantitative indicators (time-series data) was carried out though a survey instrument administered with the assistance of experts from provincial umbrella organizations representing social housing providers. The set of housing and energy efficiency retrofit indicators in the survey tracked progress using time series data on social housing projects funded through the *Canada Economic Action Plan* at the provincial and city level organized in four blocks: i) allocation of funds to public, non-profit and cooperative providers; ii) subsidies for energy efficient retrofits; iii) subsidies for building envelope and mechanical systems upgrades; and iv) basic program targets. The survey was administered by e-mail to provide a rapid assessment of the conditions in the social housing sector, market shares of different types of social providers, and access to funding to carry out energy efficiency projects. Up to 15 face-to-face interviews with housing policy experts (federal, provincial, municipal) complemented the assessment and were instrumental in compiling a typology of housing retrofit responses under the federal and provincial programs in Toronto, Vancouver, Calgary and Edmonton.[3] This first phase of the primary research was essential for the selection of case study projects for in-depth evaluation and profiling.

The case study projects were selected on the basis of recommendations from program managers with the purpose of demonstrating innovative practices in energy efficiency upgrades and some of the more comprehensive measures implemented, including building envelope, technical system upgrades and installation of renewable energy sources. Data on investment strategies and policy responses by social housing providers was collected through primary research into fifteen case studies to illustrate the diversity of experiences. The fieldwork during this second phase documented improvements in quality, technical and financial aspects, technology (types of energy efficiency measures), financial risks and cost recovery. Key informant interviews were undertaken with 30 housing policy makers, social housing providers, funding institutions, and municipal and/or provincial organizations with pertinent expertise and immediate involvement in the case study projects from March 2011 to December 2012.

[3] For example, the responses could range from simple building envelope insulation and, installation of energy efficient heating and cooling systems, to solar power and zero net energy developments.

Research findings are presented in five chapters. The first one introduces research objectives, analytical framework and methodology selected for this research. The chapter provides an overview of national energy efficiency policies affecting the social housing sector and identifies main challenges affecting the implementation of government supported programs targeting energy efficiency retrofits and quality improvements. The second chapter presents highlights from the implementation of CEAP programs in BC with illustration of key program achievements in five case studies. The third chapter follows the same approach reviewing key metrics of success in program implementation, focusing on the experience of Toronto, the largest social housing provider in Ontario. Three case studies profile the way public, non-profit and cooperative providers have implemented CEAP funding and the results achieved. Similar logic defines the analysis in chapter four focused on Alberta, featuring six case studies in Calgary and Edmonton to illustrate the diversity of challenges and opportunities. The final chapter highlights main findings in comparative perspective and provides a broad-based critical reflection on effectiveness and efficiency of CEAP programs targeting quality improvements and energy efficiency retrofits in the social housing sector across Canada.

1.2 OVERVIEW OF CANADA'S NATIONAL ENERGY POLICY

Canada is a federal state, governed by ten provinces and three territories. Because Canadian provinces have jurisdiction over energy matters within their borders, the federal government needs to work with provincial governments to build consensus on the goals and means of energy policies, as well as the provincial fair share towards advancing national energy goals (Canadian Energy Efficiency Alliance, 2010). This is further complicated due to the country's vast size, where large distances between production and consumption as well as diverse climatic regions further influence specific provincial energy efficiency targets and policies.[4]

National Energy Policy Regarding Housing

Energy savings in the built environment have a high priority on the political and scientific agenda in Canada due to their potential to improve the security of energy supply, reduce greenhouse gas (GHG) emissions and respond to climate change imperatives (Engelund & Wittchen, 2008; Itard & Klunder, 2007). In 2008, the provinces and territories collectively committed to achieving a 20% increase in energy efficiency by 2020. This was followed by Canada's announcement of its 2020 emissions reduction target (a 17% reduction from 2005 levels) under the Copenhagen Accord (International Energy Agency, 2010).The housing sector accounts for 17% of secondary energy use and for 16% of GHG emissions with over 80% of the residential energy use related to space and hot water heating (Natural Resources Canada, 2006). While experimental

[4] For some provinces, efforts should be directed towards reducing energy use to prevent different forms of pollution, particularly GHG and smog emissions, whereas for other provinces, conserving electricity and other energy supplies should be high on the agenda.

technologies in new housing and Leadership in Energy Efficient Design (LEED) certified buildings have demonstrated a potential 40% reduction in energy consumption, the impact remains limited due to the pilot nature of these projects (CMHC, 2008). More recent national and provincial commitments to energy savings have directed policy attention to measures affecting the built environment, especially within the housing sector.

Canada is committed to energy efficiency and alternative energy initiatives as part of its national *Green Plan*. National energy programs incorporate energy security, economic development and environmental protection. Canada's energy efficiency improved between 1990 and 2007 by 16% as reflected by a decrease in energy intensity (energy use per unit of GDP) by 19%. These improvements reduced energy use by approximately 1,089.7 PJ, decreased GHG emissions by 63 Mt and saved Canadians $22.8 billion in 2007. However, this increase in energy efficiency has not been coupled by a parallel decrease in per capita energy use. In fact, energy use per capita increased by 7% due to an increase in electronic appliances (Office of Energy Efficiency, 2009: 8).

Government institutions at all levels have substantial roles in energy efficiency policy and implementation (Energy Efficiency Working Group, 2008, p. 4). Natural Resources Canada (NRCan), created in 1994, is the lead federal agency and its Office for Energy Efficiency (OEE) administers the *Energy Efficiency Act* and manages the *ecoEnergy for Efficiency Initiative*. NRCan spends $220 million on energy efficiency programs of various types.[5] Federal efforts center on regulatory and fiscal instruments. An example is the current redevelopment of the *National Energy Building Code* by 2012 to improve energy efficiency standards and requirements. The federal government also plays a role in the integration of efforts into existing federal programs, such as *Infrastructure Canada's Integrated Community Sustainable Plans,* in order to increase the market penetration of energy efficiency and renewable energy technologies in Canadian communities. Currently, the main federal-provincial forum for energy efficiency discussions is the Council of Energy Ministers and the associated Steering Committee on Energy Efficiency. Provinces collaborate through the Council of the Federation. The diversity and the autonomy at the provincial level are both a challenge and an opportunity. The International Energy Agency in its review points out that Canada still lacks national efficiency targets and a national strategy to attain them, as well as systematic harmonization of policies across provinces and territories (IEA, 2010).

Federal, Provincial and Municipal Initiatives

The federal government has built a foundation for investment in energy efficiency through initiatives like the *EnerGuide Home Rating System* and regulations under the *Energy Efficiency Act*. However, provincial governments are left to their own initiative in the housing sector, which has resulted in a wide variety of financial programs and

[5] Other federal agencies include the Canada Mortgage and Housing Corporation (CMHC), the National Research Council, Transport Canada, Environment Canada, the National Round Table on the Environment and the Economy, Sustainable Development Technology Canada, and the Energy Efficiency Working Group.

standards/targets for energy efficiency. Energy efficiency in housing is promoted at several levels: i) the level of appliances used within the building; ii) the level of site planning and building envelope; and iii) the level of land uses to deliver more compact and complete communities. Policies first targeted appliances and heating and cooling systems in housing through the *EnerGuide* rating system (mandatory since 1995) and *Energy Star* rated appliances (introduced in 2001), then shifted to regulations for new home construction (R-2000) and LEED certification. More recently, federal and provincial programs targeted energy efficiency upgrades and retrofits in existing housing, combining regulatory and financial instruments. Given the fact that 58% of the residential buildings across Canada are single detached dwellings, some small scale programs attempted to provide homeowners with incentives to replace heating and ventilation systems with energy efficient furnaces as well as carry out window replacement and weatherization measures. Green mortgage programs, administered by CMHC, are one of the ways to overcome the initial cost of energy retrofits by taking into consideration resulting energy savings over the long term. Overall, the implementation of energy efficiency measures in housing within a decentralized framework of policy-making has been limited. Studies indicate that only 8% of the homes have had a retrofit, many buildings operate at 50% below their efficiency potential and that due to fragmented support policies many Canadian homes and businesses do not enjoy the benefits of efficient energy use (Canadian Energy Efficiency Alliance, 2010, p. 2).

NRCan uses financial incentives to encourage energy end-users to adopt energy efficiency and renewable energy technologies and practices. The $60 million *ecoENERGY for Buildings and Houses,* which was introduced in 2007, encourages the construction and retrofit of energy-efficient buildings and houses. The program has three additional activities: developing a more stringent *National Energy Code for Buildings and Houses*; supporting the *EnerGuide for Houses* rating system; and providing information and training on energy efficient practices and technologies. The *Energy Efficiency Act* of 1992, amended in 2009, gives the Government of Canada the authority to enforce regulations regarding performance and labelling requirements for energy-using products, including doors and windows that are imported or shipped across provincial borders. NRCan disseminates information to consumers, increases awareness of the environmental impact of energy use and encourages consumers to become more energy efficient and increase their use of alternative energy sources.

The province of Ontario was the first jurisdiction in Canada to mandate *EnerGuide 80* levels. This means that homes built after 2011 will have a 35% increase in energy efficiency compared to homes built before 2006. Ontario's *2006 Building Code* requires energy-efficient standards to be implemented for residential and institutional buildings. The extra cost to build a home to the new higher energy-efficiency standards is expected to be recovered through reduced energy bills within three years. This will result in substantial long-term energy savings as well as reduced GHG. In BC, a 'green' *Building Code* that specifies requirements for energy and water efficiency for all buildings came into effect in 2008. Insulation standards have been increased for houses, multi-family residential buildings under five stories, and commercial buildings. Builders may choose to meet these new standards or achieve an *EnerGuide* rating of

77 by other means. The latest amendments to *BC's Energy Efficiency Act*, which were adopted as of January 2009, raised the energy performance of residential low-rise and high-rise windows, skylights and doors, which will be marked by a temporary label for the heat loss coefficient.

Municipalities also play an important role in energy efficiency through the Federation of Canadian Municipalities (FCM), which manages the $550 million *Green Municipal Fund* and the Partners for Climate Protection network. Municipalities design and implement a variety of energy efficiency programs. Examples of municipal programs include the Energy Efficiency Office (EEO) of the City of Toronto, which undertook a variety of energy retrofit social housing programs under the umbrella of the *Better Buildings Partnership and the Better Buildings New Construction Program*. *A Community Action on Energy Efficiency* initiative is a pilot program that has provided financial and research support to select BC municipalities since 2005 in order to advance energy efficiency through local government policy instruments and building upgrade incentives.

In addition to governments, utilities play a significant role in the implementation of programs promoting energy efficiency. Most electricity and natural gas distributors/retailers have established demand management and energy efficiency programs (e.g. thermostats, furnace and water heater replacement programs, PowerSmart, PowerWise, PowerSense, etc.). Demand side management programs typically include information and education initiatives, low-interest loans or subsidies for the installation of energy-efficient technologies, direct or free installation of energy-efficient technologies, performance contracting, and market transformation initiatives.

1.3 ENERGY EFFICIENCY PROGRAMS IN THE SOCIAL HOUSING SECTOR

Canada introduced *The Renewable Energy Initiative* in 2009 with $70 million in funding for energy efficiency upgrades in existing social housing projects and new affordable housing projects. The federal and provincial governments contribute equally to this investment as part of Canada's *Economic Action Plan (CEAP)*. The *Economic Action Plan* provides $850 million over two years for the renovation and retrofit of existing social housing, plus a further $475 million to build new rental housing for low-income seniors and persons with disabilities. These new housing investments also address Canada's climate change and environmental goals. Overall, the *Economic Action Plan* includes $2 billion for new and existing social housing, plus up to $2 billion in loans to municipalities for housing-related infrastructure. It builds on the Government of Canada's commitment in 2008 of more than $1.9 billion over five years to help the homeless and improve and build new affordable housing. Federal funding allocation to different provinces with a corresponding number of projects supported is presented in Table 1.

Table 1 Canada's Economic Action Plan Renovation and Retrofit of Existing Social Housing - Provincially/Territorially Administered[1]		
Province/Territory	**Funds Allocated (Federal $M)[2]**	**Projects[3]**
Newfoundland and Labrador	$21.26	283
Prince Edward Island	$2.22	40
Nova Scotia	$34.34	604
New Brunswick	$26.34	438
Quebec	$155.54	1,519
Ontario	$352.16	5,817
Manitoba	$61.70	336
Saskatchewan	$51.08	831
Alberta	$45.38	1,105
British Columbia	$88.82	105
Northwest Territories	$4.68	28
Yukon	$0.86	19
Nunavut	$5.62	230
Total	**$850.00**	**11,355**
1 Program details are available through your provincial or territorial government or housing agency. http://cmhc.ca/en/inpr/afhoce/fias/fias_017.cfm 2All funding for 2009-10 and 2010-11 (fiscal) has been fully taken up. 3Total numbers of projects underway or completed as at December 31, 2011.		

Source: CMHC, 2012

This new joint federal and provincial program is expected to lead to improved energy efficiency, and will support the purchase and installation of renewable energy systems in existing and new affordable housing that are capable of generating energy and selling surplus energy back into the electrical grid. The federal funding is complemented by provincial investment. For example, the province of Ontario channels $704 million into repair and energy efficiency retrofits of social housing. In British Columbia a total of $164 million is allocated to housing projects in the BC Housing portfolio. The commitment to developing, managing and operating environmentally sustainable affordable housing is supported in the new sustainable action plan. The implementation of *'Livegreen: A Housing Sustainability Action Plan'* includes the retrofitting of more than 7,500 directly managed social housing facilities to increase energy efficient and make them more environmentally friendly. Another initiative, Solar BC, is funded by the Ministry of Energy, Mines and Petroleum Resources and delivered in cooperation with Natural Resources Canada's federal *ecoENERGY for Renewable Heat* program. It provides support to affordable housing owners and operators in the province, including not-for-profit social housing societies, for the installation of a solar water system. Provincial utilities offer additional opportunities for investing in energy efficiency and reducing energy costs. Some utility programs partially fund projects to improve building energy performance while others cover the entire cost.

In Alberta, federal funding is matched by the province and directly allocated to over 120 housing management bodies for quality, safety and energy retrofit improvements. In addition to these funds, CMHC administers a system of grants to social housing providers who manage social housing under CMHC agreements. The territorial distribution of these funds—a total of $150 million—is presented in Table 2.

TABLE 2 Renovation and Retrofit of Social Housing – CMHC Administered

Province/Territory[3]	Cooperative Housing		Non-Profit Housing		Urban Native Housing		Total	
	Funds Allocated (Federal $M)[1]	Projects[2]	Funds Allocated (Federal $M)[1]	Projects[2]	Funds Allocated (Federal $M)[1]	Projects[2]	Funds Allocated (Federal $M)[1]	Projects[2]
Prince Edward Island	$0.50	9	$1.50	40	$0.20	9	$2.20	58
Quebec	$33.20	509	$19.20	170	$0.10	3	$52.50	682
Ontario	$40.20	259	n/a	n/a	$0.30	40	$40.50	299
Manitoba	n/a	n/a	n/a	n/a	$0.30	12	$0.30	12
Alberta	$3.60	33	$7.30	80	$0.30	9	$11.20	122
British Columbia	$43.20	138	n/a	n/a	n/a	n/a	$43.20	138
Yukon	n/a	n/a	n/a	n/a	$0.10	1	$0.10	1
Total	**$120.70**	**948**	**$28.00**	**290**	**$1.30**	**74**	**$150.00**	**1,312**

1All funding for 2009-10 and 2010-11 (fiscal) has been fully taken up.

2Total number of projects underway or completed as at December 31, 2011.

3Applies only to provinces and territories where CMHC continues to directly administer existing federally-assisted social housing projects.

Source: CMHC, 2012

The above federal and provincial energy retrofit initiatives should be interpreted in the context of no national housing policy and the reduction of supply side support for social housing. Since the1990s this minimalist federal housing policy has translated into growing regional disparities between the larger provinces and the rest of the country (Hulchanski, 2004).

1.4 SOCIAL HOUSING SECTOR CHARACTERISTICS

Social housing in Canada is less than 6% of the housing stock (630,000 units). The sector operates in a market-driven environment for the provision, allocation and maintenance of housing, with limited government support. About one-third of the social housing is publicly owned, 12% is cooperative housing and the rest is owned and managed by a wide range of no-profit housing organizations as indicated by the data presented in Table 3. The CMHC, the federal housing agency, administers 15% of the housing stock, while the majority (486,300 dwellings) is administered by the provinces.

TABLE 3 Social Housing in Canada, 2011

Program	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Yukon	N.W.T.	Nunavut	Canada
Administered by Province /Territory	12,200	900	19,300	15,650	89,450	201,100	35,500	28,300	25,650	52,050	500	2,650	3,050	486,300
Administered by CMHC														
Rent Assistance	0	150	0	0	200	3,700	0	0	550	0	0	0	0	4,600
Co-operative	0	200	0	0	16,900	19,350	0	0	2,800	12,400	0	0	0	51,650
Non-Profit / Urban Native / Public Housing	0	1,550	0	0	16,900	500	450	1,000	5,050	150	100	0	0	25,700
RNH	0	150	0	0	0	0	0	50	0	0	0	0	0	200
Limited Dividend	0	0	250	0	850	0	0	0	0	0	0	0	0	1,100
On Reserve	100	50	1,150	1,000	5,000	3,700	5,100	4,150	3,100	4,800	500	0	0	28,650
Sub-Total CMHC	100	2,100	1,400	1,000	39,850	27,250	5,550	5,200	11,500	17,350	600	0	0	111,900
Rental RRAP	400	100	700	1,750	6,300	9,000	1,500	850	1,900	2,850	200	0	0	25,550
Total	**12,700**	**3,100**	**21,400**	**18,400**	**135,600**	**237,350**	**42,550**	**34,350**	**39,050**	**72,250**	**1,300**	**2,650**	**3,050**	**623,750**

CMHC: Canadian Mortgage Housing Corporation
RNH: Rural and Native Housing
RRAP: Residential Rehabilitation Assistance Program

Source: CMHC, 2010: 58.

Social housing is a provincial responsibility. However, the federal government historically supported the sector through a variety of financial instruments and programs that were largely discontinued in 1993. Most of the social housing units h developed under federal programs since 1949. The devolution of responsibilities for social housing provision started in the mid-1980s with provinces gradually moving away from the sector and eventually 'passing the buck' to municipalities and community partnerships. By the end of the 1990s a housing crisis emerged due to the growing need for affordable rental housing and increasing homelessness, particularly in cities, combined with a supply shortage due to limited new output and long waiting lists.[6]

This prompted a reengagement by the federal government in social housing in 2001 through the *Affordable Housing Initiative (AHI),* a multilateral agreement between federal, provincial and municipal governments. This initiative consisted of two phases. The first phase, with a budget of $680 million, was to create new rental housing and to renovate existing social housing, while the second phase, with a budget of $320 million, was to create housing for low-income households, aboriginals, people with disabilities, recent immigrants and seniors, resulting in 27,000 new units across Canada (Leone & Carroll, 2010).

Public housing consists of about 2% of Canada's housing stock and is owned by local and provincial government authorities. It is managed by public non-profit organizations and housing companies established by local government. The Board of Directors is appointed by a municipal council and is composed of council members and tenants. Some of the largest public housing landlords are in Toronto and Vancouver. For example, the Toronto Community Housing Corporation (TCHC) has a portfolio of 2,240 apartment buildings comprising 58,500 households, and is the largest social housing provider in Canada. Rents are geared to income, and tenants are expected to pay 25% of their gross income in rent.

Private non-profit organizations range from ethnic or religious groups to special purpose organizations that accommodate seniors people with disabilities, and more broadly, low-income households. Some of the non-profit providers build one project for the group, but there are cases in larger cities where community-based organizations build several projects (Dreier & Hulchanski, 1993). The sector is very diverse and dependent on government funding and philanthropy both in terms of supply and demand-side support.

The cooperative sector consists of 2,200 housing cooperatives with each housing cooperative containing on average 50 to 80 households, housing a total 250,000 people. More than 40% of households receive a federal or provincial housing allowance, while the rest pay market rents. Direct involvement of resident members who volunteer in committees and participate as board members in the elected Board of Directors is a key feature of cooperative governance. Seventy percent of Canada's housing

[6] The annual supply of new social housing declined by over 65% and reached levels of output lower than 5,000 per year. Meanwhile, estimates indicate that there are 1.7 million Canadians with core housing needs, unable to afford adequate housing in the marketplace.

cooperatives are managed directly by the residents while 30% of the cooperatives, usually the larger ones, have full- and part-time paid staff (Dreier & Hulchanski, 1993, p. 56) The Co-operative Housing Federation of Canada provides support and a platform for the exchange of ideas between co-ops.

Federal spending on social housing in Canada was over 1.4% of the federal budget (less than 0.15% of GDP) in the mid-1990s and remained relatively stable until 2007, when it peaked to 0.3% of GDP (see Wellesley Institute, 2008 for additional information). The municipal share has grown substantially as a result of the devolution process in the last decade. According to Hulchanski (2002), capital subsidies, rent supplements, supportive housing, rehabilitation of ageing housing and assistance for homeless people would require another 1% of the annual federal budget in order to make a significant dent in addressing Canada's housing problems. Eligibility criteria for social housing vary according to the funding regime under which it was developed. Social housing stock developed between 1974 and 1986 (15% of units) needs to be allocated predominantly to households with low incomes. Social housing stock developed since 1986 is targeted to households that meet 'core housing need' requirements defined by a measure of suitability (overcrowding), adequateness (need for repairs) and affordability (over 30% of gross income) in addition to an income threshold test (Ditch et al., 2001).

Social rents are set as fixed proportions of tenants' income rather than being property-based. Rents for social housing range from 25% to 30% of household income and increase to 'net cost' or 'low end of the market' for higher income households. There is no national rent allowance scheme. Only four provinces in Canada (Quebec, Manitoba, Saskatchewan and British Columbia) have housing allowance schemes. Low income tenants in the social and private rental sector are eligible, but out of the 3.5 million renter households in Canada only 6% receive a housing allowance or rent supplement. The elimination of supply side support has not been matched by an increase in demand-side subsidies, as overall spending on housing allowances is 0.02% of GDP (Steele, 2007, p. 61). In general, eligibility for social assistance is a pre-condition to eligibility for housing allowance. A fundamental issue is the "unemployment trap" where tenants, upon accepting low paid employment, would have to pay full housing costs (Ditch, et al., 2001).

Since the federal downloading of responsibility for social housing, the provinces have become completely autonomous in managing and administrating their social housing stock. All federal controls have been removed and provinces are free to allocate funding for developing social housing as they see fit. Provinces are also free to reduce the size of their portfolio by disposing of aging stock, which includes the stock previously under provincial-federal partnership. Recent years have seen a number of sales and conversions of social housing into condominiums, but there is no systematic assessment on the extent of these sales and/or their impact in local housing markets. In such cases the federal government, through the CMHC, receives a share of any capital gain. The autonomy gained by the provinces includes their ability to modify and rationalize the housing programs inherited from the federal government. Such

modifications could result in reducing operating and administrative costs with the increased savings retained by the province.

The downside of expanded provincial government social housing responsibilities is constrained investment in the maintenance and rehabilitation of the aging stock owned by public and non-profit housing providers. Although co-ops and other non-profit housing providers are responsible for meeting their upgrading and maintenance costs, provinces are indirectly involved by subsidizing the cost of those projects and paying the rent-geared-to-income (RGI) assistance. .

The majority of social housing stock is between 20 and 50 years old and is in need of repairs and modernization. Operating costs in public and non-profit housing are on average higher than the operating costs of co-ops, in the order of 60% and 15% respectively. Public housing tends to be older with higher turnover, which contributes to higher operation costs. The allocation predominantly to low income households also places additional requirements for ongoing social service support and capital to bridge the revenue/expenditure gap. Most co-ops and non-profit providers, have inadequate capital reserves and are not in a financial position to fulfill upkeep, major maintenance costs or essential capital replacements. The financial situation caused by insufficient capital reserves is even worse for the older non-profit projects. It is estimated that 60% of social housing providers have already depleted their capital reserve funds (Pearson, 2010).

Co-ops and non-profit community groups are also limited in their potential to intensify renovation efforts due to the shortage of financing and commitment from senior government. Furthermore, management support to empower non-profit community groups in making sound decisions for their overall portfolio is lacking.

1.5 CONCLUDING COMMENTS

While newly launched federal initiatives provide a few years of funding to address some long-standing problems in the social housing sector, large scale energy efficient retrofits needed require systematic support through well integrated regulatory, fiscal and financial measures. The lack of a long-term strategy for social housing in Canada is a challenge and within this context provincial initiatives may have limited results. Some estimates suggest that at least 18,000 to 20,000 new social housing units need to be built every year, plus 7,000 repaired and renovated, to adequately address a growing need for affordable rental housing across Canada (see Wellesley Institute, 2010). Many social housing providers are currently maintaining, renovating and retrofitting existing social housing through CEAP, but the program has been terminated and the expenditure per unit is limited to $28,000.

The next chapter describes results achieved of the CEAP program in British Columbia, focusing on Vancouver's experience. It shows the existing challenges and opportunities in the implementation process, as well as profiles some innovative responses that considered are most efficient in economic and environmental terms.

CHAPTER 2 BEYOND ENERGY EFFICIENCY: INVESTING IN SOCIAL HOUSING IN VANCOUVER

2.1 INTRODUCTION

This chapter reviews investment programs implemented in British Columbia (BC) and Vancouver through *Canada's Economic Action Plan 2009-2011 (CEAP)*. Program delivery requires co-operation between federal and provincial governments and housing providers. The primary goal of the program is to provide funding for improvements in the quality and energy efficiency of social housing in the province, while contributing to job creation.

The implementation process is examined in the context of limited government support for social housing in Canada. The sector is small, less than 6% of the housing stock (630,000 dwellings), and operates in a market-driven environment for the provision, allocation and maintenance of housing. BC has over 53,000 social housing units, about 9% of the total for Canada.

The chapter focuses on the financial and institutional mechanisms and types of retrofits in the provincial, non-profit and cooperative housing portfolio achieved through CEAP and other provincial programs in BC.[7] The research is exploratory and is the first overview of these policies with an emphasis on challenges and opportunities/achievements. Initial data from a series of interviews with policy makers and housing portfolio managers suggest that significant improvements have materialised, some focusing on energy efficiency measures, others addressing deferred maintenance and deterioration in the aging stock. The implementation has led to more strategic assessment of capital investment needs, coupled with energy efficiency audits, across the social housing portfolio. Evidence from case studies points to a particular emphasis on financing building envelope and technical installation retrofits, not necessarily with the highest return on investment.

Research methodology includes a literature review, content analysis of major policy documents and policy briefs, and input from 19 key informant interviews with policy makers, program administrators and portfolio managers for housing providers using program funds. Information gained through interviews is supplemented by site visits to several projects and an in-depth analysis of three best examples of comprehensive renovation and energy efficiency retrofits in Vancouver. The three case studies were selected by senior asset management specialists at BC Housing, which manages about

[7] The review draws on Tsenkova, S. and Cliff, Ch (2012) *Beyond Energy Efficiency: Investing in Social Housing in Vancouver*. Paper presented at the ENHR Conference, Lillehammer, Norway, June 23-26.

half of the social housing in the province and has received most of the CEAP funding. The other two case studies feature retrofits in two Vancouver coops supported through CMHC funding. These projects were selected from an officially published list of cooperative projects on the basis of their relatively large amount of funding and the agreement of the Board to participate in the study.

2.2 POLICY FRAMEWORK FOR ENERGY EFFICIENCY RETROFITS IN THE SOCIAL HOUSING SECTOR

CEAP was launched by the federal government to support energy efficiency retrofits in social housing. It is part of the economic stimulus package and supports other policy initiatives targeting an efficient response to climate change. Its implementation in BC builds on other programs in the province and some of the partnership mechanisms in the social housing sector that have evolved in the last few years. The 2007 *Energy Plan of British Columbia* combines a variety of policy tools to improve energy use, including codes and standards as well as communicative outreach to stakeholders. New energy efficiency regulations under the *Energy Efficiency Act* and *BC Building Code* set reductions of up to 27% for new homes and 18% for new commercial and institutional buildings, compared to the 1997 *Model National Energy Code for Buildings* (Government of BC, 2011; 2009). The *BC Energy Efficient Buildings Strategy* targets a 33% reduction in GHG emissions from 2007 levels by 2020 as well as electricity self-sufficiency by 2016 (Tsenkova & Youssef, 2011). The strategy spurred an investment of $30 million by the BC Ministry of Energy, Mines and Petroleum Resources (MEMPR) for energy efficiency retrofits in the social housing sector through *BC LiveSmart* (Interview data, Ministry official, January 2012).

Since 2009, CEAP funding has provided a solid financial framework for renovation and energy efficiency retrofits in the social housing sector. Administered through the *Housing Renovation Partnership (HRP)*, $177 million of federal and provincial funds supported repairs and retrofits at 81 social housing developments in BC, with $13 million invested in single room occupancy housing. Another separate stream of $43 million was administered by the CMHC at the federal level and allocated to non-profit and cooperative social housing providers operating under long-term agreements with the CMHC, which defines financing, rent setting and allocation of housing in their portfolio (see Table 4).

TABLE 4 Capital Program Investment In Social Housing In BC

Program	Funding Source	Amount Invested	
CEAP Renovation and Retrofit of Social Housing	Economic Action Plan/Housing Renovation Partnership	$164 million	105 housing developments (includes provincial and non-profit housing)
CEAP Renovation and Retrofit of Social Housing for Housing Co-operative	Economic Action Plan/CMHC	$43 million	138 co-ops
LiveSmart BC: Efficiency Incentive Program	MEMPR	$30 million	26 housing developments

Source: BC Housing, 2010a; CMHC, 2009

2.3 ENERGY INTENSITY IN BC SOCIAL HOUSING

The social housing sector in BC consists of 53,467 dwellings in 7 regions across the province. BC Housing, a provincial housing organization, manages half of the social housing in the province. The BC non-profit housing sector includes approximately 600 societies, from regional to city-specific societies. Over 90% of the sector is made up of small organizations owning 1 to 5 buildings each, with about 36% of the social housing concentrated in Vancouver. The social housing in Vancouver consists predominantly of apartments (45%), followed by townhouses as the second most popular housing form (City Green Solutions, 2010). Small-scale social housing providers also exist, largely as a result of idiosyncratic subsidy arrangements, changing systems of financial support, and specific target groups such as special needs housing.

The Strategic Energy Management Plan, commissioned by MEMPR in conjunction with the BC Non-Profit Housing Association (BCNPHA), provided an initial evaluation of energy performance and opportunities for intervention in the non-profit housing sector. The study found out that the average energy intensity of most non-profit apartment buildings is higher than the BC average.[8] For example, the average energy intensity for an apartment building in BC is 0.86 GJ/m2 (239 kWh/m2) compared to 1.36 GJ/m2 (377 kWh/m2) in the non-profit housing sector (City Green Solutions, 2010).[9] Apartment buildings also have the highest heating and gas use and the largest percentage of hydroelectricity use in the sector, and they produce the most CO_2 (City Green Solutions, 2010). Therefore, apartment buildings provide the largest energy saving opportunity within the social housing sector.[10]

In addition to high energy intensity, much of the social housing stock has structural and technical problems related to backlogs in maintenance, repairs, and lifecycle replacement of roofs, elevators, and heating and cooling installations. The replacement of asbestos, which was widely used in developments from the 1960s and 1970s, as well as mold caused by improper ventilation and/or poor insulation, have made implementing energy efficiency retrofits more demanding. In BC, social housing was built anywhere from 1930 to the early 2000's, and was constructed quickly and with limited budgets in order to address housing shortages (Interview data, Policy Advisor, BC Non-Profit Housing Association, February 2012). Low rents and less in senior government funding have resulted in critical conditions in some properties where high energy intensity is related to outdated building envelopes and technical installations.

In the past decade, a number of advances in energy efficiency technologies and updates to the building code have resulted in improved residential building construction techniques including better quality insulation, ventilation and utility distribution systems

[8] There is also higher energy intensity in buildings constructed between 1996 and 2010 (Green City Solutions,, 2010).
[9] From a sample size of 43 solely operated buildings, 35% have energy intensities above the provincial average. Where providers pay all utility charges, the energy intensity is the highest 2 GJ/m2 (556 kWh/m2) (City Green Solutions, 2010).
[10] The intensity is reduced if there is a lower amount of energy consumed (U.S. Department of Energy, 2008).

(CMHC, 2001; Arman, et al., 2009).[11] *The Strategic Energy Management Plan* identified reduction of average energy intensity in social housing, particularly in apartment buildings, as a priority. It is estimated that a16% to 23% reduction in energy use in the social housing sector can be achieved through energy saving technologies and tenant education (City Green Solutions, 2010). Furthermore, it is estimated that each percentage of energy reduction in the non-profit housing sector would result in $500,000 in energy saving annually (City Green Solutions, 2010).

2.4 IMPLEMENTATION FRAMEWORK

An analysis of the implementation framework for three energy efficiency programs in the BC social housing sector revealed differences and similarities. The analysis focused on institutional and financial arrangements and program management. With respect to financial mechanisms, as identified in Table 5, all three programs provided grants to eligible social housing providers, one used Energy Service Companies (ESCOs) to administer program implementation, and there were isolated experiments with power purchasing agreements and pay-as-you-save implemented by utility companies.

TABLE 5 Financial Mechanisms for Energy Efficiency Upgrades

Mechanism	Brief Description
Additional Financial Support	Financial support provided by grants, incentives or programs
Energy Service Companies (ESCOs)	Energy savings achieved are used to pay back the cost of the project or to reinvest for capital upgrades
Power Purchasing Agreements	Installation of a solar thermal hot water heater, where billed energy used serves as payment for the system
Pay-As-You-Save	Energy savings achieved through levied meters

Source: Adapted from City Green Solutions, 2010: 36.

Program delivery was managed in two ways: through an intermediary third party or through a self-managed process. BC Housing, which received all $164 million of its funding through the *Housing Renovation Partnership* (HRP), used third party contract services through an ESCO for 52 housing developments. Two ESCOs were selected through competitive bidding processes and tasked with the responsibility to carry out energy efficiency audits in the BC Housing portfolio. Their task included auditing the management of the construction and renovation process, the selection of contractors, and monitoring energy savings (BC Housing, 2012). The retrofit program for each development was assessed by the BC Housing Portfolio Management Team using a set of criteria including lifecycle assessment, costs and energy savings to determine the actual scope of the project. Funding under the HRP provided retrofits to 8,338 units, about a third of the 27,000 social housing units currently in the BC Housing portfolio (Interview data, BC Housing Senior Asset Manager, February 2012).

Retrofits in cooperatives and non-profits under federal contracts with CMHC were funded separately. Project submissions were reviewed by a special CMHC committee

[11] According to the Canadian Home Builders' Association, between 1990 and 2008 GHG emissions in the residential sector in BC rose by 3.5%, which is low compared to Alberta, which grew by 31.9% and Ontario at 17.9% (Canadian Home Builders' Association, 2011).

and went through a complex and vigorous application process that was centrally managed in Ottawa. The CMHC selected eligible projects in BC based on predetermined criteria for a total of $43 million (CMHC, 2010). About a third of the applicants received funding. Cooperatives used an intermediary, such as the Provincial Federation of Housing Coops, to prepare project submissions and in many cases to manage the construction process once the project was approved. Once funded, some cooperatives hired project managers to complete contracting and supervision as the deadlines were tight – all work had to be completed by April 2011. Large cooperative providers could supply project management expertise from in-house. Throughout the application and implementation process, cooperatives received support from the federal governing body of housing co-operatives, the Co-operative Housing Federation of Canada (Interview data, Policy Expert, April 2012).

The BC *LiveSmart Efficiency Assistance Program* **(**LEAP) ran two programs, one managed by a utility company and another by the non-profit association (EAGA Canada and City Green Solutions, n.d.). These two intermediaries managed $30 million allocated for energy efficiency retrofits in 1,949 units in low income housing developments. The $2,000 per unit funding cap geared the selection of retrofit measures toward small-scale improvements such as lighting, weatherization, fan replacement and thermostat installation. MEMPR approved applications and decided upon the amount of funding per unit. Housing providers were asked to select the buildings that had a history of poor energy performance. For programs managed by the utility companies, the unit amount could be exceeded on a case-by-case basis. The utility companies also provided matching funds to achieve higher electricity or natural gas savings (interview data, January 2012).

Cash flow was also managed differently based on the presence or absence of a third party. For example, accountability for financing and budgeting was a part of the BC Housing and ESCO contract. BC Housing had discretion over the use of funds and prioritization of types of retrofits. The CMHC was the central administrator and distributor of funds for the cooperative housing program and disbursed the money on the basis of completed works. CMHC personnel were involved in overseeing the management of projects by housing cooperatives and/or non-profit providers through on-site visits. Project managers in some of the larger developments were responsible for procurement of construction works, financing, and reporting to CMHC. In cases where social housing providers did not use a third party, they managed cash flow and implementation themselves within a retrofit plan and with expenses approved by CMHC.

Key informant interviews indicated that housing providers using an intermediary were able to undertake retrofits in a more efficient manner due to economies of scale and a higher degree of professionalism (Interview data, BC Housing Asset Management Team, February 2012). Housing providers who managed funding themselves struggled with staff capacity and the ability to deliver programs effectively and on time. An exception was when building managers had replacement reserve plans, building condition assessments and/or energy audits already in place. Another major difference in the program delivery was the degree to which energy efficiency was a focus of the

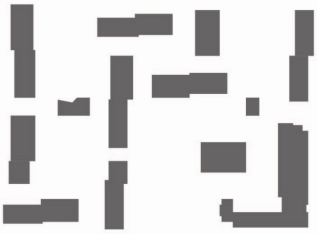
retrofit. The ESCOs used energy audits to identify and prioritize measures that aligned with the reduction of GHG emission targets (BC Housing, 2012). Cooperatives and non-profits funded by the CMHC used energy assessments only if they had applied for and received funding to conduct one. Retrofits for cooperatives were selected first on the basis of critical replacement needs, and second on the best value offered by the energy efficiency retrofits. "Often the lower cost retrofits were not necessarily the most efficient ones." There were very few projects in the cooperative model that solely addressed energy efficiency (Interview data, Policy Advisor, April 2012). *BC LiveSmart* explicitly targeted small-scale energy efficient retrofits with quicker returns. This program is ongoing.

2.5 VANCOUVER CASE STUDIES OVERVIEW: BC HOUSING PROJECTS

Three case studies in Vancouver, BC provide more specific project implementation details. These case studies were chosen to highlight best practices in energy efficiency retrofits from the ESCO model funded by HRP in BC's Housing portfolio. They highlight the types of retrofits and projected feasibility of energy and financial savings. Implementation was undertaken with a combined package of renovation and energy retrofit measures.

The three case studies are Grant McNeil Place, Culloden Court and Ted Kuhn. Grant McNeil and Culloden Court are low- to mid-rise multi-apartment developments serving a mix of singles, seniors and families, whereas Ted Kuhn is composed of two high rise towers of eight and twenty-one storeys respectively, which provides housing for those transitioning from homelessness.

All three case study developments were built between 1969 and 1976. All of the units operate under a rent-geared-to-income (RGI) scheme, where 30% of income is paid to the housing provider in rent and the province subsidizes the remainder. Although exact rental rates were hard to quantify, rents typically ranged from $400 to $500 per month depending on the size of the dwelling. Many of the residents did pay utility bills, but the cost of heating was included in the rent.

TABLE 6 Case Study Profiles: BC			
Study Area	**Grant McNeil Place** North Vancouver, BC	**Culloden Court** Vancouver, BC	**Ted Kuhn** Surrey. BC
	 Metro Vancouver		
			
	 Building footprints		
Project Type & Characteristics			
Year of Construction	1976	1969	1972 – 1976
Building Type	Low rise apartment	Low rise apartment & townhouse	High rise apartment
Bedrooms	2 – 4 bed	1 – 5 bed	Bachelor – 2 bed
Storeys	2 – 3 storey	2 storey	8 storey and 21 storey
No. of Units	112 units	132 units	436 units
Total Area	113,832 sq. ft.	171,082 sq. ft.	243,061 sq. ft.
Project Economics			
Total funding received	3.1 million	3.7 million	11.1 million
Type of rent	RGI	RGI	RGI
Rent	$500/month	$500/month	Under $500/month
Tenants			
Tenant turnover	Very low	Low	Medium – high
Tenants pay utilities/heating included in rents	Yes	Yes	Yes

Source: BC Housing, 2009; BC Housing, n.d. and Interview data, Capital projects manager, February 2012[12]

Tenant turnover in these developments varied. Tenants in Grant McNeil Place and Culloden Court have more stable situations, while Ted Kuhn has a higher turnover based on the transient status of its residents. Ted Kuhn is also the only housing provider with mental health and addiction support staff (Interview data, Housing Manager, February 2012). Tenant turnover can affect profitability and financial building

[12]The information in the case study profiles is taken from the feasibility report provided by BC Housing: Ted Kuhn (pp. 4.6, 5.5, 6.3, 7.3), Grant MacNeil (pp. 21, 22, 24 – 26) and Culloden Court (pp. 58-60).

operations. If vacancies are frequent and lengthy, less cash is collected in rent even though units still require upkeep. On the affordability continuum, these projects fall between supportive housing and social housing.

Types of Retrofits Completed

TABLE 7 Retrofits Completed: BC			
Retrofits Completed	**Grant McNeil Place** North Vancouver, BC	**Culloden Court** Vancouver, BC	**Ted Kuhn** Surrey. BC
Energy audit performed	Yes	Yes	Yes
Boiler replacement	□		□
Domestic hot water	□	□	□
Solar hot water system		□	
Heat pump (Furnace)		□	
Low flow water fixtures	□	□	□
Water metering	□		
Window replacement	□	□	□
Door replacement	□	□	□
Lighting	□	□	□
CPTED	□	□	□
Common area	□	□	□
Insulation			□
Exhaust upgrade	□	□	□
Mould/asbestos removal	□	□	□
Other	Bathtub caulking Fence/balcony replacement	Community centre renovation	Security system
Tenant Feedback			
	Increased comfort Discontent with low flow shower water pressure	Increased comfort Didn't like paying utilities	Increased comfort Issue with windows and automatic fans

Source: BC Housing, 2009; BC Housing, n.d. and Interview data, BC Housing Asset Manager, February 2012

Energy assessment performed by the ESCOs identified a comprehensive package of retrofits responding the needs of each development. Many of these included window or door replacement, sealing and caulking to reduce air leakage, replacement of lighting and provision of low flow equipment. Larger retrofit projects were also completed, such as upgrades to space heating, exhaust systems and domestic hot water systems (see Table 7).

One of the most common retrofits was window replacement, installing double-glazed argon filled windows to improve insulation and temperature control. Grant McNeil Place and Ted Kuhn replaced the domestic hot water heaters and boilers, while Culloden Court was the only development to install solar panels and an accompanying solar hot water pump. Grant McNeil Place also reinsulated ageing piping. It was reported that major systems such as domestic hot water and boilers made the most difference in energy savings, second to window and other insulation (Interview data, Housing manager, February 2012). To some degree all buildings dealt with asbestos and mold abatement due to the use of dated building construction methods, poor thermal bridging, and general building lifecycle issues. It is interesting to note that retrofits do not include installation of meters to determine energy consumption (heating) in individual dwellings, thus no incentive is provided to tenants to save energy.

The ESCO-BC Housing contract included the recruitment of a tenant engagement coordinator to inform tenants about the impact of construction on daily living. There were a number of open houses and tenant meetings to keep tenants informed about on-going project activities. In addition, the coordinator was present on-site to address questions or concerns with construction. The major advantages of the mandated public engagement strategy included an improvement to prior BC Housing tenant engagement processes and an enhanced understanding by tenants of the importance and positive effects of retrofits. This helped improve tenant buy-in and supported effective communication between tenant engagement coordinators and construction project managers (Interview data, February 2012). As a result of the retrofits, many tenants reported better comfort due to insulation measures such as door, window and boiler replacements. Those at Grant McNeil Place said they now enjoy more reliable hot water for showering. There have been a few complaints regarding the adjustment to automatic systems and thermostat controls. Some tenants disliked the automatic bathroom fans and others did not like the new low flow showerheads due to less pressure.

Energy and Cost Saving Metrics

Feasibility studies from BC Housing indicate an overall decrease in projected annual energy and costs saving for each project (BC Housing 2009; BC Housing, n.d.) The data provided was in the form of preliminary results and more complete information will be provided in documentation yet to be released.

In comparing energy savings, Grant McNeil Place had an annual projected energy savings of 38%, whereas Culloden Court reported a 52% projected reduction (Table 8). Cost savings were dependent on the amount of money originally invested and on the type of retrofits implemented. For example, Culloden Court had an original investment of $3.7 million, with annual energy costs savings of $54,158, resulting in a simple cost recovery time of approximately 67 years. This was the longest cost recovery time compared to Ted Kuhn and Grant McNeil Place at 39 and 43 years respectively.[13]

[13] Calculations for return on investment figures = annual projected cost savings divided by the original investment.

TABLE 8 Annual Costs and Energy Savings Pre- And Post-Retrofit			
Energy and consumption costs	Grant McNeil	Culloden Court	Ted Kuhn
GJ	10,427	8,109	Not reported
kWh	1,061,649	760,332	2,789,020 eKWh
Cost of use ($)	$205,412	$183,960	$274, 174
Energy and cost savings*			
GJ	3,981	4,208	Not reported
Energy savings	(38%)	(52%)	
kWh	45,118	8,658	Not reported
Tonnes GHG	Not reported	211	404
Cost savings	$71,330	$54,158	$284,296

Source: Feasibility studies GM p. 27, CC p.61, TKT p. 1.2
*Projections from feasibility studies

2.6 VANCOUVER CASE STUDIES OVERVIEW: RETROFITS IN HOUSING COOPS

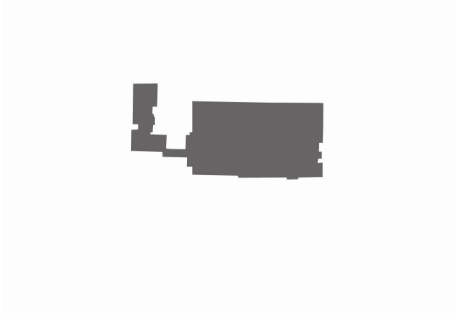
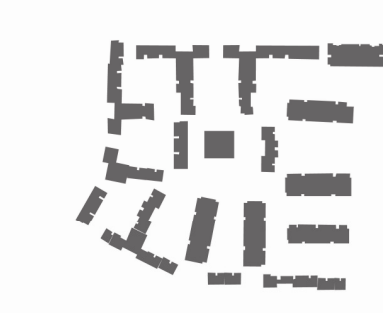
Data in Table 9 profiles two projects in Vancouver that received CEAP funding administered by the CMHC. The case studies are not necessarily representative of the variety of strategies used and the upgrades carried under the program by 31 coops in the city. The total allocation was $10.3 million over a two-year period.

Killarney Gardens coop is a fairly large development that was built in the 1960s and consists of 227 units in townhouses and low rise apartments. With the support of COHO repair services, members applied for $3.1 million through the CEAP/CMHC program to replace roofs, windows and patio doors. The retrofits were difficult to implement with no tenant relocation. There were significant structural and envelope issues that had to be addressed. Some of the most important retrofits were:

- Double-paned argon filled windows to rectify condensation issues
- Roof replacement and insulation.

Tenants do not pay utility bills separately, but the management is aware of the positive impact on the cost of heating and has seen a significant reduction in the natural gas bill. Management of the coop has been proactive and has secured funding from *LiveSmart* for smaller, low cost energy efficient retrofits, such as programmable thermostats, shower heads, kitchen aerators and bathroom fans (Interview data, Property Manager, September 2012).

TABLE 9 Cooperative Retrofits Completed and Tenant Feedback: BC

Study Area	Four Sisters Housing Co-op Vancouver, BC	Killarney Gardens Housing Co-op Vancouver, BC
		
		
		
Project Type & Characteristics		
Year of Construction	1987	1960's
Building Type	Low & mid-rise apartment	Low rise apartment & townhouse
Bedrooms	Bachelor – 3 bed	1 – 3 bed
Storeys	4, 5 & 7 storeys	2 & 5 storeys
No. of Units	153 units	227 units
Project Economics		
Total funding received	$197,876	3.1 million
Type of rent	30% near market/share purchase	30% RGI & 30% near market/share purchase
Rent	$500 - $1,000/month	$800 - $1,300/month $2,800 - $4,100/family
Tenants		
Tenant turnover	Very low	Very low
Tenants pay utilities	Yes	No
Retrofits Completed		
	Retrofit of all external metal works (clean up, treatment, painting).	Roof replacement, patio doors and window replacement
Tenant Feedback		
	Extensive involvement of tenants, joint decisions with co-op members to go forward	Managers report high level of tenant satisfaction with new windows, improved thermal and noise comfort and reduction in utility costs.

2.7 CONCLUDING COMMENTS

Program Successes

Capital funding through the *Economic Action Plan* and the *BC Housing Renovation Partnership* has provided a major opportunity for the implementation of a comprehensive package of retrofits and improvements in the social housing sector. This program is successful in meeting its targets, and accounts for improvements in about 20% of the social housing in the province. As the most significant share has been allocated to BC Housing, it is not surprising that the program addressed in a comprehensive manner both energy efficiency and capital improvement needs in the provincial housing portfolio. The majority of the funding, $164 million, was directed toward repairs at 84 social housing developments managed by BC Housing and 38 projects by the non-profit housing sector (with over 2,000 units). Half of the social housing developments are located in Vancouver, which provide affordable housing to households in the greatest need as well as people transitioning from homelessness. One of the major challenges in the program, particularly the component administered by the CMHC, has been the decision to tradeoff between energy efficient retrofits and the replacement of deteriorated components. Sometimes there was not enough funding to do both. However, even if retrofits did not incorporate a high level of energy efficiency, efficiency would have been improved through the replacement of these components.

CEAP has made a substantial difference in the social housing sector in BC, and in Vancouver in particular, given its scale and emphasis on overall building envelope improvements and retrofits of mechanical systems. Interview data indicates that energy and costs savings were realized, and feedback from tenants has been positive. Overall, housing providers believe that the goals of the programs have been realized, but it remains to be seen how much actual energy is saved across the entire portfolio. BC Housing has developed a business model where they partner capital projects with sustainability initiatives from other provincial programs, such as funds for carbon neutral public sector through the *Public Sector Energy Conservation Agreement* (administered through BC Hydro). Nearly $75 million has been allocated as capital funding to retrofit existing provincial public sector buildings, such as the public housing stock. BC Housing has leveraged three different funding sources to maximize the reduction in energy use and GHG emissions of its housing stock, including *BC LiveSmart.* The program has more modest targets, but the $2,000 per unit subsidy provides an incentive to introduce measures with quick returns and to engage utility companies in follow-up retrofits.

As these are grant funds, program participants do not attempt to recover costs through rent, but the federal government has made it clear that the program is not going to be continued and 'it is a job creation and not a housing program' (Interview data, Senior Policy Expert, February 2012).[14] While provincial programs do provide some funding for

[14] Exact data is yet to be released on job creation. A BC government press release reported that 88,000 jobs were to be created through HRP and 1,130 jobs were to be created specifically for the energy efficiency retrofits in social housing (Government of British Columbia, 2009).

maintenance upgrades, the investment needed to support the entire BC social housing portfolio has not been addressed. On the institutional side, the programs have prompted a more strategic approach to asset management and assessment of both energy retrofit and capital investment needs with major housing providers. The Cooperative Federation in BC developed a partnership with VanCity, a credit union, to provide a combination of grants and low cost mortgages to sustain retrofitting in the cooperative sector. The cooperatives were able to address the tension between short-term affordability goals and the long-term viability of their housing stock through the program, which created a necessity for strategic planning (Interview data, Director, February 2012). This improved governance and decision-making around capital planning projects.

TABLE 10 BC Housing Priority Ranking System	
REPORTABLE ENERGY REDUCTION MEASURES IMPACTING SERVICE PLAN TARGET	
First priority in measure selection will be given to measures that directly impact Service Plan Target of 5% Reduction in Greenhouse Gas Emissions per year.	
CAPITAL RENEWAL MEASURES BASED ON NEEDS OF MAJOR BUILDING SYSTEMS	
Additional priority in measure selection will be given to capital renewal measures to partner renewal needs with energy reduction measures for management efficiencies. Further energy-use reduction on renewal items can be delivered with a focus different than energy-use reduction.	
A	Measures with a high energy-use reduction and quick payback (the *"Cream")*
A-	Measures with a low energy-use reduction and a longer payback (the *"Right-thing"*)
B+	Items that cannot be deferred any longer (the *"Required"*)
These are measures that are renewal in nature and may not have any impact to energy-use reduction, but require the expedient resolution offered by the ESCO process.	
B	Items that have little energy reduction but are desired (the *"Wishlist"*)
These measures are renewal in nature and may not have any impact to energy-use reduction, but make sense to partner with a selected energy reduction measure or are Owner-requested.	

Source: BC Housing, Capital Asset Management, Interview data, February 2012

BC Housing reported a similar outcome. The large investment opportunity in the last three years increased accountability and fostered new practices in the housing sector's business model (Interview data, Portfolio manager, February 2012). Managing large capital projects raised the credibility of the sector and its capacity to deliver successful retrofit programs. Another critical success factor was the incorporation of the ESCOs in program management at 52 BC Housing properties. BC Housing commissioned an overall assessment of the entire public housing stock, where two ESCOs recommended energy use reduction strategies based on a number of criteria (payback/alignment with provincial criteria for funding programs and carbon credit available from provincial government at $25/tonne). Such evaluations were further refined using a simple ranking system developed by BC Housing to define priority retrofits to be supported through

CEAP (see Table 10). While the ESCO model was more expensive than the project manager/contract services model used by the coops, there were value-added components inclding efficiency in program delivery and execution due to economies of scale and expertise, and a 'one stop shop' approach and enhanced accountability for planning, financing and monitoring projects. The partnerships between BC Housing and the ESCOs did signal that small housing providers would benefit from the model and the accumulated experience in managing and executing retrofit programs in the future (Lepri, 2009).

Program Challenges

Program challenges have been associated with tight timelines and difficulties in coordinating and planning strategic retrofits. Although the projects supported through the *Economic Action Plan* were deemed 'shovel ready', housing providers and building managers had to operate within a two-year timeframe. Unexpected building envelope problems were frequently reported, resulting in cost overruns, project delays and potential loss of funding if projects were not implemented on time (Interview data, April 2012). More flexible deadlines were incorporated into the second round of funding, which alleviated the pressure to retrofit or lose it.

One of the greatest challenges is the high cost of the program and the lack of sustainability in funding. In more comprehensive improvement and energy efficiency projects, such as those in the case studies, payback periods are anywhere between 39 to 67 years. Even though the financial viability and cost-benefit of these programs were not the main objectives, they highlight the future economic challenges. The ESCOs, despite their efficiency, increase the costs and do not function as a mechanism that enhances cost recovery. Rent reforms and other approaches to secure long-term funding and more effective asset management practices will be needed, in addition to strong political motivation to improve the quality and the energy efficiency of the sector.

CHAPTER 3 ENERGY EFFICIENCY RETROFITS IN SOCIAL HOUSING: A REVIEW OF POLICY AND PRACTICE IN TORONTO, ONTARIO

3.1 INTRODUCTION, OBJECTIVES AND METHODOLOGY

"Energy conservation is the most efficient and effective way for municipalities to reduce energy cost and protect the environment" (Association of Municipalities of Ontario, 2012). As a part of the 2009 *Canada's Economic Action Plan*, the federal government allocated $352.16 million to the Province of Ontario (ON) to renovate and retrofit the existing social housing stock in the province. The province matched federal funding and distributed the money between the 47 Consolidated Municipal Service Managers, who then selected eligible social housing providers from their respective portfolios. The aim of the *Social Housing Renovation and Retrofit Program* (SHRRP) was to improve the quality of the housing stock, while helping low-income Canadians and creating opportunities for jobs in construction and related industries.

This chapter investigates the implementation of energy efficiency measures through SHRRP, as well as the CMHC administered renovation and retrofit programs aimed at improving the social housing stock in Toronto. The paper builds on a literature review of energy efficiency programs for the social housing sector in Canada and the reviews of energy efficiency retrofit policy and practices in British Columbia and Alberta (Tsenkova and Youssef, 2012; Tsenkova and Clieff, 2012). Given the size of the social housing sector in Ontario and the diversity of institutional arrangements, this chapter will focus on the City of Toronto, and the administration of SHRRP and the Renewable Energy Initiative. Toronto has the largest social housing portfolio in the province with over 90,000 social housing units eligible for funding under SHRRP and the Renewable Energy Initiative. The analysis will review the main programs implemented with a focus on funding mechanisms, implementation criteria, types of retrofits completed and outcomes.

Three case studies from Toronto's social housing portfolio were identified to analyze program implementation and outcomes. These three case studies were selected to represent the renovation strategies of the three major types of social/affordable housing providers in Toronto: (i) the local housing corporation—Toronto Community Housing Corporation (TCHC); (ii) non-profit housing corporations; and (iii) cooperative housing corporations. The selection was also guided by recommendations from the Managers and the projects leads from the City of Toronto's Social Housing Unit. Each housing provider profiled in this report agreed to participate in the study.

In addition to the literature review, a content analysis of major policy documents and the case study analyses, 12 key informant interviews and site visits were undertaken in September and December 2012 to develop an understanding of program

implementation measure outcomes and on-site challenges/issues related to program management, as well as to obtain feedback from housing managers that may be useful for future policy recommendations. Specific emphasis was placed on a systematic comparison of the types of energy efficiency retrofits and renovation measures to highlight different investment strategies, as well as to document simple return on investment. Retrofit measures were grouped in three major categories: (1) major mechanical; (2) non-mechanical/building envelope; and (3) renewable energy.

3.2 SOCIAL HOUSING IN TORONTO

The City of Toronto's social housing portfolio represents approximately one-third of all the social housing in the Province of Ontario (City of Toronto, 2001). As of 2011, there were 93,198 units under management and administration by the City's Social Housing Unit of the Shelter, Support and Housing Administration Division, including 3,877 units that are a part of the private rent supplement and housing allowance programs (City of Toronto, 2011). Social housing is a significant feature within Toronto's landscape. It provides 29% of all rental units in the City, houses approximately 220,000 people, and plays a critical role in the provision of affordable housing services for low-income households since over 70,000 housing units provide rent geared-to-income (RGI) assistance. The waiting lists for social housing (RGI) have grown significantly over time, signalling a high level of need for affordable housing.[15]

The types of social housing organizations managing the social housing stock are: (i) the local housing corporation, Toronto Community Housing Corporation (TCHC), a non-profit corporation owned by the City of Toronto and governed by a board of directors appointed by City Council,[16] (ii) private non-profit housing owned and operated by community based non-profit organizations, (iii) and cooperative housing owned and operated by community-based non-profit cooperative corporations, whose members are residents of the cooperative (City of Toronto, 2012). Of the total social housing stock, 63% is owned and operated by the TCHC (City of Toronto, 2011). The remainder of the social housing in the City is provided by 250 non-profit and cooperative housing organizations (City of Toronto, 2011).[17]

[15] The City of Toronto manages a centralized list, which at the end of 2006 had 67,083 households waiting to access a RGI unit in social housing – about the same number of households already living in subsidized units. Waiting times range from 2 to 12 years, depending on the unit size that a household is eligible for, the rate at which units become available and the length of the waiting list for buildings selected by the household.

[16] Toronto Community Housing Corporation is the country's largest landlord.

[17] In January 2001 and May 2002, the City of Toronto, along with the other municipalities in Ontario, assumed the administration and funding responsibilities of the social housing programs previously funded and administered by the federal and provincial governments. The *Social Housing Agreement* (SHA), which was signed in November 1999, initiated the transfer of administrative responsibilities. The SHA was an agreement between the Ministry of Municipal Affairs and Housing (MMAH) and the CMHC. The agreement required the transfer all federal responsibilities for social housing programs to the Province of Ontario, with the exception of the federal cooperative housing program which continues to be funded and administered by the CMHC. Following the SHA was the *Social Housing Reform Act* (SHRA) in 2000, which required municipalities to assume responsibility for the funding and administration of social housing programs from the Province and/or the CMHC. The SHRA was completed in two stages. In stage one of the transfer, ownership, funding and administrative responsibilities of the public housing stock (then known as the Metro Toronto Housing Authority, now known as the Toronto Community Housing Corporation) was transferred to the City of Toronto, which administers its Service Manager role through the Shelter, Support & Housing and Support Administration Division. In stage two of the transfer, responsibility for the remaining social housing programs was

TABLE 11 Profile Of Social Housing in Toronto, 2007*			
Program	**Total Units**	**RGI Units**	**Housing Providers/Owners**
Social/Affordable Housing			
Non-Profit Housing Corporations	20,740	10,401	159
Coop Housing Corporations	7,448	4,789	68
Toronto Community Housing Corporation	58,194	52,429	1
City Developed Non-Profit Projects	832	660	13
Sub-Total	**87,214**	**68,279**	**241**
Market Housing**	3,665	2,690	9
Total	**90,879**	**70,969**	**250**

***** Data refers to housing under City administration as of December 31, 2006
**Market housing includes private housing under rent supplement, housing allowance pilot and limited dividend housing
Source: Adapted from City of Toronto, 2007

A profile of Toronto's social housing portfolio is presented in Table 11. Data from 2011 indicate that the total number of social housing has increased to 93, 198, while the number of corporations has grown to 254 (City of Toronto, 2011). With the exception of the TCHC, social housing in the City is owned by relatively small housing providers. Only three of the housing providers operate more than 500 units, while most operate a single building with fewer than 200 units. Several studies assessing the physical condition of the City's social housing stock found that the buildings were generally in good condition, but that most housing providers (including the TCHC) will not have sufficient funds to meet their future capital repair needs such as roof repairs, and mechanical and electrical systems upgrades (City of Toronto, 2001; 2011). The TCHC reported immediate capital repair needs of $751 million (2012 dollars), stating that failure to make these investments will result in the withdrawal of housing units due to the failure to meet an appropriate standard for occupancy. As the capital repair backlog increases each year, the TCHC expects that the capital needs will exceed by $ 1 billion by 2012 in the absence of new sources of funding (see TCHC, 2013 for further detail). The report on the non-profit and cooperative social housing portfolio indicated that to meet future capital repair needs, funding of housing provider capital reserves should be increased by $34 million annually. Reports to Council pointed out a significant financial exposure and risk to the City for unfunded future capital repair needs (see City of Toronto, 2007 for additional discussion of these issues). The physical condition of the social housing portfolio and the lack of adequate reserves to address capital needs, as well as the limited institutional capacity of some small community based non-profit organisations to undertake complex retrofit programs, affects the implementation of the SHRRP.

Most social housing providers do not have the economies of scale to undertake complex retrofit programs, nor do they have the money to repay loans until their first

transferred to the City. As a result, 95,350 units, including community non-profit, non-profit cooperative, and the City's municipal non-profit housing corporation units, are now under the administrative and management of the City of Toronto (City of Toronto, 2001).

mortgage is paid off, which may not be until 2020.[18] Furthermore, the responsibility to provide RGI assistance to half of the tenants does not allow rent increases and accumulation of sufficient capital reserves. In the TCHC's portfolio, social assistance subsidies are even more important because about 80% to 90% of its social housing is RGI.

3.3 FUNDING PROGRAMS AND MECHANISMS

In 2009, the federal and the provincial government of Ontario launched a number of policy initiatives and capital grant programs to support energy efficiency retrofits in social housing. In addition to improving the condition of existing social housing and tenant quality of life, these efforts were aimed at stimulating job creation and reducing energy consumption and impacts on the environment (Tsenkova & Youssef, 2011). The policy tools and initiatives directly relevant to this research are discussed below.

Social Housing Renovations and Retrofit Program

The SHRRP is a capital grant program under the *Canada-Ontario Housing Initiative*. The federal and provincial governments jointly fund the SHRRP with Ottawa contributing $352.16 million through the *Renovation and Retrofit of Existing Social Housing Initiative* (part of the CEAP) and Ontario matching the funds to support its *Poverty Reduction Plan.* A total of $704 million was available over a two year period (2009 to 2011 fiscal year) (City of Toronto, 2009a). Eligible social housing programs included public housing projects developed by the Ontario Mortgage and Housing Corporation (formerly the Ontario Housing Corporation) and transferred to service managers under the *Social Housing Reform Act* (SHRA);[2] projects funded under the SHRA and formerly under federal/provincial non-profit housing programs (non-profit and cooperative housing) and unilateral provincial non-profit housing programs (non-profit and cooperative housing); projects developed under the federal Section 95 housing program including the Urban Native Housing Program; projects developed under the Section 26 housing program (including the Limited Dividend Program) and the Section 27 housing program directly funded by the CMHC; and off-reserve projects funded under the Rural and Native Housing Rental Program (Ministry of Municipal Affairs and Housing, 2009). The Ministry of Municipal Affairs and Housing used notional allocation to distribute the funds to the 47 consolidated municipal service managers in Ontario, which received a share of the $704 million corresponding to the relative share of social housing in their service area compared to the total units in the province. If the service manager administers 30% of the total social housing units in the province, they received 30% of the funding available. Service managers had authority, within the parameters of the Provincial Guidelines, to distribute funds to social housing providers (Interview data, Provincial Program manager, August 2012). This simple rule ensured some fairness in

[18] The City of Toronto Social Housing Reserve Funds provided $26.0 million in non-interest bearing loans to non-profit providers for capital repairs. The loans are repayable after the first mortgage on each property is paid off at a rate established by the City, amortized over a 15-year period.

the distribution of funds across the province and left the service managers sufficient autonomy to address priority needs.

The City of Toronto is one of the 47 service managers in Ontario, and over a two year period, the SHRRP provided approximately $220 million to the City for construction ready capital repair projects in the social housing sector (City of Toronto, 2009). The SHRRP funding was an indispensable investment to improve the state of social housing in the city, and was consistent with the direction of *Housing Opportunities Toronto* and the City's *Ten Year Affordable Housing Action Plan*. The SHRRP funding also reduced the impact of the withdrawal of federal and provincial funding resulting from the social housing transfer in 2002,[2] and therefore was a necessary investment to fund capital repairs required for exiting social housing across the province. The three key priorities of the SHRRP were to: (1) improve the health and safety of tenants; (2) increase the energy efficiency of buildings; and (3) increase building accessibility for seniors and persons with disabilities (Ministry of Municipal Affairs and Housing, 2009). The two categories of capital projects permitted under the program were renovation and retrofit projects and regeneration projects.

TABLE 12 Capital Program Investments in The Social Housing Sector: Ontario & Toronto

Program	Funding Source	Amount Invested	Projects
CEAP Renovation and Retrofit of Existing Social Housing Initiative	Economic Action Plan/Housing Renovation Partnership	$704million ($220 million in Toronto)	5,817 housing developments (includes city owned, non-profit housing and coops) (~2,500 projects in Toronto)
CEAP Renovation and Retrofit of Existing Social Housing Cooperatives	Economic Action Plan/CMHC	$40.5 million ($6.0 million in Toronto)	299 coops (48 projects in Toronto)
Renewable Energy Initiative	MMAH	$70 million ($30.6 million in Toronto)	NAV (92 projects in Toronto)

Source: CMHC, 2012; Interview Data, Program Director, September 2012

Federally Administered Retrofit Program

Retrofits in cooperatives and non-profits under federal contracts with the CMHC were funded separately. Project submissions were reviewed by a special CMHC committee and went through a complex and vigorous application process that was centrally managed in Ottawa. The CMHC granted $40.5 million to eligible projects in Ontario based on predetermined criteria (CMHC, 2010). About a third of the applicants received funding. Cooperatives used an intermediary, such as the Provincial Federation of Housing Coops, to prepare project submissions and in many cases to manage the construction process once the project was approved. Once funded, some cooperatives hired project managers to complete contracting and supervision as the deadlines were tight—all work had to be completed by April 2011. Large cooperative providers had in-house project management expertise, while others received support from the Cooperative Housing Federation of Canada (Interview data, Policy Expert, April 2012). Nearly 300 projects received grants for renovation and energy efficiency retrofit work in

Ontario, and about 16% of these projects were located in Toronto (see Table 12). Grants were relatively small and covered specific measures such as the replacement of heating systems and windows, and improvements to the units.

Renewable Energy Initiative

In 2010 the Ministry of Municipal Affairs and Housing (MMAH) provided $70 million in federal and provincial funding to further facilitate social housing renovation and retrofit initiatives (City of Toronto, 2010b). As a one-time funding opportunity, the *Renewable Energy Initiative (REI)* was aimed at further reducing operating costs for housing providers by installing renewable energy technologies for heating, cooling and/or generating electricity. Specifically, the program supported investment in: (i) solar photovoltaic (roof top systems); (ii) solar water heating; (iii) solar air heating; (iv) geothermal; and (v) mid-sized wind technologies (City of Toronto, 2010b). The Province required REI supply and installation contractors to be selected from an approved vendor of record list. The list was administered by the Ontario Power Authority.

Council approved applications were submitted as eligible renewable energy projects by the Shelter, Support and Housing Administration. The province awarded $30,672,243 as a conditional allocation under the REI for 59 projects from the TCHC portfolio ($21,396,674) and for 33 projects from the non-profit and cooperative housing provider portfolios ($9,275,569) (City of Toronto, 2010b). Funding allocation was based on compliance with program requirements, regional fairness across the province, and a balanced distribution of technology implementation.

Toronto Community Housing Corporation Retrofit Initiatives

While the TCHC has faced many challenges in managing the largest share of social housing in Toronto, it has also initiated a number of programs to enhance tenant quality of life. SSHRP and REI funding allowed these efforts to be scaled up and implemented in a more efficient manner. The TCHC has the ability to raise funds directly due its AA class debt rating from Standard & Poor, which has allowed borrowing from capital markets to fund redevelopment projects such as Regent Park and Don Mount Court, as well as to address backlogs in capital repairs.[19] Some of the TCHC initiatives prior to the launch of SHRRP include:

- Building Renewal Plan: $100 million, four-year investment in 19 communities
- Neighbourhood revitalization: $7 million to open and renew community spaces, playgrounds, community gardens and sports facilities to enhance community safety
- Energy Efficiency: a partnership with Brahms Energy Saving Team to reduce energy consumption in their community through energy-saving light bulbs, by saving $17,000 in energy costs and winning *the 2006 Green Toronto Award for Community Initiative*

[19] In 2007 the TCHC placed a $250 million bond to address capital repairs and redevelopment needs. Interviews suggest that the TCHC may have exhausted its current debt servicing capacity.

- Appliance Replacement: replacement of fridges, stoves, showerheads, toilets and furnaces with energy efficient models, saving over $1.2 million, reducing energy consumption by 3% across the portfolio and winning *2006 NRCAN Energy Star of the Year Award*
- Unit Refurbishment Program: $75 million invested to upgrade about 9,000 bathrooms and kitchens (and related unit mechanical systems) to improve unit interiors.

Because of the size of its social housing portfolio, the TCHC has the ability and the capacity to benefit from different programs in order to improve tenant living conditions, and has emphasised the importance of energy and water savings by installing energy and water efficient systems and devices. The TCHC has a large asset management team, manages its own Building Renewal Energy program to fund such measures from its capital reserve fund and has set up a project management clearing house—Housing Solutions Inc.—to oversee a more holistic approach to renovation and energy efficiency retrofits. The entity is a subsidiary of TCHC and manages many retrofit projects (Interview Data, Asset Management Team, September 2012). While the greening of social housing has many benefits, the installation of "green" technologies is a strain on capital reserves, some with a lengthy payback.[20]

3.4 PROGRAM IMPLEMENTATION RESULTS

Institutional Framework

Administration of SHRRP funding was structured around an Administration Agreement between the City and the Province. This agreement served to outline the partnership between the Province and the City by specifying the principles, requirements and procedures guiding reporting, payments and the creation of funding agreements for projects. City staff were also responsible for ensuring that the SHRRP guidelines and reporting requirements were met through the invoice verification of invoices and financial statements submitted by housing providers, and by undertaking site visits. Since the monitoring of the program required staff resources, the Province committed additional funding to offset administrative costs over the two years the program was run (City of Toronto, 2010a).

Figure 2 shows the institutional framework for social housing investments by federal, provincial, and municipal government in the City of Toronto. The City of Toronto is the SHRRP Service Manager through the Shelter Support and Housing Administration Division (SSHA). With City Council approval, this department is responsible for administering the SHRRP program, including the distribution of funds and monitoring of projects. In the two-year period the staff working on SHRRP has ranged between 4-9 people with asset management experts involved at the start of project submission,

[20] The Social Housing Services Corporation has been working for several years to deliver its Energy Management Program, which assists smaller social housing providers with green retrofits. Funds come from the Ontario Power Authority, Toronto Hydro and other utilities.

review and approval. The present staff is extensively involved in monitoring, site inspections, advice and capacity building on capital planning, particularly for some of the small housing providers. City staff was also instrumental in initiating audits for small housing organizations and promoting holistic thinking about the building and retrofit cycle (Interview data, Program Manager, September 2012). Some of the funded projects specifically targeted energy efficiency measures as City staff placed them in the category of 'big utility spenders' to ensure that unsustainable high utility bills are addressed through retrofit measures. Once funding was approved, all projects were self-managed by the individual housing providers and contractors were chosen on the basis of a tendering process. The SSHA reports to City Council and MMHA on program results, disbursement of funds and general metrics of performance.

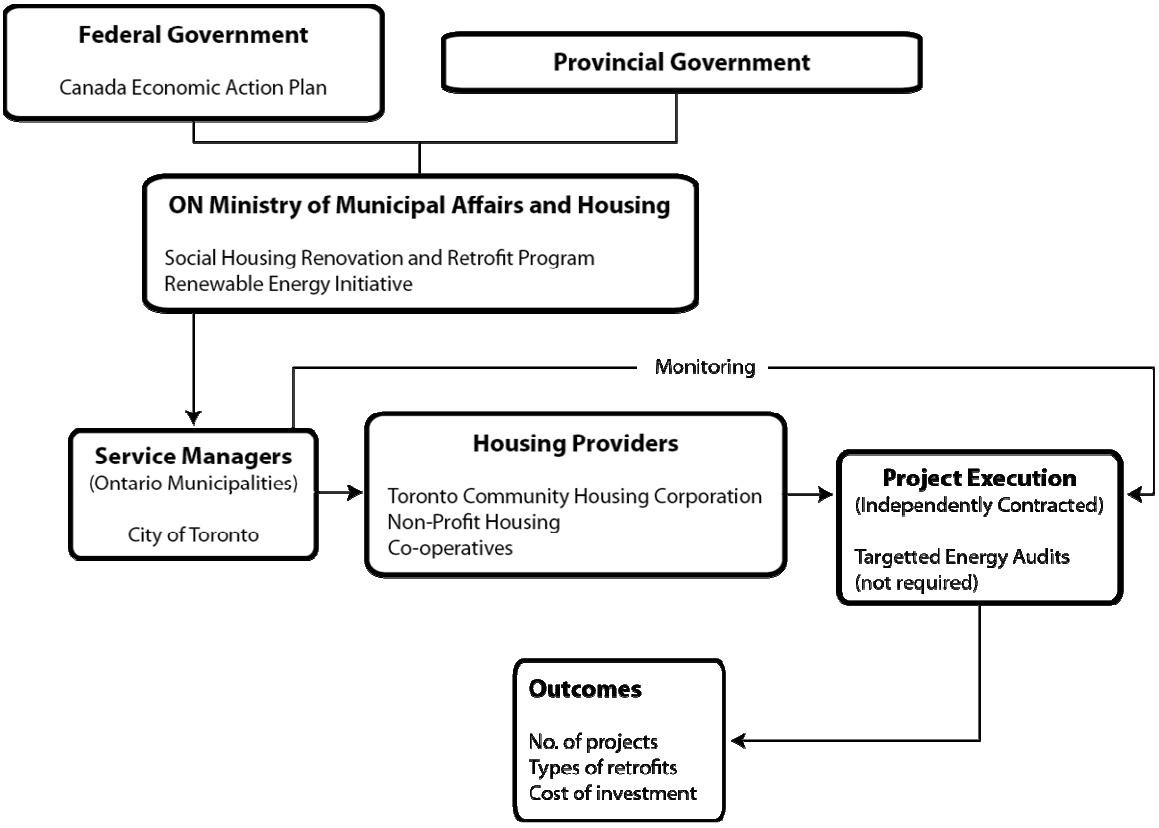


FIGURE 2 Institutional Framework of Social Housing Renovation and Retrofit Programs Implemented in the City of Toronto.
Source: Author, 2012.

Metrics of Performance

For both the SHRRP and the REI, the City of Toronto Council authorized the Shelter, Support and Housing Administration to submit projects on behalf of the City to the MMAH, and to subsequently allocate funding to the TCHC, non-profit and cooperative housing providers. For each project approved by the Province for funding, the City and Province entered into a *Provincial Funding Agreement*. Upon execution of the

agreement, the Province transferred 20% of the project funds to the City (City of Toronto, 2009b). Upon the commencement of construction, 50% of the funding was forwarded, and the remaining funds were transferred when the project reached 90% completion (City of Toronto, 2009b). As program administrator, the City disbursed the funds to housing providers through a *Provider Funding Agreement* upon completion of specified project milestones.

The total SHRRP allocation of $259 million had a significant impact on the social housing portfolio in Toronto. The TCHC received the largest share (58%), followed by the non-profit housing providers (31%). In terms of the impact measured by the number of units affected, the TCHC improved over half of its portfolio with SHRRP funds, while units impacted in the non-profit and coop sector accounted for 34% and 11% of the total. However, a comparison of these statistics against the number of units managed by non-profits and coops in the City (see Table 13) reveals that every non-profit and coop housing provider received funding and support to upgrade over 90% of the units in their portfolios. It does not seem that notional allocation of funds was a management objective, rather City staff worked hard to ensure that smaller organizations were successfully included. The allocation model used to distribute the REI funding was based on submissions from each social housing provider (refer to Table 13). The data indicates that REI funding supported more TCHC projects, perhaps due to its institutional capacity to absorb grants and the existing management structure that had promoted energy efficiency retrofits and the use of renewal energy features since 2006.

TABLE 13 SHRRP & REI Funding Allocations & Impact

Proportion of SHRRP & REI Funding Allocated

	SHRRP		**REI**	
TCHC	$150,688,073	58%	$21,396,674	70%
Non-Profits (other than TCHC)	$79,841,232	31%	$5,797,272	19%
Cooperatives	$28,505,246	11%	$3,478,297	11%
Total	**$259,034,551**	**100%**	**$30,672,243**	**100%**

Proportion of Units Impacted by SHRRP & REI

	SHRRP		**REI**	
TCHC	32,419	55%	7645	70%
Non-Profits (other than TCHC)	19,924	34%	2200	20%
Cooperatives	6,610	11%	1152	10%
Total	**58,953**	**100%**	**10,997**	100%

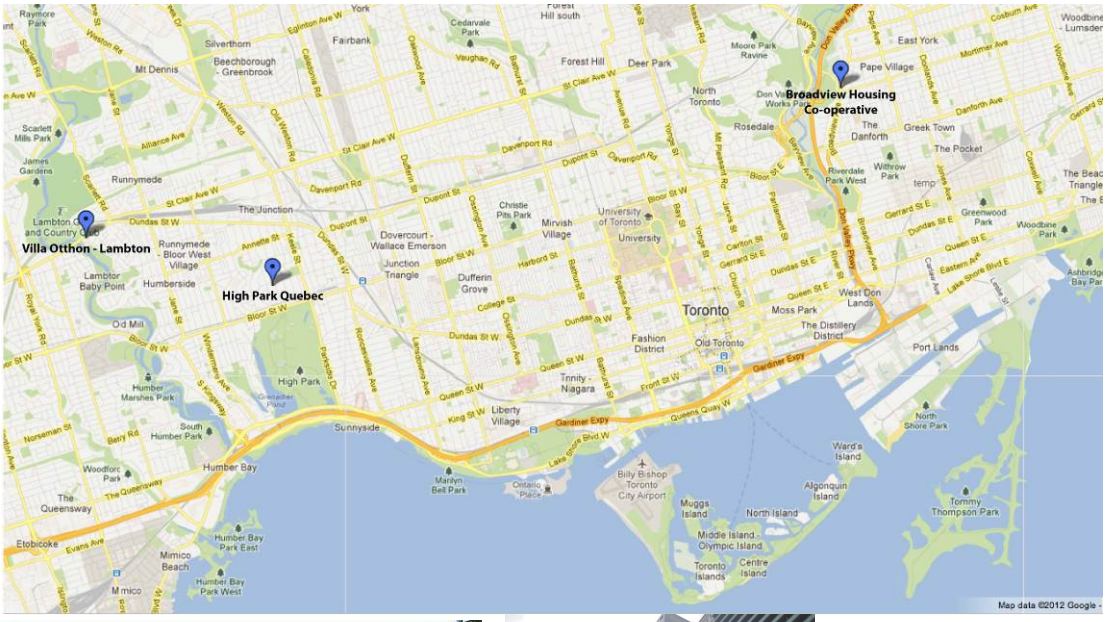
Source: Interview Data, Program Manager, City of Toronto, September 2012

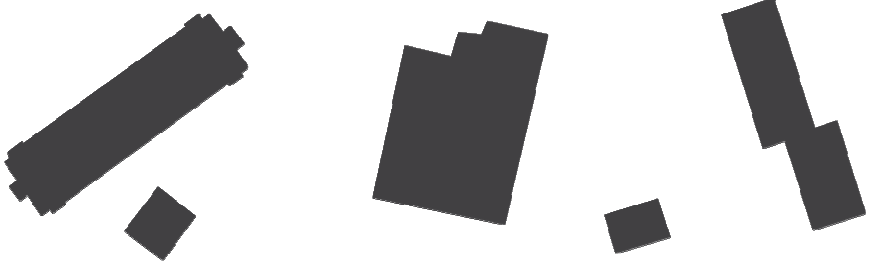
Although the administration of the program was complex, the City of Toronto's SSHA efficiently managed the process. As a result, there was an overall increase in the number of projects submitted for funding in the second year. In the first year, 109 social housing providers were approved for funding with the TCHC portfolio accounting for 70% of all the projects, whereas in the second year, 178 housing providers requested funding (City of Toronto, 2010a). As a result of more staff resources, sufficient time to recruit consultants, and effective collaboration and communication with the social housing providers, program opportunities were maximized. The number of smaller

housing providers in the non-profit and cooperative sectors that received funding from 2010 to 2011 increased substantially to 55% of the total (City of Toronto, 2010a).

3.5 TORONTO CASE STUDIES

TABLE 14 Case Study Profiles: Toronto			
Study Area	**Villa Otthon Lambton**	**Broadview Housing Cooperative**	**High Park Quebec**
	4062 Old Dundas St. W	1050 Broadview Avenue	100 High Park Avenue High Park Quebec Townhomes





Building footprints

Project Type/Characteristics			
Year of Construction	1989	1965, renovation in 1997	1969
Building Type	Residential tower/ Townhouse Complex	Residential Tower	Residential Tower
Bedrooms	1-3 bed	1-3 bed	Bachelor – 3 bed
Storeys	11	15	24
No. of Units	194 apartments (+6 under construction in Year 1)/8 Townhouse	111 apartments	449 apartments
Project Economics			
Total SHRRP Allocation	$3,937,164	$700,753	$2,175,049[21]
Funding Per Unit	$18,929	$6,313	$4,844
Type of Rent	65% RGI 1b.$1,000; 2b.$1,200 Townhouse $1,400	60%RGI 1b-$900; 2b.$1,110	90% RGI 1b.$850; 2b.$1,200
Average Rent	NAV	NAV	$1,651
Tenants			
Tenant Turnover	Medium (21 units vacant)	Very small	Medium
Tenant Pay Utilities	No	No	No

Source: Interview data, 2012b & 2012c

Three case studies were chosen for Toronto to comparatively analyze SHRRP program implementation. The case studies represent retrofit strategies by the three main housing provider types in Toronto: (i) non-profit; (ii) cooperative; and (iii) the local housing corporation - TCHC. The case studies also highlight best practice in energy efficiency retrofits under the SHRRP program. The first section profiles the projects, followed by an overview of the types of retrofits implemented and estimated energy and cost savings.

Villa Otthon, Broadview Housing Cooperative and High Park Quebec are all residential towers ranging from 11 to 24 storeys in height. The Villa Otthon and High Park developments also include a small town house complex. The buildings were built between 1969 and 1989. All the units operate have controlled market rents, with 60% to 90% of the tenants receiving RGI housing assistance. Monthly market rents typically range from $800 to $1,200 depending on the size of the unit. Residents do not pay utility bills and the cost of heating and hot water is included in the rent. Tenant turnover is an issue in Villa Otthon as a result of the comprehensive retrofit measures and the work required in each of the units. The project took 18 months to complete and initially met with a great deal of tenant opposition (Interview data, Building Manager, September 2012).

Types of Retrofits Completed

Audits completed for each case study identified key retrofits that responded to the specific needs of each development. These studies were used by City staff to identify

[21]SHRRP funding was offered on a "use it or lose it" basis. Under the SHRRP rules, if the funding was not used or approved projects are not completed within the fiscal year, funds would be reallocated to other projects by the MMAH. The original amount requested and approved for the High Park development under the SHRRP program was $3,992,229. As a result of reallocation, the actual funding was $2,175,049.

potential projects for SHRRP support. Mechanical upgrades, such as the replacement of heating systems, makeup air units and cold-water booster pumps, accounted for the majority of the investment, whereas non-mechanical upgrades such as general repairs to building facilities and replacement of appliances represented the smallest percentage of project investment (see Table 15). Retrofits related to renewable energy technology were the solar thermal installations in Villa Otthon and Broadview, accounting for 2% and 32% of project costs. Lighting improvements, as well as the installation of low flow toilets and water conserving showerheads, were implemented in High Park. These different types of projects demonstrate different and unique priorities. For example, the replacement of the electric heating plant with a gas-fired heating plant in Villa Otthon did cost $2.9 million, but was prompted by a disproportionately high bill for heating and utilities that exceeded $400,000/per year. The new system uses natural gas, which resulted in a major reduction in utility bills (Interview data, Building manager, September 2012).

TABLE 15 Summary Of Retrofits Completed

	Villa Otthon	Broadview	High Park*
Renewable Energy	**2%**	**32%**	
Solar Thermal System	$60,000	$225,196	
Mechanical	**81%**	**55%**	
Makeup Air Units[22]	$110,000	$15,617	X
Heating Plant (boilers and conversion)	$2,944,757	$215,408	X
Cold Water Booster Pumps	$40,000	$85,728	
Building Automation Controls	$75,000	$69,144	X
Non-Mechanical	**7%**	**1%**	
General Building Upgrades[23]	$165,793		
Audits[24]	$8,065	$4,061	X
Unit Kitchen & Bathroom Upgrades[25]	$96,879		X
Other Costs	**11%**	**12%**	X
Total SHRRP Allocation (100%)	**$3,937,164**	**$700,753**	**$2,175,049**

*Data on the cost of individual project components are not available for High Park
Source: Interview data, Program Manager, City of Toronto & Building Mangers, September 2012

[22]The Makeup Air Unit category also includes garage ventilation.
[23]The General Building Upgrades category also includes replacement of balcony panels, elevator room repairs, paint and signage upgrades, lighting upgrades, pipe rehabilitation (corrosion control), and backflow prevention device installation.
[24]The Audits category also includes asbestos audit and abatement (in the case of Villa Otthon), building condition audits and capital reserve fund forecast
[25]Unit Kitchen & Bathroom Upgrades category includes appliance replacement, low flow toilet installation and water conserving showerhead installation.

FIGURE 3 Major retrofits at Villa Otthon.

Figures 3 and 4 illustrate some of the major retrofits implemented in the case study projects. Initiatives supporting the retrofits included staff training to ensure efficient use and maintenance of new systems, communication strategies to articulate renovation and retrofit plans and the potential benefits to building tenants, and occupant behavioral change programs to encourage energy responsible behavior, especially in buildings where tenants are not responsible for individual utility costs (Interview data, Building Managers, September and December 2012). In Villa Otthon, management constructed two mock up apartments to demonstrate the impact of the retrofit measures. This was particularly helpful in addressing tenant concerns. Building managers worked proactively to minimize the disruption caused by construction work in the building and had ongoing support from City staff. Tenants reported high levels of satisfaction with the improvement measures and appreciated the tangible benefits to common areas in the buildings.

Energy and Cost Saving Metrics

Energy Audits and feasibility studies conducted prior to the implementation of renovation and retrofit projects projected an overall decrease in energy consumption resulting in cost savings for each case study. The data provided in Table 16 represents these preliminary estimates. Post retrofit studies are required to confirm the impact on actual energy consumption of projects supported by social housing renovation and retrofit and energy efficiency initiatives.

With respect to energy savings, Villa Otthon had an annual projected estimate of 37% in savings, Broadview projected an estimate of 27% in savings, and the High Park development projected an estimate of 16% in savings. The projected energy cost savings exceeded $100,000 for Vila Otthon and High Park. These estimates included energy retrofit incentives provided by Enbridge Gas and the City of Toronto's Building Better Partnerships, as well as rebates offered by Ecoenergy in Ontario (Finn Projects, 2007a; 2009b). In addition to the economic benefits of reducing energy use, the feasibility studies claim significant environmental gains resulting from reduced consumption of water and GHG emissions. For example, a reduction of 295 tonnes of GHG is equivalent to growing 7,565 tree seedlings for 10 years, or taking 54 passenger

cars off the road for a year. Such gains are impressive, given the fact that in two of the projects the GHG reduction is twice and three times the projected amount.

TABLE 16 Projected Annual Costs And Energy Savings				
Energy and Consumption Costs Pre-retrofit	**Villa Otthon Lambton**	**Broadview Housing Co-operative**	**High Park**	
			100 High Park Ave	**High Park Quebec**
Electric kWh	3,062,123	962,425	2,862,827	127,911
Gas cu.m.	235,135	284,021	801,240	1
Water cu.m.	N/A	N/A	81,803	1
Cost of use ($)	$455,373	$210,636	$724,608	$17,734
Energy and Cost Savings Post-retrofit*				
Electric kWh	1,675,176	184,484	221,062	24,117
Gas cu.m.	-57,124	91,451	217,076	0
Water cu.m.	N/A	N/A	3,449	0
GHG Reduction	296	772	455	5
Energy Savings	37%	27%	16%	19%
Cost Savings	$168,244	$56,949	$118,594	$3,344

*projected
Source: Finn Projects (2009a); Finn Projects (2009b); Ameresco Canada Inc. (2009)

As with the research completed in British Columbia and Alberta (Tsenkova and Clieff, 2012; Tsenkova and Youseff, 2011), the return on investment was dependent on the amount of capital, energy cost savings, and types of retrofits implemented. For example, Broadview had an original investment of $611,093 for mechanical retrofits with a projected annual energy savings of $26,815. Table 17 presents the simple payback period of these measures, ranging from 19 to 68 years (in the case of solar thermal systems). In comparison, Villa Otthon invested $3,229,975 for mechanical retrofits, contributing to energy savings with a simple payback period of 7 to 77 years (in the case of the heating plant). Collectively these measures projected annual energy savings of $63,300. The data remain limited, as the non-mechanical upgrades also affect building envelope insulation and may reduce energy and water consumption.

FIGURE 4 Major retrofits at Broadview Housing Coop.

TABLE 17 Costs and Payback of SHRRP Funded Energy Retrofits			
Broadview Housing Co-operative Mechanical - Energy Retrofit Description	**Cost**	**Projected Annual Energy Savings ***	**Anticipated Simple Payback**
Make-Up Air Units	$15,617	$7,059	2.2
Heating Plant	$215,408	$10,993	19.6
Solar Thermal System	$225,196	$3,298	68.3
Cold Water Booster Pumps	$85,728	$3,265	26.3
Building Automation Controls	$69,144	$2,200	31.4
All SHRRP Retrofits	**$700,753**		
Villa Otthon Mechanical - Energy Retrofit Description	**Cost**	**Projected Annual Energy Savings***	**Anticipated Simple Payback**
Make-Up Air Units	$75,000	$11,700	6.4
Heating Plant (boilers and conversion)	$2,944,757	$38,000	77.5
Solar Thermal System	$60,000	$3,900	15.4
Cold Water Booster Pumps	$40,000	$2,600	15.4
Garage Ventilation	$35,000	$2,600	13.5
Building Automation Controls	$75,000	$4,500	13.6
All SHRRP Retrofits	**$3,937,164**		

*Gas savings only (does not include electricity savings) are used in the simple payback calculations.
Source: Finn Projects (2009a); Finn Projects (2009b); Ameresco Canada Inc. (2009); Interview data, Program Manager, September 2012

3.6 REGENERATION PROJECTS AND DESIGN INNOVATION

42 Hubbard Boulevard – TCHC Regeneration Project

Under the SHRRP, service managers were permitted to use up to 10% of the total two-year funding allocation to fund regeneration projects. In the second year of the SHRRP, the TCHC requested $4,050,000 for regeneration of the Hubbard Boulevard development. The building was 80 years old and in need of significant repairs and retrofits to improve the performance, functionality and accessibility of the units. In 2008, during kitchen and bathroom repairs, TCHC determined that the building could not be maintained due to major renovation requirements to remediate mold, asbestos, and other safety issues. The social housing development is adjacent to the boardwalk in the Beaches, one of the most attractive historic neighbourhoods in downtown Toronto, and is itself a historic resource. The building contributes to the character of the neighbourhood and has ensured the integration of social housing tenants in the area. During the reconstruction, only the original façade of the 3-story, 27-unit property was preserved. In addition to the installation of an elevator and other accessibility features,

the primary goal of the regeneration was to meet a 40% efficiency improvement and create a new amenity area for tenants.

The interior was completely rebuilt with original stained glass windows and other historic elements incorporated in the new design. The emphasis on sustainability and simplicity in design is remarkable and certainly defines the unique attributes of this development (Interview Data, project Architect, September 2012). The regeneration was completed in January 2012 and the building is fully occupied. The total cost of the regeneration was $5,894,340, and it provided 27 apartments. SHRRP funding and other energy efficiency and regeneration resources were used to cover project costs.[26] This one-of-a-kind regeneration project had a significant price tag with costs of $210/sq ft, close to the $230/sq ft cost of newly built housing. Half of the original tenants were able to come to Hubbard Boulevard and live in RGI housing units. The other 18 apartments have market-based rents, ranging from $1,200 to $1,500 per month. These rent levels are reportedly half of what true market rents will be in the Beaches (Interview Data, Project manager, September 2012).

Table 18 Project Costs for 42 Hubbard Boulevard

Description of Works	**Cost**
General Site Costs	$388,750.00
Construction Management	$120,000.00
Architecture & Engineering	$400,000.00
Landscaping	$30,000.00
Earthwork / Shoring / Demolition	$837,680.00
Concrete / Masonry / Structural Steel	$876,350.00
Rough Carpentry / Framing / Gypsum	$865,650.00
Roof / Green Roof / Roof Anchors	$266,600.00
Windows / Exterior Doors / Curtain Wall	$227,910.00
Plumbing / HVAC / Controls / Sprinklers	$831,700.00
Electrical Service / Communication / Security	$538,200.00
Elevator	$98,500.00
Solar PV	$50,000.00
Building Automation System	$113,000.00
Contingency	$250,000.00
Total Expenses	**$5,894,340.00**

Source: Interview data, Project manager, September 2012

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BOX 1 42 Hubbard Boulevard – Energy Efficiency by Design

SHRRP funding and other energy incentive programs offsetting the cost of energy efficiency and renewable energy measures allowed for new design features, including:

- Insulation and new windows to make units more comfortable and to reduce heating costs
- Energy efficient heating, air conditioning, and lighting
- Rooftop solar panels to generate electricity
- A green roof to improve aesthetics, building cooling, and rain water management
- A building automation system to fine tune energy use.

Solar Walls

Through SHRRP funding, four Toronto housing providers have installed solar air heating systems. SolarWall© air heating is a renewable energy technology developed in Toronto. SolarWall© systems are typically wall-mounted (although modular rooftop systems—SolarDuct©—are also available) and can be designed to cover an entire wall or to blend into windows and other architectural details on a wall. SolarWall© resembles a traditional metal wall cladding system. The exterior is comprised of a specially perforated collector installed 6 to 12 inches from the exterior wall, creating an air cavity. It acts as the ventilation air-intake for the building. Fresh air is heated as it passes through the perforations in the system and the heated air is collected in the air cavity behind the wall, where it is directed into the building's HVAC system. The solar heating reduces the energy load on the conventional heater (City of Toronto, 2011).

Three TCHC projects in Moss Park used REI funding to instal SolarWalls© (275, 285 and 295 Shuter Street). Two towers installed two wall-mount systems totaling 3,388 sq ft, which should offset over 85 tonnes of CO_2 each year (see Figure 5). A rooftop system was installed on the third tower. The choice was prompted by the fact that SolarWalls© provide a renewable energy technology blending both solar pre-heated air and heat recovery from suite ventilation, while reducing energy consumption. The SolarWall© heating system is most affordable and the payback is best when installed as part of a cladding replacement project. In the Harry Sherman Crowe Housing Cooperative at York University Campus, the systems were installed on a wall covering

6,400 sq ft. (see Figure 5). These systems are heating 18,000 cfm of air for the building, and provide energy savings of over $15,000 each year. The systems are expected to offset over 130 tonnes of CO2 each year.

FIGURE 5 Solar Walls in two SHRRP projects in Toronto.
Source: City of Toronto, SHRRP newsletter, 2011

3.7 CONCLUDING COMMENTS

The renovation and retrofit programs were successful in achieving the goals of improving the quality of social housing in Ontario, reducing energy costs, and improving the overall condition of the housing stock. Nearly 300 projects received grants for renovation and energy efficiency retrofit work in Ontario, and about 16% of those are located in Toronto through the CMHC administered program. In the SHRRP program, the Ministry of Municipal Affairs and Housing used notional allocation to distribute funds to the 47 consolidated municipal service managers in Ontario who received a share of the $704 million corresponding to the relative share of social housing in their portfolio. This simple rule ensured some fairness in the distribution of funds across the province and left the service managers sufficient autonomy to address priority needs. In the City of Toronto the investment was critical in addressing the lack of resources needed to fund capital repairs and system upgrades in the aging social housing stock. The capital shortfall for social housing in Ontario is estimated at $2 billion, and is not particularly well quantified. The City of Toronto reports to Council illuminated significant financial exposure and risk to the City for unfunded future capital repair needs. The physical condition of the social housing portfolio and the lack of adequate reserves to address capital needs, as well as the limited institutional capacity of small community based non-profit organisations to undertake complex retrofit programs, affected the implementation of the SHRRP.

Interviews consistently pointed out that without the combined funding from SHRRP and REI, most of these retrofits would not have materialized. The issues are particularly critical for small social housing providers in the non-profit and coop sector that do not have the capacity to raise funds for critical upgrades, nor necessarily the institutional expertise to deal with complex retrofit programming and budgeting operations. In terms of overall impact, SHRRP provided grant funds for a variety of mechanical, structural

and building envelope improvements affecting two thirds of the social housing portfolio in Toronto. The impact, in terms of units upgraded, was particularly significant for the non-profit and cooperative housing providers, which saw over 90% of their portfolio affected by program measures. The capital investment enabled the renovation and retrofit of nearly half of TCHC social housing, including comprehensive energy efficiency projects through SHRRP and REI funding as well as innovative demonstration projects. As the largest social housing provider in the City of Toronto, and indeed in Canada, the TCHC received over 55% of the funding (over 70% of REI) due to its institutional capacity and previous experience with energy efficiency retrofits.

Part of the City of Toronto's success is attributed to the institutional framework established to manage funds in an effective and efficient manner. City staff worked hard to overcome the constraints of a decentralized model of social housing providers to ensure that program benefits were available to all. Efforts included capacity building, assistance with project submissions, project co-ordination and in some cases commissioning audits to ensure greater response rates in year two of the SHRRP and REI program cycle. Constant monitoring, site inspections, advice and training ensured consistency between planned and actual program measures. Some of the most popular retrofits, in addition to lighting—'the low hanging fruit'—were mechanical system upgrades (boilers), roofing, window replacement and cladding/insulation (Interview data, Manager and project lead, September, 2012).

Some of the challenges were associated with the tight deadlines and the need to quickly identify shovel ready projects, when a systematic approach based on building and energy audits would have been more beneficial. City staff continues to oversee disbursement of SHRRP funds, reallocated for other measures or reassigned across the portfolio (Interview data, Program management team, September 2012). Some of these issues are related to the diverse institutional landscape of social housing providers in Toronto—some social housing providers with the institutional capacity to undertake major projects, and others in need of significant assistance in managing these projects. Program management was stressful and program administration absorbed significant City staff time. Despite these constraints, the approach was strategic and integrated energy efficiency considerations with capital need improvements.

The specific retrofit measures in the case studies are diverse and illustrate the significant challenges of such programs in economic terms. If the simple payback of energy efficiency measures is used as an overall consideration for return on investment, it will be difficult to make the case for green retrofits in the social housing sector. Feasibility studies, however, point to significant environmental benefits resulting from reduced energy and water consumption, and reduced GHG emissions. Some of these metrics of performance, as well as the social impact measured in tenant satisfaction and improved health and wellbeing, are difficult to measure. Because of the size of its social housing portfolio, the TCHC has emphasised the importance of energy and water savings by installing energy and water efficient systems and devices. While the greening of social housing has many benefits, the installation of green technologies is a strain on its capital reserves. REI has provided an important financial boost to

experimentation with sustainable design and green technologies such as solar walls/roofs and green roofs which could become mainstream in the future.

Regardless of the overall success of the programs, the funding only temporarily addresses the lack of resources available to maintain the social housing stock. A longer term and consistent funding model needs to be developed to ensure the sustainability of results achieved.

CHAPTER 4 RENOVATION AND RETROFIT OF SOCIAL HOUSING IN ALBERTA

4.1 INTRODUCTION AND METHODOLOGY

Housing is a priority on the agenda of the Province of Alberta, with a target of 11,000 new social housing units to be built by the end of 2012.[27] That target is paralleled by efforts to renovate and retrofit existing social housing built 30 to 40 years ago (Alberta, 2011; MHUA, 2011). "Building stronger communities starts with housing first" (interview data, Minister of Urban Affairs, November 7, 2011). The Province of Alberta has provided a total of $42.4 million to housing management bodies and service providers to support housing stock upgrades, which has been matched by the federal government. Overall, over 700 renovation projects have been completed in the province, which has benefited more than 20,000 units (interview data, Program supervisor, May 2012). The $84.5 million in retrofit funding supported the repair or replacement of major building components including roofs, windows, heating, and plumbing (MHUA, 2011).

The objective of this chapter is to review the results of the two-year CEAP program targeted at upgrading the social housing stock in Alberta, particularly in its largest cities—Edmonton and Calgary. The research methodology includes a literature review to identify main retrofit categories, content analysis of policy documents related to program administration at the federal and provincial level, profiles of select case studies in Edmonton and Calgary, and site visits and key informant interviews. Eight categories of retrofits were used as a broad framework for comparison of the work implemented:[28] (1) window and door replacement, (2) heating system upgrade, (3) roof work, (4) interior modernization, (5) flooring, (6) landscaping, (7) lighting, and (8) other.

A list of housing service providers (cooperatives and non-profit housing corporations) and housing management bodies (HMBs)[29] who received CEAP funding was reviewed to select the organisations that have received the largest amount of funding, often corresponding to a fairly large share of retrofitted units. This led to a stratified sample of case study projects to represent comprehensive intervention in the public, non-profit and cooperative sector in Calgary and Edmonton. Six projects are profiled in this chapter, which complements a general overview of CEAP program performance for funds administered by: i) The Ministry of Housing and Urban Affairs (a joined provincial-federal program); and ii) CMHC (a federal program). Housing providers and HMBs were asked to 'self-select' retrofit projects that they deemed representative of program implementation work.[30] Although the sample is small and does not adequately represent

[27] As of September 2011, the Government of Alberta is on track to achieve this goal as 11,636 social housing units have been supported through the program (9,035 newly constructed units and 2,601 purchased/renovated units); 3,424 units were constructed in 2011 (http://municipalaffairs.gov.ab.ca/units_target_achieved.cfm).
[28] See Yang et al., 2010 for specific definitions.
[29] HMBs in Alberta manage housing owned by the Alberta Social Housing Corporation. They are established by Ministerial Order under the *Alberta Housing Act*. There are 53 HMBs in the province for family housing and 110 HMBs for seniors housing (AUMA, 2012).
[30] In the case of the Greater Edmonton Foundation, the case study profiled is selected to represent the diversity of retrofits and other building envelope improvements.

the work carried out in over 700 retrofit projects across Alberta, the main objective of the research is to provide an overview of investment strategies used by different housing providers and to illustrate best practices.

In addition to the case studies chosen, 15 key informant interviews were undertaken to get a better sense of challenges and opportunities in the implementation of retrofit measures. Informants were selected based upon their key role in the decision-making and administration of CEAP funds, as well as in the actual implementation of renovation and retrofit strategies. Interviewees included program supervisors, program analysts, executive directors, board directors, managers, corporate representatives, and information officers.

4.2 SOCIAL HOUSING PORTFOLIO

Alberta has 26,500 social housing units in 1,100 sites that are funded by the federal and provincial governments, as well as 14,000 units supported by provincial rent supplements. Of the 26,500 units, approximately 8,645 units are in Calgary and 9,300 are in Edmonton (see Table 19). All units are managed by 130 local housing management bodies on behalf of the province. Additionally, 36 non-profit organizations manage special needs housing, which is also eligible for repair funding (MHUA, 2011). Although official data on the overall condition of the housing stock is lacking, recent reports have highlighted the challenges associated with the deteriorating condition of social housing, particularly in the public sector (Auditor General of Ontario, 2009).

TABLE 19 Social Housing Portfolio: Alberta

	Edmonton	Calgary	Alberta
Social Housing Units	9,300	8,645[a]	26,500
Percentage of Total	35%	33%	100%
HMB[b]	15	14	130

[a] City of Calgary (2011: 41)
[b] Based on data from http://housing.alberta.ca/522.cfm

4.3 POLICY FRAMEWORK FOR ENERGY EFFICIENCY RETROFITS IN THE SOCIAL HOUSING SECTOR

The Government of Canada and the Government of Alberta have partnered on a joint investment to build new and renovate existing affordable housing. Both levels of government officially signed an amendment to the *Canada–Alberta Affordable Housing Program Agreement* and announced $386 million over two years beginning in March 2009 for affordable housing (CMHC, 2009). The stimulus was intended for projects that were 'shovel-ready' with the expectation that work was complete by March 2011. While there was a formal extension by the Prime Minister of the CEAP infrastructure stimulus fund until December 2011, the social housing projects were considered 'on-schedule' as far as the funds administered by CMHC were concerned, but CEAP funds still continue to be administered by the provinces, including Alberta.

The four main objectives of the *CEAP Renovation and Retrofit Initiative* were to:

- Address the demand for renovations and general improvements,
- Address the need for energy efficiency upgrades,
- Address the accessibility needs for persons with disabilities, and
- Create jobs (CMHC, 2010).

In Alberta, the program was administered by a department in the Ministry of Housing and Municipal Affairs that worked directly with HMB on projects submissions, approval and disbursement of funds. The Ministry does not have specific guidelines or priorities to complement the federal guidelines and priorities, but has considered requests for building envelope improvements, measures addressing safety and accessibility, replacement of heating and ventilation systems and other specific energy efficiency retrofits (Interview data, Director, November 2012).

CEAP funds administered by CMHC had specific Canada-wide guidelines and standardised procedures. Eligible repairs and renovations included the following:

1. Major building components: roofs, exterior wall finishes, exterior doors and windows,
2. Major building services: heating systems and boilers, hot water tanks, circulating pumps and air handling systems,
3. Basic facilities: kitchen facilities such as stoves, refrigerators, sink and faucet installation, countertops and cabinets; bathroom facilities such as toilets, sinks and other fixtures,
4. Safety features such as fire alarm systems, emergency lighting and intercom systems, and
5. Other major facilities, equipment and features such as parking, flooring, garbage disposal systems and other items such as foundations, plumbing systems and emergency generators (CMHC, 2010).

Priority was given to housing providers with well-managed housing stock and $4,500 per unit or less in their replacement reserves. Priority was also given to renovations and retrofits that included major critical building systems and services, such as roofs, windows, doors, exterior building envelopes, heating systems, plumbing, electrical and ventilation, as well as those renovations that were required for the health and safety of residents and/or modifications for the disabled. In general, renovations of individual components were required to meet minimum energy standards. For example, window replacement using double paned Low-E Argon windows, roof replacements involving the use of attic insulation to a minimum of R-40, and replacing appliances with Energy Star-rated products. Renovations and repairs were not required to result in a specific overall energy rating unless the work was specifically intended as an energy retrofit.[31]

[31] Energy retrofit work is required to result in the unit meeting provincial or territorial energy efficiency standards, based on the age of the building. For example, a low rise building constructed in 1970 would be expected to achieve an Energuide rating equivalent to a range of 63-72. Existing high rise buildings would be expected to be more energy efficient than the Model National Energy Code for Buildings (see CMHC 2010, 2011 & 2012 for additional information).

4.4 POLICY IMPLEMENTATION

The institutional framework for CEAP program management is presented in Figure 6. All of the projects were self-managed by housing providers and HMBs with general monitoring and control exercised by the Ministry and the CMHC-Prairies Office. Contractors were chosen based on a tendering process, following standard procurement guidelines for public works. The disbursement of funds was done on the basis of invoices for completed retrofits and renovation items included in the project approval document (Interview data, Senior Program Administrators, November, 2011).

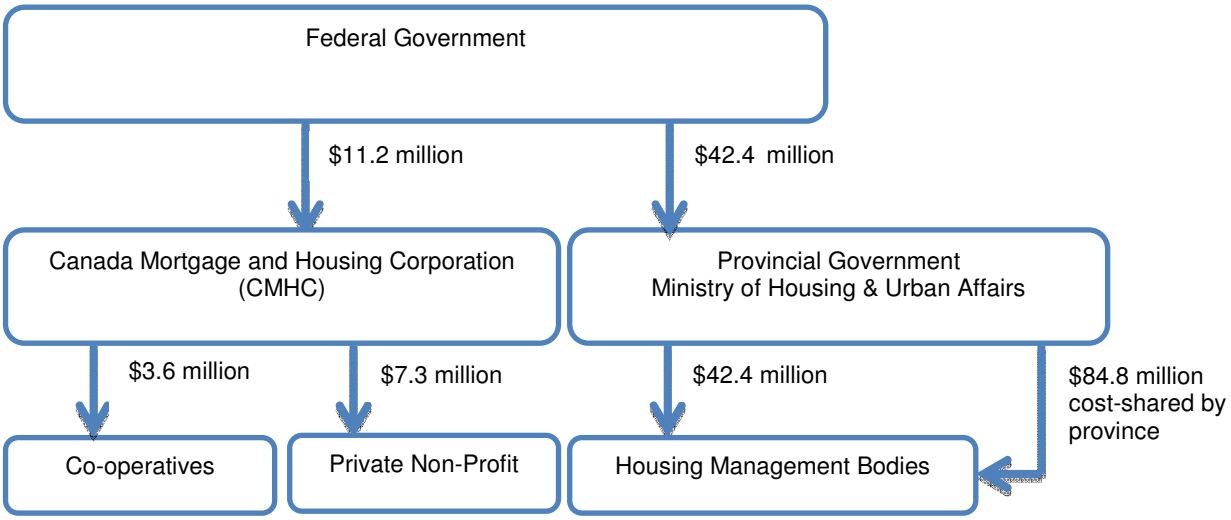


FIGURE 6 Institutional framework for the administration of program funding.

TABLE 20 CEAP Social Housing Retrofit Program Results In Alberta					
Province / City	**Funds Allocated (Federal $M)**	**Funds Allocated (Provincial $M)**	**Total Funding (Provincial & Federal $M)**	**Projects (not necessarily the number of Housing Management Bodies**	**Units**
Alberta	$42.43	$42.43	$84.86	747	20,827
Edmonton	$13.78	$13.78	$27.56	169	7,774
Calgary	$16.48	$16.48	$32.96	164	7,005
Rest of Alberta	$12.17	$12.17	$24.34	414	6,048

Source: Ministry of Housing & Urban Affairs, Interview data, November 2012

Data in Table 20 and 21 provide essential metrics of performance and program results. Provincially administered program funds were allocated to 747 projects and impacted over 20,827 units. Two thirds of these units are in Edmonton and Calgary, with the largest share of funding allocated to the two largest HMBs in the province: the Capital Region Housing Corporation (CRHC) and the Calgary Housing Corporation (CHC).The CRHC in Edmonton manages municipally owned and non-profit projects, and received $17.4 million. The CHC manages municipal and non-profit projects, and received $22.4

million.[32] In the non-profit sector, the Greater Edmonton Senior's Foundation received the largest amount of funding: $3.7 million (Interview data, Program Director, November 2012). Federally administered program funds of $11.2 million also targeted coops and non-profit providers in the two largest cities in the province.

TABLE 21 CMHC Social Housing Retrofit Program Results In Alberta

Province/ Territory	Cooperative Housing		Non-profit Housing		Total*	
	Funds ($million)	Projects	Funds ($million)	Projects	Funds ($million)	Projects
Alberta	$3.60	33	$7.30	80	$11.20	122
Edmonton	$1.82	12	$3.02	31		
Calgary	$1.01	6	$4.05	40		

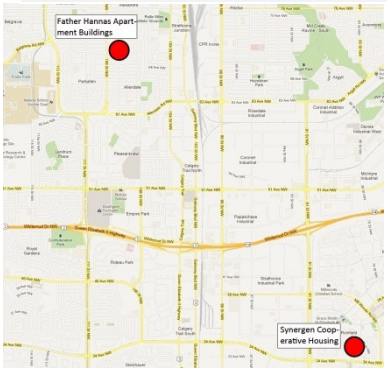
*Total funds and total projects includes Urban Native Housing
Source: CMHC (http://www.cmhc-schl.gc.ca/housingactionplan/reresoho/lipr.cfm)

4.5 EDMONTON CASE STUDIES OVERVIEW

Three case studies have been chosen in Edmonton—two supported through CEAP provincially administered funds, and one housing cooperative supported through CMHC administered program funds. The profile presented below follows the approach outlined in the analytical framework in Chapter 1. Table 22 highlights key characteristics of the housing development, data on project economics and types of retrofits implemented.

[32] The Calgary Housing Company also received $2.7 million from the CMHC for family housing upgrades (Interview data, Senior Partnership Consultant, April 2012).

TABLE 22 Case Study Profiles: Edmonton			
Housing Provider	**Capital Region Housing Corporation**	**Greater Edmonton Foundation**	**Synergen Housing Cooperative**
Project Name		**Father Hannas Apartment Building**	**Synergen Housing Cooperative**
Location / Address	Edmonton, AB	10809 70 Ave NW Edmonton, AB	428 Richfield Rd NW Edmonton, AB



Building footprints

Project Type / Characteristics			
Year of Construction		1972-1995	late 1970s
Building Type	Townhouses and apartment buildings	Apartment buildings	Townhouses
Bedrooms		Bachelor / 1 bed	
Storeys		3 storey	2 storey
No. of Units	Over 5,000 units	43 units	44 units
Project Economics			
Total funding received	$17,407,843	$580,800	$660,349
Average funding / unit	$3,121	$13,507	$15,008
Type of rent	RGI	RGI	RGI
Rent	$516/month	$500/month	Under $500/month
Tenants			
Tenant turnover	Very low	Low	Medium - High
Tenants pay utilities	Yes	Yes	Yes

Source: Interview data, CRHC Manager of Property Assets, November, 2011; Interview data, CHC Executive Director, May 2012; CMHC, 2012

Types of Completed Retrofits

The Capital Region Housing Corporation has utilized *CEAP Renovation and Retrofit* funding to complete the following work at various sites in Edmonton[33] (CRHC, 2012):

- Kitchen cabinet replacement in over 150 units,
- Furnace replacement in over 150 units,
- Flooring replacement in over 800 units,
- Re-roofing, and
- Upgrading attic insulation to approximately 3,500 units.

The choice to use the funding across the portfolio was strategic, prompted by the need to provide building envelope improvements as well as retrofits of mechanical systems. Preference was given to measures aligned with the general lifecycle needs replacement, rather than those targeting energy savings. The work resulted in substantial improvement in terms of safety, quality and standard in half of the units across the portfolio. Close to 7% of the funds were set aside as a reserve for future investment. There are plans to monitor energy savings in one apartment building to identify financial return on investment, but there is no long-term planning for energy efficiency due to the lack of guaranteed funding from provincial and federal governments as well as the high cost of implementing high-tech solutions (Interview data, Manager of Property Assets, November 2011). The CRHC did not carry out energy audits prior to commencement of renovation/retrofit work. Nevertheless, a target of a 20% reduction of energy consumption was set.

The Greater Edmonton Foundation for Seniors improved 1,606 units (96%) of its portfolio, implementing a range of renovations and retrofit measures (Interview data, Executive Director, May 2012). The renovations of some buildings, such as Porta Place (73 units) were focused on interior and HVAC upgrades, while in Virginia Park (140 units) and in Canora Gardens (98 units) the focus was on elevator modernization. Projects also included electrical and lighting upgrades, which did not amount to a considerable portion of the budget. Father Hannas Apartment building, which is profiled in Table 22, was a notable exception with a relatively comprehensive retrofit that included roof and window replacement as well as lighting upgrades. In general, the Greater Edmonton Foundation had to make tough investment decisions. Its housing portfolio consists of buildings that are 30 years old. Management states that they need an additional $10 million to address all issues. Despite the tight frame for program implementation, there was sufficient time to plan, tender and complete the retrofit work. Nevertheless, there were scheduling and construction challenges, and an extension of the time period to cover two consecutive summer seasons would have made implementation much more feasible (interview data, Executive Director, May 2012).

Table 23 provides an overview of the types of retrofits completed in the case studies with some indication of costs per component, depending on data availability.

[33] Window replacement was undertaken on one site: Tipaskan I (CRHC, 2012).

TABLE 23 Retrofits Completed: Edmonton			
Retrofits Completed	**Capital Region Housing Corporation**	**Father Hannas Apartment Building (% of total investment)**	**Synergen Housing Cooperative**
Window / Door Replacement	□	33%	□
Heating System	□		□
Roof Work	□	34%	
Interior Modernization	□	4%	
Flooring	□	13%	
Lighting / Electrical		4%	□
Other	□	12%	□
Total Investment	$17,407,843	$580,800	$660,349

Source: Interview data, CRHC Manager of Property Assets, November 2011; Interview data, Executive Director, May 2012; CMHC, 2012

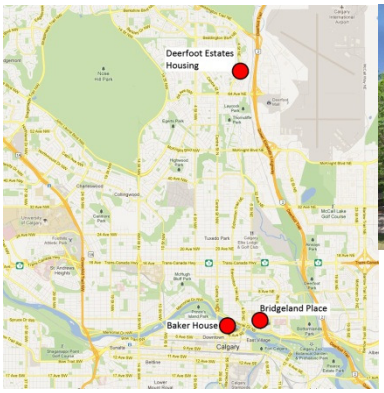
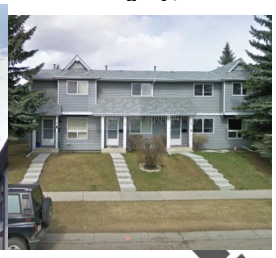
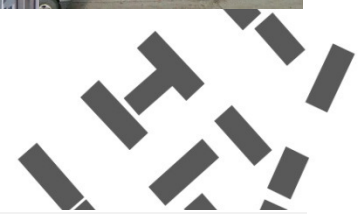
4.6 CALGARY CASE STUDIES OVERVIEW

Three case studies in Calgary illustrate program results. Two of the development projects were implemented by CHC, supported through CEAP provincially administered funds, and one of the developments is a housing cooperative supported through CMHC administered program funds. Table 24 highlights key characteristics of the housing development, data on project economics and types of retrofits implemented.

Types of Retrofits Completed

The case studies illustrate an emphasis on renovating major building components: doors and windows, heating systems, hot water tanks and air handling systems. Other improvements included new kitchen and bathroom facilities, elevators, and safety features. Energy efficiency measures were not explicitly targeted, although the renovation of building and service components will reduce heating costs and energy consumption. Table 25 summarizes the retrofits completed in the three case studies. In Baker House, the first priority was window and door replacement, followed by interior modernization (elevator, kitchen and laundry refurbishment) and access for the disabled (Interview data, Project Manager, April 2012). The window replacement recycled existing bronze metal window frames while replacing the glass panels as a cost reduction measure. Funds used for interior modernization were also considerable due to elevator replacement, comprising 20% of total funds. The high rise building houses low income tenants, and the current revenue does not allow for the accumulation of sufficient reserve funds to carry out much-needed life cycle replacement of building envelope elements and service systems. Other renovations are still needed, despite major improvements resulting from CEAP grant funds. Tenants do not pay for heating costs, which are included in the rent, and even if individual controls are installed in the units to regulate room temperature, there is no real incentive to use them (Interview data, Project Manager, April 2012).[34]

[34] The baseboard radiators were controlled via a dial on the fins. Several floods resulted when water pipes burst.

TABLE 24 Case Study Profiles: Calgary			
Housing Provider	**Calgary Housing Company**	**Calgary Housing Company**	**Deerfoot Estates Housing Co-op**
Project Name	**Baker House**	**Bridgeland Place**	**Deerfoot Estates Housing Co-op**
Location / Address	230 – 5th Ave SE, Calgary, AB	736 McDougall Ct NE, Calgary, AB	47 HunterhornGardens, Calgary, AB
			 
Building footprints			
Project Type & Characteristics			
Year of Construction	1971	1971	
Building Type	High rise apartment Apartment	High rise apartment & townhouse	Townhouses
Bedrooms	173 bachelor, 39 1-bed, 1 2-bed	75 1-bed, 135 2-bed	2, 3, 4-bed*
Storeys	16 storey	18 storey	2 storey
No. of Units	213 units	210 units	72 units
Total Area	120,319 sq. ft.	188,583 sq. ft.	76,536 sq.ft.
Project Economics			
Total funding received	$1,987,120	$1,147,352	$211,628
Average funding / unit	$9,329	$5,464	$2,939
Type of rent	RGI	RGI	No subsidy
Rent	$500/month	$500/month	$865-$928/month
Tenants			
Tenant turnover	Very low	Low	Low
Tenants pay utilities	No	No	Yes

Source: Interview data, CHC Portfolio Manager, April 2012; Interview data, Coop coordinator, October 2012
*Information available at: http://www.sacha-coop.ca/PDFs/Co-ops/DeerfootEstates.pdf

TABLE 25 Retrofits Completed: Calgary			
Retrofits Completed	**Baker House (% of total investment)**	**Bridgeland Place (% of total investment)**	**Deerfoot Estates Housing Cooperative**
Window / Door Replacement	35%	71%	

Heating System	14%	19%	100%
Interior Modernization	34%		
Flooring	5%	6%	
Landscaping	7%	3%	
Lighting / Electrical		1%	
Other	5%		
Total Investment	$1,987,120	$1,147,352	$211,628

Source: Interview data, CHC Portfolio Manager, April 2012; Interview data, Coop Co-ordinator, October 2012

In Bridgeland Place, another high rise project in CHC portfolio housing families and seniors, window and door replacement absorbed almost three-quarters of the budget, followed by upgrades to the heating system (boiler, radiator fins, and valves) that absorbed 19% of the budget.

The third case study was a non-profit housing cooperative, the Deerfoot Estates, whose overall strategy was to replace inefficient furnaces in all units, and to replace the hot water tanks in 66 of those units. Digital thermostats were also installed. These measures reduced the energy bill by 50% (Interview data, Co-ordinator, October 2012). The federal funding allowed the cooperative to proceed with comprehensive energy retrofits, as the cost of one furnace was $2,179 and that of a hot water tank was $695. Additional fees were incurred to handle issues related to program management, including fund disbursement by CMHC, and issues with contractors (Interview data, Co-ordinator, October 2012).

4.7 CEAP RENOVATION AND ENERGY RETROFIT PROGRAM RESULTS

Federal-Provincial Cost-matched Projects

CEAP funds were invested to improve the building envelope, mechanical and electrical systems of the social housing stock in Alberta, as well as to enhance its quality through interior modernisation, safety and accessibility measures. The program supported 747 projects that impacted over 20,827 units, which is over 80% of the social housing in the province.

TABLE 26 CEAP Renovation/Retrofit Spending by Category In Alberta

Category	Funding ($million)	Percentage of Total
Window / Door Replacement	$16.72	20%
Heating Systems	$6.08	7%
Roof Work	$8.55	10%
Interior Modernization	$12.05	14%
Flooring	$6.67	8%
Landscaping	$1.66	2%
Lighting/Electrical	$2.30	3%
*Other	$30.83	36%
Total Spending	$84.86	100%

*Other includes elevator modernization, plumbing, pavement and sidewalk upgrades, along with exterior upgrades.
Source: Ministry of Housing & Urban Affairs, Interview Data, Senior Program manager, November 2012

Although the HMBs made different choices depending on capital needs and servicing requirements across their portfolio, most of the CEAP funding was allocated for window/door replacement (20%), followed by interior modernization (14%) and roof work (10%). Heating and lighting system upgrades target specific energy efficiency measures, accounting for 10% of the total CEAP budget. Return on investment from energy savings did not seem to be a decisive factor in retrofit choice. The decisions were driven by the need to improve building envelope and service systems and to ensure better quality housing through a range of renovation measures. What generally characterizes the case studies profiled in Edmonton and Calgary is the improvement of the building condition and interior space for tenants in such a way that tenants 'feel' the difference. Thus, less emphasis was placed on energy efficiency retrofits while the achievement of other program objectives were a priority, such as general renovations and improvements in safety and quality of social housing. Some of these measures, such as replacement of windows, roofs and insulation, no doubt have had an impact on energy consumption and have reduced energy costs. The CEAP funding was timely in that it allowed the HMBs to replace building and servicing components in their aging building stock that had reached, or were very close to reaching, the end of their life-cycle.

Despite the challenging time frame for completing retrofit work, large HMBs were in an advantageous position compared to smaller cooperatives and non-profit organizations in terms of their institutional capacity to administer funds, and therefore account for the largest share of program funding.

Federally Funded Projects

TABLE 27 Type Of Retrofits Supported Through CMHC Funds

Type of Retrofit Work	No. of projects	No. of units	No. of beds
Window /Door Replacement	54	888	45
Heating System	36	811	61
Roof Work	26	433	30
Interior Modernization	12	430	--
Flooring	5	65	8
Landscaping	2	24	--
Lighting	1	19	--
Other	19	448	24
Total*	155	3,118	168

* Totals in this table are not net totals due to overlap of projects or units undertaking several types of retrofit work.
Source: Interview data, CMHC Senior Partnership consultant, April 2012

A total of 2,043 cooperative and non-profit housing units in Alberta were retrofitted in year one (62% in Calgary; 34% in Edmonton), while 1,275 units (61% in Calgary; 28% in Edmonton) and 152 beds (75% in Edmonton) benefited from renovations in year two. Half of the cooperatives in Alberta have received funding. Nine cooperatives received $1.3 million in funding in year one, of which 65% went to three coops in Edmonton and one coop in Calgary. Of the $2.2 million funding in year two, 90% went to nine coops in

Edmonton and five coops in Calgary.[35] The retrofits focused on window and door replacement, followed by upgrades to the heating system and roofs (see Table 27). These are capital intensive measures, and given the rent revenue constraints in the social housing sector, it is not surprising that providers selected to finance these with grant funds.

Heating system upgrades constituted a shared retrofit category for cooperatives and non-profits that undertook roof, window replacement, or interior modernization. However, some projects exclusively undertook interior modernizations (e.g. renovating kitchen cabinets and countertops). In general, energy audits were not performed and/or required. For some cooperatives without a strong management capacity, participation in the program was not straightforward as it required a great deal of volunteer time to comply with program guidelines and requirements. CMHC staff in the Prairie Office worked extensively with non-profit and coop organisations to assist with project submissions, alignment of priorities and to increase the success rate of applicants, which is evidenced in the allocation of funds in the second year of the CEAP program (Interview data, Senior Program manager, April 2012). For small cooperatives, the planning, application and approval process took over two years while the actual renovation work was performed in a shorter period of time (interview data, Co-ordinator, October 2012).

4.8 CONCLUSION

The objective of this chapter was to delineate the major categories of retrofit upgrades chosen by different social housing providers, and to evaluate the impact of the CEAP in upgrading the social housing stock in Alberta, particularly in Edmonton and Calgary. Considerable qualitative upgrades to the housing stock were realised due to the funding administered by the province and CMHC. Undertaking major upgrades was beyond the financial capacity of public, non-profit and cooperative housing providers and would not have materialised or would have been deferred if CEAP grant funding was not available. The retrofit upgrades have enhanced the quality of the social housing sector, and in some cases have resulted in significant energy savings. Both programs were administered efficiently using existing institutional structures at the central and provincial level, leaving a fair amount of autonomy to the HMBs to decide on the types of retrofits and renovation measures needed.

Despite some diversity, both programs document that investment in window/door replacement, roofs and heating/mechanical systems was a preferred choice, perhaps due to the capital intensive nature of these measures. In most of the projects, rents are geared to income and there is a limited capacity to fund such improvements through general rent revenue or reserve fund accumulation. The largest HMBs in the province accounted for the largest share of program funds, but took a very different approach to project implementation. CRHC in Edmonton selected several measures and invested

[35] Information on the total number of co-operatives in Edmonton and Calgary was retrieved from http://www.chfcanada.coop/eng/pages2007/about_3a.asp?Prov=AB

across all projects within their portfolio, while CHC in Calgary opted for more comprehensive investment and improvements in selected buildings. Without specific data, it is difficult to say which is better or more strategic, but in both cases energy efficiency was not a priority.

Some of the challenges faced by social housing providers within the retrofit programs relate to tight deadlines for program management and administration, which given the sometimes unpredictable nature of construction work has led to program extensions and reallocation of funds for other types of measures. The reason behind the unofficial prolongation of the two-year period of the program is mainly due to the time needed for tendering and contracting retrofit work, as the delays result from permit applications and building inspection processes (Interview data, Program supervisor, August 2012). Some of the smaller HMBs reportedly faced capacity constraints and difficulties in the management of construction work, contracts, and even qualifying for program funds due to complex guidelines and procedures.

CHAPTER 5 RETROFITS FOR THE FUTURE: LESSONS FROM AFFORDABLE HOUSING AND ENERGY EFFICIENCY PROGRAMS IN CANADA

5.1 INTRODUCTION

Recognizing the potential impact of energy savings in housing, this report reviewed the effect of new federal and provincial initiatives on energy efficiency retrofits in the social housing sector. The comparative analysis focused on the experiences of three provinces in Canada—BC, Ontario and Alberta—to highlight the diversity of approaches, program achievements and challenges in program implementation. Highlights from twelve case studies of best practices in the four largest cities, where the program was administered, highlight a range of investment strategies deployed by public, non-profit and cooperative housing providers. The social housing sector is targeted as a field of policy intervention, where socially responsible and very professional housing providers have the potential to capitalize on government funding to leverage further investment in energy efficiency retrofits as well as to showcase the results of transformative change. The research points to several interrelated opportunities. First, an energy efficient social housing stock will contribute to the larger objective of mitigating climate changes resulting from GHG emissions. Second, in regard to the low-income families and social tenants, an energy efficient social dwelling will reduce utility costs and thus shield them from energy poverty. Third, because energy efficiency activities have the potential for creating jobs in the local economy with spill over economic effects on local businesses, suppliers and service providers. Finally, energy retrofits and better housing conditions in social housing will have a positive impact on the well-being of tenants and thus reduce their dependence on other social services and support.

The research documents challenges in the implementation process as well as profiles innovative responses that tend to be efficient in economic and environmental terms. Similar approaches have been used in the European Union and the United States to pilot test the mix of regulatory, fiscal and financial measures designed to promote energy efficiency implementation (Brophy et al, 2010). Such policy reforms recognize the growing importance of energy efficiency retrofits in environmental terms, but also the economic and social benefits of green job creation, lower housing costs, improved housing quality, health and community well-being (Stephenson et al, 2010). While the emphasis in this review is on the social housing sector, this first systematic assessment has the potential to offer important insights into policy responses that might benefit the residential sector as a whole. As the number of successful projects grows, green and affordable housing could be seen as a proven, cost-effective approach to creating healthy, vibrant communities. These significant advances in implementation, due in large part to public sector leadership, could signal an emerging transformation in housing and energy policy through federal and provincial commitment. The engagement of government agencies and social housing institutions is critical for the continued success in the implementation process.

5.2 PROGRAM SUCCESSES

Canada's Economic Action Plan (CEAP) has provided a major opportunity for the implementation of a comprehensive package of retrofits and improvements in the social housing sector. The two programs—managed by the provinces and by the Canada Mortgage and Housing Corporation (CMHC)—provided $972 and $95 million of public funding in BC, Ontario and Alberta from 2009-2012. **In terms of efficiency**, the investment was critical in addressing the lack of resources to fund capital repairs and system upgrades in the aging social housing stock. The programs were highly relevant, timely and successful in meeting their broad objectives, and account for improvements in about 20% to 50% of the social housing in BC, Ontario and Alberta. CEAP provided grant funds for a variety of mechanical, structural and building envelope retrofits affecting two thirds of the social housing in Toronto, Calgary and Edmonton. The impact, in terms of units upgraded, was particularly significant for the non-profit and cooperative housing providers, which saw on average over 60% of their portfolio affected by program measures.

Box 2 *Greenbrook Sustainability Project, Surrey, British Columbia*

Built in 1974, Greenbrook is a public housing development owned and operated by BC Housing, consisting of 127 units in 28 townhouses that are home to 380 people. The Greenbrook sustainability project combined both building envelope replacement and energy upgrades to achieve significant energy savings and physical improvements. The use of high efficiency heating and electrical systems reduced GHG emissions by 86% in 2010 compared to the baseline recorded in 2005. The project boasts the largest residential solar panel installation in Western Canada which offsets about 10% of the site-used electricity and a large portion of the remaining energy consumption, resulting in a housing complex that is very close to being carbon neutral.

Source: Tsenkova, S.; Youssef, K., 2012

Part of the success is attributed to the efficient management of the programs by existing federal, provincial and municipal housing institutions. The institutional framework for rapid deployment of program funds (centralized in BC versus decentralized in Ontario)

left the service providers sufficient autonomy to address priority needs. Large social housing providers in Vancouver, Toronto, Calgary and Edmonton, due to their institutional capacity, were able to address in a more comprehensive manner both energy efficiency and capital improvement needs in their social housing portfolio. A more robust policy framework for energy efficiency retrofits in BC and Ontario—incorporating a range of regulatory, fiscal and institutional policy instruments—positively influenced portfolio investment strategies. In Alberta, less emphasis was placed on energy efficiency retrofits for the benefit of general renovations of the social housing stock, safety improvements and enhanced accessibility for persons with disabilities. By contrast, BC Housing developed a business model where energy efficiency was systematically pursued through partnering of CEAP capital projects with provincial sustainability initiatives (e.g. *Public Sector Energy Conservation Agreement and BC LiveSmart),* while in Ontario housing providers leveraged funding from the *Renewable Energy Initiative* and other utility managed programs to maximize the reduction in energy use and GHG emissions in the social housing sector. Such examples are profiled in Box 2 and Box 3.

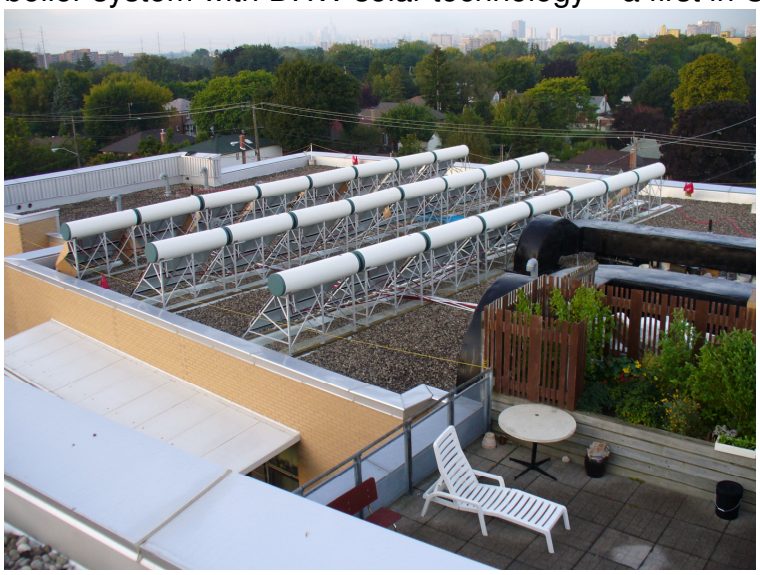
The effectiveness of CEAP programs is difficult to evaluate in the absence of a systematic monitoring and post-retrofit evaluation system. Nevertheless, evidence from twelve case study projects in the four cities under review demonstrates substantial improvements in the quality of social housing, targeted approaches to retrofits, integrating both mechanical and building envelope measures, and high potential for energy savings (20% to 45%). Notwithstanding the emphasis on 'best practices' in the analysis, it is evident that the programs have prompted a more strategic approach to asset management and energy retrofits by major public, non-profit and cooperative housing providers. Another critical success factor was institutional innovation in BC using energy service companies (ESCOs). While the ESCO model was more expensive than the project manager/contract services model, there were value-added components including economies of scale, the 'one stop shop' approach and enhanced accountability for planning, financing and monitoring projects.

The CMHC managed program targeted federal housing coops. Staff at the federal level worked hard to overcome the constraints of a decentralized model of social housing providers to ensure that program benefits were available to all. Efforts included assistance with project submissions, and monitoring of spending and site inspections to ensure consistency between planned and actual program measures. Some of the most popular retrofits, in addition to lighting—'the low hanging fruit'—were roofing, window replacement, cladding/insulation and mechanical system upgrades (boilers). Energy efficiency retrofits were supported, but this was not necessarily a priority. The cooperatives were able to address the tension between short-term affordability goals and the long-term viability of their housing stock using program funds, thus developing much-needed experience with strategic planning.

Box 3 Wilmar Court Non-profit Seniors Residence, Scarborough, Ontario

Built in 1974, Wilmar Court is a joint venture between Wilmar Heights United Church Non-Profit Homes Inc. and the City of Toronto Shelter, Support & Housing. It has 72 units of RGI and market mix housing for seniors.

The residence is managed through an integrated approach to conservation and sustainable development. All initiatives are reviewed as a three-step process. Step one introduces specific education programs to residents (marketing brochures, information packages and orientation training) to alter behaviours and assist in the effective implementation, reduction and/or conservation initiatives. Step two examines the existing equipment and facility and ensures that maintenance programs and repairs have the systems running to manufacturer's specifications. Step three introduces enhanced technologies to work in conjunction with retrofitted equipment or as a replacement for the equipment. Solar thermal technology for supplemental domestic hot water (DHW) has been introduced to reduce the natural gas consumption as well as a boiler system with DHW solar technology – a first in Canada for retrofits.



The results indicate savings of natural gas used for water heating of 40%, a 15% reduction in both the total gas consumption (70,000 m^3) and gas billing per year, and a reduction of 20.4 tonnes of CO_2 emission per year. Solar thermal collectors with evacuated tube technology, despite their higher heat conversion efficiency, have limited implementation due to high capital costs. Subsidies of up to 50% ensure a simple ROI (return-on-investment) of 11.5% and average payback period of 9.7 years. Half of the subsidies are provided through a federal "ecoENERGY for Renewable Heat" program, matched by the Ontario government.

In 2010, Wilmar Court was among the 27 finalists for the Green Toronto Award in Energy Conservation as well as recipient of the Ontario Non-Profit Going Green Award.

Source: Tsenkova, S.; Youssef, K., 2012

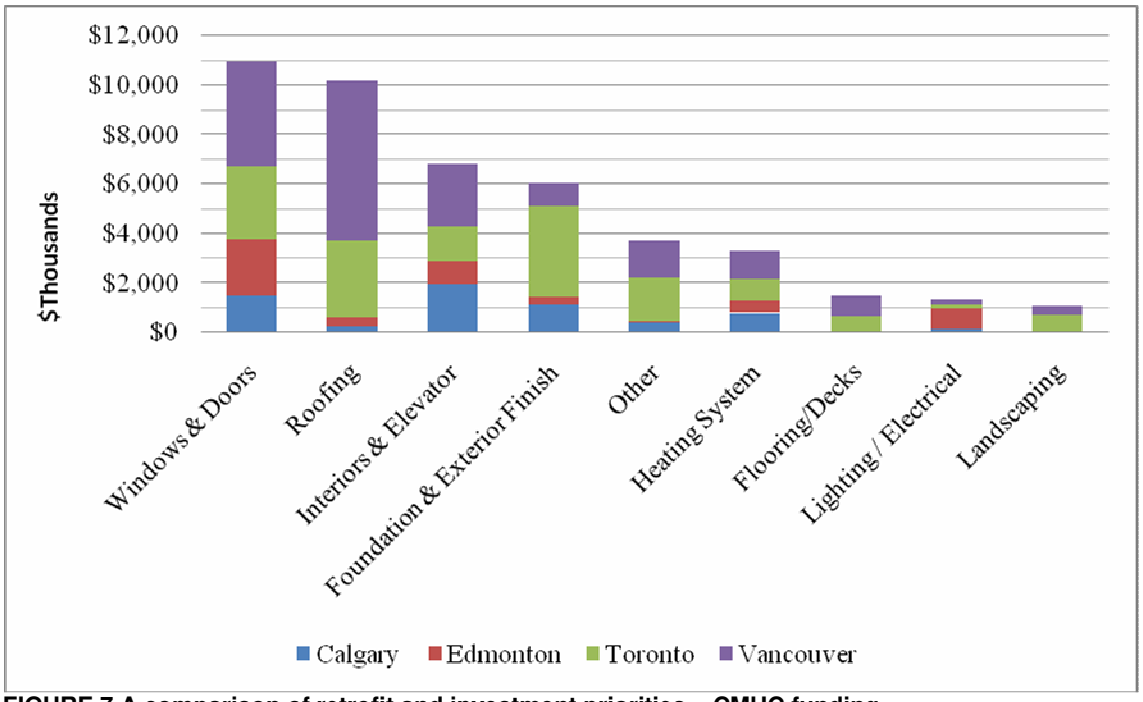


FIGURE 7 A comparison of retrofit and investment priorities – CMHC funding.
Source: Interview data, CMHC Program Director, August 2012.

Figure 7 profiles the allocation of funds from the CMHC administered program to federal housing cooperatives in the four cities under review. The data illustrates the investment priorities and choices made by a variety of housing organisations measured by the cost of major retrofits. Window and door replacement consumed a considerable portion of the budget in the four cities ($11 million). In Edmonton this accounted for 43% of the total spending and for 29% of the total spending in Calgary. Roof replacement was the second most important type of retrofit ($9 million), and was particularly significant in Vancouver and Toronto. Other major categories of retrofits—interior upgrades and foundation work/exterior cladding/insulation—accounted for $7 million and $6 million. The first was important for cooperatives and non-profits in Calgary and Vancouver, while the second was critical for social providers in Toronto.

Regardless of the overall success of the programs, the funding only temporarily addresses the lack of resources available to maintain the social housing stock. A longer term and consistent funding model needs to be developed to ensure the sustainability of results achieved. Rent reforms and other approaches to secure long-term funding and more effective asset management practices will be needed, in addition to strong political motivation to improve the quality and the energy efficiency of the sector.

5.3 PROGRAM CHALLENGES

Program challenges were associated with tight timelines and difficulties in coordinating and planning strategic retrofits. Although the projects supported through CEAP were deemed ‘shovel ready’, housing providers and building managers had to operate within a two-year timeframe. Unexpected building envelope problems were frequently

reported, resulting in cost overruns, project delays and potential loss of funding if projects were not implemented on time.

The tight deadlines for program management and administration, which given the sometimes unpredictable nature of construction work, have led to program extensions and reallocation of funds for other types of measures. The reason behind the unofficial prolongation of the two-year period of the program is mainly due to the time needed for tendering and contracting retrofit work, as the delays resulted from permit applications and building inspection processes. Some of the smaller social housing organisations reportedly faced capacity constraints and difficulties in the management of construction work, contracts, and even qualifying for program funds due to complex guidelines and procedures.

One of the greatest challenges was the high cost of the program and the lack of sustainability in funding. In more comprehensive improvement and energy efficiency projects, such as those in the case studies, simple payback periods are anywhere between 39 to 67 years. Even though the financial viability and cost-benefit of these programs were not the main objectives, they highlight future economic challenges if programs need to be operated on a cost recovery principle. *Limited market penetration of energy efficiency in social housing is constrained by lack of access to capital, high risk and split incentives* (Haney et al., 2010; Jollands et al., 2010). Social housing providers face significant challenges accessing standard loans and mortgages based on cash flow and general rent revenue, making investments in energy efficient components much more challenging, given their high upfront costs, lengthy payback period and uncertainty in energy pricing. Rents in the social housing sector are often set as a percentage of household income, inclusive of utilities, so tenants do not have a direct incentive to reduce their energy consumption. While social housing providers are interested in investing in energy efficient mechanical systems, tenants often object to such measures as they create temporary inconvenience during the implementation period. Such split incentives, in addition to general behavioural failures and reluctance on behalf of consumers to adopt an energy responsible behaviour, hinder the adoption of energy efficiency measures (Moezzi 2009).

Furthermore, for a number of social housing providers, particularly in Alberta, energy efficiency was a low priority relative to other portfolio considerations. This is also true for a number of small community-based social housing organisations (non-profits and cooperatives) in BC and Ontario which lack the institutional capacity to comprehensively plan for energy efficient retrofits due to limited, asymmetric information and other structural barriers. The physical condition of the social housing portfolio and the lack of adequate reserves to address capital needs significantly affected the implementation of the programs. *The tradeoff between energy efficient retrofits and the replacement of deteriorated mechanical and building envelope components was a major challenge of the programs*, particularly the component administered by the CMHC. Sometimes there was not enough funding to do both.

The specific retrofit measures in the case studies are diverse and illustrate the significant challenges of such programs in economic terms. *If the simple payback of*

energy efficiency measures is used as an overall consideration for return on investment, it will be difficult to make the case for green retrofits in the social housing sector. Feasibility studies, however, point to significant environmental benefits resulting from reduced energy and water consumption, and reduced GHG emissions. Some of these metrics of performance, as well as the social impact measured in tenant satisfaction and improved health and wellbeing, are difficult to quantify and there has been a very limited attempt to introduce a system to monitor and evaluate achieved results, even on a pilot basis.

While the greening of social housing has many benefits, the installation of green technologies is a strain on capital reserves. CEAP and REI have provided an important financial boost to experimentation with sustainable design and green technologies such as solar walls/roofs and green roofs, but there are significant market barriers for effective implementation.

5.4. KEY RECOMMENDATIONS

There is substantial literature identifying barriers to energy efficiency retrofits and the appropriate policy responses to overcoming these barriers (Haney et al. 2010; Moezzi 2009). A major distinction is made between regulatory, fiscal and financial policy instruments to address market barriers and market failures, both of which contribute to explaining the energy efficiency gap (International Energy Agency 2007). Energy efficiency investments are often irreversible with a fair amount of uncertainty about both the benefits and energy savings of new technology. Accordingly, customers and investors show a high degree of risk aversion in their decision-making resulting in maintaining the status quo and resistance to change (Farsi 2010). Added to the irreversibility and uncertainty in investment returns is the preference to select measures that offer a short payback over other strategic options that may have better advantages over the long-term (Jackson 2010). A successful strategy that promotes energy efficiency retrofits is one that combines “sticks” (regulations) with “carrots” (incentives) and “tambourines” (awareness raising campaigns) (Kaufman and Palmer, 2011; Tsenkova, 2003).

Financial incentives fall into two broad categories: investment subsidies and soft loans. Such subsidies aim at reducing the investment cost of retrofits and shorten payback time, thus allowing social housing providers to overcome one of the main market barriers / failures to energy efficiency investment: access to capital. The most common measure to overcome this barrier is through soft loans, or by third-party financing via ESCOs energy service companies that are reimbursed by energy savings made, or special purpose funds, revolving funds, credit lines and loan guarantees (Sarkar and Singh 2010). **Fiscal incentives** include measures to reduce the annual income tax paid by providers who invest in energy efficiency renovations, such as accelerated depreciation, tax credits and tax deductions, tax reduction when purchasing energy efficient equipment or when investing to improve energy efficiency in buildings (e.g. GST exemption). Such incentives are considered less costly for public budget. Preference for economic instruments (subsidies and taxes) over command-and-control

instruments (e.g. performance standards) has been made in the literature with respect to innovation in energy efficiency and contribution to environmental policy goals (Noailly and Batrakova 2010). Complementary to the above policy instruments is the **category of information, capacity-building programs and educational measures.** Information programs typically provide information about potential energy savings or examples of energy savings in order to increase awareness and motivation for energy efficiency investments (Kikuchi et al, 2009). Capacity-building programs usually take the form of training programs and 'energy retrofits' counselling.

Although it is beyond the scope of this research project to formulate comprehensive recommendations to enhance the potential of energy efficiency retrofits in social housing, the following key recommendations should be considered:

1. The federal and provincial governments need to secure funding for the continuation of CEAP programs with well-defined program targets that link general quality improvements in the social housing sector to energy efficiency retrofits. It is important to continue to address the funding gap in the sector, as well as to provide a more structured policy framework for energy efficiency in order to avoid the negative effect of 'start-and-stop' programs. The program needs to provide a long term sustainable source of funding with clear quantitative targets for energy efficiency improvement and metrics of performance.

2. Provincial governments, in partnership with financial institutions, need to identify a suite of economic incentives such as soft loans, low cost secondary mortgages, credit lines and loan guarantees to allow leveraging of additional funds for renewal and energy efficiency retrofits by social housing providers. These will be different across provinces depending on provincial priorities, acceptance by the housing finance market and the diverse institutional landscape of social housing providers across Canada. The issues are particularly critical for small social housing providers in the non-profit and cooperative sector that do not have the capacity to raise funds for critical upgrades, nor the institutional expertise to deal with complex retrofit programming and budgeting operations.

3. Provincial governments, in partnership with the largest social housing providers, need to provide systematic training and capacity building to improve the governance and decision-making around capital planning projects. The large investment opportunity in the last three years increased accountability and fostered new practices in the housing sector (e.g. ESCOs) as well as documented the value added approach of strategic packaging of retrofit measures. Managing large capital projects raised the credibility of the sector and its capacity to deliver successful retrofit programs. Small non-profit and cooperative housing providers would benefit from the accumulated experience in managing and executing retrofit programs in the future.

4. Federal and provincial governments, in partnership with the largest social housing providers, need to disseminate evidence from ex-post evaluation of select best practices to overcome capacity and information constraints in the sector. They should

develop effective training programs for tenants based on social marketing that has the potential of triggering energy responsive behaviour, reducing consumption by 20% and addressing split incentives. It is important to move beyond the present delivery mechanisms in the form of 'one-way' assistance to a model that includes tenants and low income households as local program agents.

5. Federal and provincial government agencies need to commit to monitoring and evaluating CEAP programs. Comprehensive reports and studies are needed to evaluate the success and failures of the programs as well as the outputs, results achieved and actions implemented. These are non-existent and there is even less information on the impacts in terms of costs and energy savings. This may be explained by evaluation difficulties specific to 'low income' programs such as obstacles for data collection, lack of official data, and specific program targets and monitoring requirements. Such post-retrofit evaluations of the recent experience in the social housing sector would be useful as a guide in promoting successful and reliable retrofit strategies for the rest of the residential sector.

REFERENCES

CHAPTER 1

Beerepoot, M. (2007). *Energy Policy Instruments and Technical Change in the Residential Building Sector*. Amsterdam: IOS Press.

Brandsen, T., van de Donk, W and Putters, K. (2005). Griffins or Chameleons? Hybridity as a Permanent and Inevitable Characteristic of the Third Sector. *International Journal of Public Administration* 28 (9/10), 749–765.

Canada Mortgage and Housing Corporation (CMHC). (2008) Analysis of Renewable Energy Potential in the Residential Sector. *Technical Series*. Ottawa: CMHC.

Canada Mortgage and Housing Corporation (CMHC). (2008). Analysis of Renewable Energy Potential in the Residential Sector. *Technical Series*. Ottawa: CMHC.

Canada Mortgage and Housing Corporation (CMHC). (2010). *CHS - Public Funds and National Housing Act (Social Housing) 2009.* Ottawa: Canada Mortgage and Housing Corporation.

Canada Mortgage and Housing Corporation (CMHC). (2012). *CEAP- Renovation and Retrofit Projects.* Ottawa: Canada Mortgage and Housing Corporation. Retrieved November 12, 2012 from http://www.cmhc.ca/housingactionplan/reresoho/lipr.cfm.

Ditch, J., Lewis, A., and Wilcox, S. (2001). *Social Housing, Tenure and Housing Allowance: An International Review.* New York: Department of Works and Pensions.

Dreier, P., and Hulchanski, J. D. (1993). The Role of Nonprofit Housing in Canada and the United States: Some Comparisons. *Housing Policy Debate* 4, 43-80.

Energy Efficiency Working Group. (2008). Energy Efficiency in Canada: Final Report: Energy Sector Sustainability Table. Ottawa: Government of Canada.

Engelund, K. and Wittchen, K. (2008). *European National Strategies to Move Towards Very Low Energy Buildings*. Hørsholm: Aalborg University, Danish Building Research Institute.

Environment Canada. (1994). *Canada's National Report on Climate Change*. Ottawa, Ontario.

Federation of Canadian Municipalities (FCM). (2008). *Sustaining the Momentum: Recommendations for a National Action Plan on Housing and Homelessness*. Ottawa: Federation of Canadian Municipalities.

Fuller, M. (2009). *Enabling Investments in Energy Efficiency; a study of energy efficiency programs that reduce first-cost barriers in the residential sector*. Berkeley: University of California, California Institute for Energy and Environment.

Foshay, E. (2008). *Economic Outcomes of The Apollo Economic Recovery Act*. Retrieved from Appollo Alliance: Clean Energy & Good Jobs: http://apolloalliance.org/data-points-nap/data-points-economic-outcomes-of-the-apollo-economic-recovery-act/

Gruis, V. and Nieboer, N. (eds.). (2004). *Asset Management in the Social Rented Sector: Policy and Practice in Europe and Australia*. Dordrecht: Kluwer Academic Publishers.

Gruis, V., Tsenkova, S. and Nieboer, N. (eds.). (2009). *Management of Privatised Housing: International Perspectives*. Chichester: Wiley-Blackwell.

Hamilton, B. *et al.* (2010). *A Comparison of Energy Efficiency Programmes for Existing Homes in Eleven Countries*. Burlington: Vermont Energy Investment Corporation.

Hulchanski, D. J. (2004). What Factors Shape Canadian Housing Policy? The Intergovernmental Role in Canada's Housing System. In R. Young & C. Leuprecht (eds.). *Canada: The State of the Federation 2004: Municipal-Federal-Provincial*

Relations in Canada. Montreal & Kingston. London. Ithaca: McGill-Queen University Press.
International Energy Agency (IEA). (2008). *Worldwide Trends in Energy Use and Efficiency: Key Insights from IEA Indicator Analysis*. Paris: International Energy Agency.
International Energy Agency (IEA). (2010). *Energy Policies of IEA Countries - Canada 2009 Review*. Paris: International Energy Agency.
Itard, L. and Klunder, G. (2007). Comparing Environmental Impacts of Renovated Housing Stock with New Construction. *Building Research & Information* 35 (3), 252-267.
Kickert, W., Klijn, E. and Koppenjan, J. (eds.). (1997). *Managing Complex Networks; Strategies for the Public Sector*. London: Sage Publications.
Leone, R., & Carroll, B. W. (2010). Decentralisation and Devolution in Canadian Social Housing Policy. *Environment and Planning C: Government and Policy 28*, 389-404.
Mlecnik, E., Visscher, H., and van Hal, A. (2010), Barriers and Opportunities for Labels for Highly Energy-Efficient Houses. *Energy Policy* 38 (8), 4592-4603.
Natural Resources Canada. (2006) *The State of Energy Efficiency in Canada*. Ottawa: Natural Resources Canada.
Office of Energy Efficiency. (2009). *Energy Efficiency Trends in Canada 1990-2007*. Ottawa: Natural Resources Canada.
Pearson, S. N. (2010). *Financing Capital Improvements and Renovation of Soical Housing in Ontario.* Ontario: Social Housing Services Corporation.
Pitt, M. (2007). *Linking Social Housing and Energy Efficiency*. Ottawa, ON: Social Housing Services Corporation.
Schüle, R. (2009). *Energy Efficiency Watch; Final Report on the Evaluation of National Energy Efficiency Action Plans.* Berlin: Wuppertal Institute.
Steele, M. (2007). Canadian Housing Allowances. In P. A. Kemp (Ed.), *Housing Allowances in Comparative Perspective*. Bristol: The Policy Press, University of Bristol.
Thibert, J. (2007). *Inclusion and Social Housing Practice in Canadian Cities: Following the Path from Good Intentions to Sustainable Projects.* Ottawa: Social Housing Services Corporation.
Tsenkova, S. (2011) *Investing in Social Housing: Lessons from Ex Post Evaluations of CEB Programmes.* Paris: Council of Europe Development Bank
Tsenkova, S. (2006) *Ex-Post Evaluation of Social Housing Programs in Finland*, Paris: Council of Europe Bank.
Van Bortel, G. and Elsinga, M. (2007). A Network Perspective on the Organization of Social Housing in the Netherlands: the Case of Urban Renewal in The Hague. *Housing, Theory and Society* 24 (1), 32-48.
Van Bortel, G. and Mullins, D. (2009). Critical Perspectives on Network Governance in Urban Regeneration, Community Involvement and Integration. *Journal of Housing and the Built Environment* 24 (2), 203-219.
Wellesley Institute. (2008). *Universal Periodic Review (Canada) – Statistical Annex*. Toronto: Wellesley Institute Report.
Wellesley Institute. (2010). *Precarious Housing in Canada*. Toronto: Wellesley Institute Report.

CHAPTER 2

Arman, M., Zuo, J., Wilson, L., Zillante, G. & Pullen, S. (2009).Challenges of responding to sustainability with implications for affordable housing. *Ecological Economics, 68*, 3034-3041.
BC Housing. (n.d.). Feasibility Study Report: Culloden Court. *Energy Management Contract.* Internal Document. Vancouver: BC Housing.

BC Housing. (n.d.). Feasibility Study Report: Grant MacNeil Place. *Energy Management Contract.* Internal Document. Vancouver: BC Housing.

BC Housing. (2009). Comprehensive Feasibility Study: Ted Kuhn Towers. *Energy Management Contract.* Internal Document. Vancouver: BC Housing.

BC Housing. (2010). *Canada - British Columbia Affordable Housing Agreement*. Retrieved February 3, 2012 from http://www.bchousing.org/aboutus/agreements/CANBC.

BC Housing. (2010b). *Housing Renovation Partnership.* Retrieved February 3, 2012 from *www.bchousing.org/.../Fact_sheets/BCH-Factsheet-HRP-Renovations.*

BC Housing. (2012). *BCH and ESCO: Implementing the Energy Service Companies (ESCO) Briefing Notes.* Draft Internal Document. Vancouver: BC Housing.

Canadian Home Builders' Association. (2011). *Energy Use and Greenhouse Gas Emission Performance in Canadian Homes Since 1990: 1990 - 2008 Update.* Ottawa: Canadian Home Builders' Association.

CHFC. (2010). *Co-operative Housing Federation of Canada. News Brief, 2010, v. 18 n. 2*. Retrieved February 2, 2012 from http://www.chfcanada.coop/eng/pages2007/news_3.asp.

City Green Solutions. (2010). *Strategic Energy Management Plan: Engaging the Non-Profit Housing Sector in Energy Management*. Internal report. Vancouver: City Green Solutions.

Canada Mortgage and Housing Corporation (CMHC). (2001). Healthy High-Rise: A Guide to Innovation in the Design and Construction of High-Rise Residential Buildings. *Enhancing Energy Performance*. Retrieved March 20, 2012 from http://www.cmhc-schl.gc.ca/en/inpr/bude/himu/hehi/index.cfm.

Canada Mortgage and Housing Corporation (CMHC). (2009). *Renovation and Retrofit of Existing Social Housing: Provincially/Territorially Administered Renovation and Retrofit of Existing Social Housing Initiative.* Retrieved November 30 from http://www.cmhc.ca/housingactionplan/reresoho/lipr.cfm.

Canada Mortgage and Housing Corporation (CMHC). (2010). *Application Guidelines: Renovation and Retrofit of Existing Social Housing Administered by CMHC.* Retrieved November 30 from http://www.cmhc.ca/housingactionplan/reresoho/index.cfm.

Fuller, M. (2009). *Enabling Investments in Energy Efficiency; a study of energy efficiency programs that reduce first-cost barriers in the residential sector*. Berkeley: University of California, California Institute for Energy and Environment.

Hulchanski, D. J. (2004). What Factors Shape Canadian Housing Policy? The Intergovernmental Role in Canada's Housing System. In R. Young & C. Leuprecht (Eds.), *Canada: The State of the Federation 2004: Municipal-Federal-Provincial Relations in Canada*. Montreal & Kingston. London. Ithaca: McGill-Queen University Press.

Government of British Columbia. (2007). *BILL 44 — 2007GREENHOUSE GAS REDUCTION TARGETS ACT.* Retrieved March 20, 2012 from http://www.leg.bc.ca/38th3rd/1st_read/gov44-1.htm.

Government of British Columbia. (2009). Press Release. *B.C., CANADA PARTNER TO RENEW SOCIAL HOUSING***.** October 14, 2009. Retrieved March 5, 2012 from http://www2.news.gov.bc.ca/news_releases_2009-2013/2009PREM0050-000481.htm.

Lepri, D. (2009). Monthly Update Newsletter for C.A.M. Group: Energy Service Company Reducing the Greenhouse Gas Emission of the Public Housing Stock. *CAM Times,* May 2009.

Tsenkova, S. and Cliff, Ch. (2012). *Beyond Energy Efficiency: Investing in Social Housing in Vancouver.* Paper presented at the ENHR Conference, Lillehammer, Norway, June 23-26.

Tsenkova, S. and Youssef, K. (2012). Canada. Energy efficiency retrofits: policy solutions for sustainable social housing. In Tsenkova, S.; Niebor, N.; Gruis, V.; van Hal, J. (eds.) (2012) *Energy Efficiency in Housing Management: Policies and Practice in Eleven Countries.* London: Routledge.

U.S. Department of Energy. (2008). *Energy Intensity Indicators in the U.S.: Efficiency vs. intensity*. Retrieved March 20, 2012 from http://www1.eere.energy.gov/ba/pba/intensityindicators/efficiency_intensity.html.
U.S. Department of Housing and Urban Development (HUD). (2011). *Evidence Matters: Transforming Knowledge into Housing and Community Development Policy. Quantifying Energy Efficiency in Multifamily Rental Housing.* Retrieved April 8, 2012 from http://www.huduser.org/portal/periodicals/em/summer11/index.html.

CHAPTER 3

Ameresco Canada Inc. (2009). *Toronto Community Housing Corporation: Building energy renewal program investment grade feasibility study for High Park Quebec Development*. Toronto, ON: Ameresco Canada Inc.
Association of Municipalities Ontario. (2012). *Energy conservation should be first priority,* Retrieved October 11, 2012 from http://www.amo.on.ca/wcm/AMO/AMO_/AMOAdvocacy.aspx?issue=Energy
Canada Mortgage and Housing Corporation (CMHC). (2012). *Canada's Economic Action Plan: Renovation and retrofit of existing social housing*. Retrieved from http://www.cmhc.ca/housingactionplan/reresoho/lipr.cfm
City of Toronto. (2001). *Social housing transfer plan*. Toronto: City of Toronto Administration.

City of Toronto, Shelter, Support and Housing Administration. (2007). *Tied in knots: Unlocking the potential of social housing communities in Toronto*. Retrieved from http://www.toronto.ca/legdocs/mmis/2007/cd/bgrd/backgroundfile-8980.pdf
City of Toronto, Shelter, Support and Housing Administration. (2009a). *Economic stimulus funding investments in social housing renovation and retrofit.* Retrieved from http://www.toronto.ca/legdocs/mmis/2009/cc/bgrd/backgroundfile-21365.pdf
City of Toronto, Shelter, Support and Housing Administration. (2009b). *Update on the social housing renovation and retrofit program*. Retrieved from http://www.toronto.ca/legdocs/mmis/2009/cd/bgrd/backgroundfile-24902.pdf
City of Toronto, Shelter, Support and Housing Administration. (2010a). *Social housing renovation and retrofit program. – allocation of year two funds*. Retrieved from http://www.toronto.ca/legdocs/mmis/2010/cd/bgrd/backgroundfile-26593.pdf
City of Toronto, Shelter, Support and Housing Administration. (2010b). *In year budget adjustment for economic stimulus renewable energy investments in social housing: shelter, support and housing administration.* Retrieved from http://www.toronto.ca/legdocs/mmis/2010/ex/bgrd/backgroundfile-33034.pdf
City of Toronto, Social Housing Unit. (2011). *Toronto social housing by the numbers.* Retrieved from http://www.toronto.ca/housing/social_housing/pdf/shbynumbers.pdf
City of Toronto. (2012). *Social Housing Unit*. Retrieved from http://www.toronto.ca/housing/social_housing/index.htm
Finn Projects (Synchronicity Projects Inc.). (2009a). *Building energy audit for Broadview Housing Co-operative: 1050 Broadview Ave.* Toronto, ON: Finn Projects.
Finn Projects (Synchronicity Projects Inc.). (2009b). *Building energy audit for Villa Otthon – Lambton: 40062 Old Dundas St. W.* Toronto, ON: Finn Projects.
Ministry of Municipal Affairs and Housing. (2009). *Canada-Ontario affordable housing initiative: social housing renovation and retrofit program (SHRRP)*. Retrieved from http://www.mah.gov.on.ca/AssetFactory.aspx?did=6867
Toronto Community Housing. (2012a). *42 Hubbard Boulevard*. Retrieved from http://www.torontohousing.ca/market_rent_buildings/southeast_toronto/hubbard_42

Toronto Community Housing. (2012b). *42 Hubbard Boulevard.* Retrieved from http://www.torontohousing.ca/investing_buildings/42_hubbard_blvd

Tsenkova, S. & Clieff, C. (2012). *Retrofitting BC Social Housing for Energy Efficiency: A review of policy and practice in Vancouver*. University of Calgary, Faculty of Environmental Design.

Tsenkova, S. & Youssef, K. (2011). *Green and affordable housing in Canada: Investment strategies of social housing.* University of Calgary, Faculty of Environmental Design.

CHAPTER 4

Alberta (2011). *Budget 2011.* Retrieved May 2012 from: http://alberta.ca/acn/201102/2995902%20BudgetSummarybyMinistry_Budget2011%20-%20Final.pdf

Alberta Energy Efficiency Alliance (2010). *Alberta Energy Efficiency Act – Discussion Paper*. Retrieved November 2012 from: http://www.aeea.ca/pdf/EE%20Act%20Discussion%20Paper%20-%20AEEA%20-%20Final%20-%20Jan%202010.pdf

Alberta Urban Municipalities Association [AUMA] (2012). Retrieved November 2012 from:http://www.auma.ca/live/MuniLink/Communications/Member+Notices?contentId=15244

Canada Mortgage and Housing Corporation [CMHC] (2009). News Releases – June 25. *Canada-Alberta Agreement Boost Affordable Housing Funding.* Retrieved July 2011 from: http://www.cmhc.ca/en/corp/nero/nere/2009/2009-06-25-1230.cfm

Canada Mortgage and Housing Corporation [CMHC] (2010). *Application Guidelines: Renovation and Retrofit of Existing Social Housing Administered by CMHC*. Ottawa: CMHC

Canada Mortgage and Housing Corporation [CMHC] (2011). *Canadian Housing Observer 2011*. Ottawa: CMHC

Canada Mortgage and Housing Corporation [CMHC] (2012). *Success Stories.* Retrieved October 2012 from:http://www.cmhc.ca/en/inpr/afhoce/sust/sust_114.cfm. Ottawa: CMHC

Capital Region Housing Corporation [CRHC] (2012). CEAP Renovation and Retrofit. Retrieved May 2012 from:http://www.crhc.ab.ca/project-development/ceap-renovation-and-retrofit.aspx

City of Calgary (2011). *2011 Survey of Non-Market Rental Housing in Calgary*. Revised September 18, 2012. Retrieved November 2012 from: http://www.calgary.ca/CSPS/CNS/Pages/Social-research-policy-and-resources/2011-Survey-of-Non-Market-Rental-Housing-in-Calgary.aspx

Co-operative Housing Federation of Canada [CHF] (Fall 2010). *News Brief*. National Edition, 18 (2). Retrieved July 2012 fromhttp://www.chfcanada.coop/eng/pdf/NB/NB2010-11.pdf

Ministry of Housing and Urban Affairs [MHUA] (2011). *Annual Report 2010-2011*. Retrieved May 2012 from:http://housing.alberta.ca/documents/2010_11_HUA_annualreport.pdf. Edmonton: MHUA

Office of the Auditor General of Ontario. *Annual Report 2009.* Retrived May 2012 from http://www.auditor.on.ca/en/reports_en/en09/312en09.pdf

CHAPTER 5

Brophy, H; Jamasb, H; Platchkov, L; Pollitt, M. (2010). Demand-side Management Strategies and the Residential Sector: Lessons from International Experience. In *EPRG Working*

Paper 1034; Cambridge Working Paper in Economics 1060: Electricity Policy Research Group, Cambridge:University of Cambridge.

Farsi, M. (2010). "Risk aversion and willingness to pay for energy efficient systems in rental apartments." *Energy Policy* no. 38 (6):3078-3088.

International Energy Agency (2007). Mind the Gap: Quantifying Principal-Agent Problems in Energy Efficiency: Paris: OECD Publishing.

Jackson, J. (2010) "Promoting energy efficiency investments with risk management decision tools." *Energy Policy* no. 38 (8):3865-3873.

Jollands, N.; Waide, P.; Ellis, M.; Onoda, T,; Laustsen, J; Tanaka, K.; Serclaes, Ph.; Barnsley, I.; Bradley, R.; Meier, A. (2010) "The 25 IEA energy efficiency policy recommendations to the G8 Gleneagles Plan of Action." *Energy Policy* no. 38 (11):6409-6418.

Haney, A; Jamasb, T.; Platchkov, L.; Pollitt, M. (20100 Demand-side Management Strategies and the Residential Sector: Lessons from International Experience. In *EPRG Working Paper 1034; Cambridge Working Paper in Economics 1060*: Electricity Policy Research Group, Cambridge: University of Cambridge.

Kaufman, N. Palmer, K. (2011) "Energy efficiency program evaluations: opportunities for learning and inputs to incentive mechanisms." *Energy Efficiency*:1-26.

Kikuchi, E.; Bristow, D.; Kennedy, Ch. (2009) "Evaluation of region-specific residential energy systems for GHG reductions: Case studies in Canadian cities." *Energy Policy* no. 37 (4):1257-1266.

Moezzi, M. (2009) Behavioral Assumptions in Energy Efficiency Potential Studies. California: California Institute for Energy and Environment CIEE.

Noailly, J. and Batrakova, S. (2010) "Stimulating energy-efficient innovations in the Dutch building sector: Empirical evidence from patent counts and policy lessons." *Energy Policy* no. 38 (12):7803-7817

Sarkar, A. and Singh, J. (2010) "Financing energy efficiency in developing countries--lessons learned and remaining challenges." *Energy Policy* no. 38 (10):5560-5571.

Stephenson, J.; Barton, B.; Carrington, G.; Gnoth, D.; Lawson, R.; Thorsnes, P. (2010). Energy cultures: A framework for understanding energy behaviours. *Energy Policy,* 38 (10), 6120-6129.

Tsenkova, S. (2003) Housing Policy Matters: The Reform Path in Central and Eastern Europe: Policy Convergence? In Tsenkova, S. and S. Lowe (eds.) *Housing Change in Central and Eastern Europe.* Aldershot: Ashgate Publishing Limited, pp.193-205.

Tsenkova, S. (2009) *Housing Reforms in Post-socialist Europe. Lost In Transition*. Heidelberg: Springer-Verlag.

Tsenkova, S.; Youssef, K. (2012). Canada: Energy efficiency retrofits – policy solutions for sustainable social housing in N. Nieber, S. Tsenkova & Gruis, V. van Hal, (eds). *Energy Efficiency in Housing Management.* London: Routledge; pp.209-231