UNIVERSITY OF CALGARY

# An Energy Reduction Program for New and Existing Alberta Residential High-rise Buildings

by

Angela Mah

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## Abstract

The residential sector is the third largest energy consuming sector after the industrial and transportation sectors in Alberta. The residential sector is dominated by single family housing, but residential high-rise buildings are becoming an increasingly important necessity or choice of housing for many Albertans. Despite increasing energy prices, and concerns regarding the environmental impact of increased use of conventional energy, consumers and the building industry have been slow to adopt cost-effective energy reduction measures. The inertia is a result of market risks and barriers. The solution is to intervene in the market for energy reducing goods and services to eliminate or reduce the risks and barriers with market transformation programs. A case-based design study using comparative analysis on two well recognized North American multifamily programs, employing market transformation strategies, was conducted to aid in the design of an energy reduction program for Alberta residential high-rise buildings.

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## Dedication

This work is dedicated to my husband and father.

To my husband who made personal sacrifices, supported my decisions, and provided me encouragement to complete this work and pursue my passions.

To my father, who is battling with his health and has taught me the value of perseverance and dedication to one's work.

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## List of Symbols, Abbreviations, Nomenclature

**American Council for an Energy-Efficient Economy (ACEEE)**

**Alternative energy** – includes waste heat recovery, combined heat and power, district energy, wind, active and passive solar, geoexchange, geothermal, tidal, and biomass.

**Apartment with less than five storeys** – a dwelling unit attached to other dwelling units or other non-residential space in a building that has fewer than five storeys (Statistics Canada, 2009).

**Apartments –** defined by Natural Resources Canada (2010), apartments include dwellings in apartment blocks or hotels; flats in duplexes or triplexes; suites in converted houses; living quarters above or in rear of business premises; caretaker's quarters; and private quarters for employees in hospitals or other types of institutions.

**Building owners** – include developer-owners, building owners, condo or co-operative owners and their representatives.

**Canada Mortgage and Housing Corporation (CMHC)**

**Comprehensive Residential Information System (CRIS)**

**Energy conservation measure (ECM)** – is energy conservation through behaviour and technologies such as programmable thermostats.

**Energy efficiency and alternative energy (EEAE)**

**Energy efficiency and conservation measures (EECMs)** – include energy efficiency and conservation technologies and practices.

**Energy reduction** - refers to reductions in conventional fossil fuel use by way of energy efficiency, conservation, and alternative technologies and practices.

**Energy reduction measures (ERMs)** – include energy efficiency, conservation, and alternative energy technologies and practices.

**Energy reduction initiatives** – a series of acts or strategies intended to address energy reduction in the market.

**End users** – include developer-owners, building owners, condominium or co-operative boards, building managers, tenants, and unit owners in reference to multifamily housing.

**Energy service provider (partner, energy management firm)** – provides services such as auditing, project management, and expertise on energy efficiency, conservation and alternative energy measures.

**Greenhouse gas (ghg)**

**Heating, ventilation, and air conditioning (HVAC)**

**High-rise** – a structural building with five or more storeys.

**Intervention** – a deliberate act or strategy by program administrators to reduce or eliminate risks and barriers associated with the market for energy reducing goods and services, thereby increasing the adoption of energy reduction measures.

**Market actors** – include those involved in the transactions of energy reducing goods and services.

**Multifamily Building Performance (MBP)**

**Multifamily Performance Program (MPP)**

**Multi-unit residential building (MURB)**

**Natural Resources Canada (NRCan)**

**New York Energy $mart$^{SM}$ (NYE$)**

**New York State Energy Research and Development Authority (NYSERDA)**

**Program associates** – include those contracted to work on program implementation, quality control and quality assurance, evaluation, and/or advisement.

**Public Service Commission (PSC)**

**Single-detached house** - A single dwelling not attached to any other dwelling or structure (except its own garage or shed). A single-detached house has open space on all sides, and has no dwellings either above it or below it (Statistics Canada, 2009).

**Toronto Atmospheric Fund (TAF)**

**TowerWise Energy Education Action Committee (TEEAC)**

**TowerWise Program (TWP)**

# Chapter One: Introduction

Chapter One contains three sections discussing the purpose and significance of the research, overview of my position and the research objectives, and the organization of the report.

## 1.1 Purpose and Significance of Research

Canadian residences use approximately 17% of the total energy consumed for residential, commercial/institutional, industrial, transportation, and agricultural purposes (Natural Resources Canada [NRCan], 2010). The residential sector has climbed from 1282 Petajoules (PJ) in 1990 to 1465 PJ in 2008, a 14% increase associated with an 8% increase in greenhouse gas emissions and a 33% increase in the number of households (NRCan, 2010). Although the energy intensity per household is decreasing, energy consumption and greenhouse gas emissions in Canada's residential sector continues to increase and those working in the residential building industry and consumers have been slow to adopt energy efficiency, conservation, and alternative energy technologies and practices[1] at levels shown to have cost-effective energy savings. Market failures and barriers contribute to the less than optimal adoption of energy reduction measures and a solution has been to intervene in the market for energy reduction measures through various energy policies and programs (Brown, 2001; Brown, Levine, Short and Koomey, 2001; Ürge-Vorsatz, Harvey, Mirasgedis and Levine, 2007a; Ürge-Vorsatz, Koeppel and Mirasgedis, 2007b).

In Canada multiple levels of government, utilities, organizations, institutions and non-profit agencies oversee energy efficiency and alternative energy (EEAE) programs for new construction and retrofitting single family and multi-unit residential buildings (NRCan, 2009a). Typical programs try to increase

[1] Energy efficiency, conservation, and alternative energy technologies and practices will be referenced as energy reduction measures.

market uptake in energy reduction measures by providing services (e.g., information, education and awareness, technical assistance, products, training, software) to end users[2] and/or providing financial incentives (e.g., rebates, grants, loans, subsidies, tax credits) to end users, and influencing policies (e.g., building codes, standards, regulations, labelling). A large majority of these programs are almost entirely focused on single-family residences as they are over 50% of Canada's housing stock (NRCan, 2009a and 2010; Statistics Canada, 2006). Approximately 9% of residences are apartments with five or more storeys (residential high-rises) and are the third most common form of structural dwelling in Canada after single-detached housing (55%) and apartments with less than five storeys (18%) (Statistics Canada, 2006). High-rise apartment dwellings are an increasingly important housing necessity or choice for many Canadians, as more cities promote smart growth. Energy reduction measures are needed in residential high-rises as high-rise apartment dwellings consume more energy than single family homes on a per unit floor area basis even though apartment dwellings have much less exposed exterior surfaces (Canada Mortgage and Housing Corporation [CMHC], 2001a). Apartment dwellings consume three times more energy per unit of floor area when compared to leading edge Advanced House standards[3] for energy consumption (CMHC, 2001a). More importantly, much of the building stock that exists today will exist fifty years from now and continue to consume energy at current rates if nothing is done.

The majority of Canadian high-rise dwellings are found in the major urban centres of Ontario, Quebec, British Columbia, and Alberta (Statistics

[2] End users are home owners (single family) or developer-owners, building owners, condominum or co-operative boards, building managers, tenants, unit owners (multifamily).

[3] "Natural Resources Canada launched the Advanced Houses Program in the early nineties to help develop and test innovative methods of reducing energy consumption, provide better indoor environments, and reduce the environmental impact of houses" (Charron, 2009). Houses built to the Advance House standards use half the energy of R2000 homes (i.e., 14,000 kWh average yearly energy consumption), (Charron, 2009).

Canada, 2006), but very few energy reduction programs for residential high-rises exist in Canada. Having programs for residential high-rises are important as they are a means to increasing the uptake and enabling long-term adoption of energy reduction measures through interventions in the market place and ultimately addressing matters concerning:

1) Unrealized potential energy savings and reducing greenhouse gas emissions in a growing residential high-rise sector;
2) Challenges associated with energy performance in residential high-rises;
3) Affordable living conditions for renters, a group that often reside in residential high-rises and can least afford to pay for escalating energy prices;
4) Minimizing the future costs of retrofitting residential high-rises;
5) Establishing energy profiles for benchmarking residential high-rises;
6) Transitioning to alternative energy sources in residential high-rises.

### 1.1.1 Unrealized Energy Savings

Modern buildings are often not built and commissioned with energy efficiency in mind and a significant amount of greenhouse gas emissions result from the construction, operation, and maintenance of buildings (Commission for Environmental Cooperation [CEC], 2008). There are however advanced technologies for buildings and significant opportunities to improve energy efficiency in buildings to mitigate greenhouse gas emissions (CEC, 2008; International Energy Agency [IEA], 2005; Ürge-Vorsatz et al., 2007a; Wiel, Martin, Levine, Price and Sathaye, 1998). Yet we fail to close the “energy efficiency gap” or realize potential energy savings resulting from the difference between what is actually invested in energy efficiency measures compared to a higher level of investment from a rational economic point of view (Brown, 2001; Charles, 2009; IEA, 2007; Lutzenhiser et al., 2009). Unrealized energy savings in residential high-rises have been documented in studies and have indicated

potential energy savings anywhere from 10% to 50% in Canada, 20% to 75% in the U.S., and 28% in Europe.[4] Findings from the study in Canada are summarized below.

In an energy mapping study done for the City of Calgary, the Canadian Urban Institute (2008) indicated that energy efficiency in residential high-rises can potentially be improved by 10% to 50% over the Model National Energy Code for Buildings (MNECB[5]) depending on new or retrofitted residential high-rises. This comprehensive study was done in response to how best to achieve Calgary's proposed greenhouse gas reduction target of 50% below 2005 levels[6] by 2050 through the use of energy efficiency in the built environment and alternative energy strategies and technologies modelled for the city. Details in the study indicate that for new residential high-rises (with more than 4 stories), 25% improved energy efficiency over the MNECB would require a balanced approach to building window to wall ratios, improved window performance, improved domestic hot water efficiency, and more efficiency in the HVAC systems. A 50% energy efficiency improvement over the MNECB would require an additional focus on the building envelope, and variable speed control and waste heat recovery on the mechanical systems (Canadian Urban Institute, 2008). As for the existing buildings, 10% improved energy efficiency over the MNECB could be obtained from improved lighting controls with 25% improved energy efficiency over the MNECB from additional heating upgrades and envelope air tightness upgrades (Canadian Urban Institute, 2008).

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[4] More information on the U.S. and European studies can be found in Brown and Wolfe (2007) and Guertler and Smith (2006), respectively.

[5]The 1997 MNECB is a Canadian national building code intended to help in the design of energy efficient buildings. The MNECB contains cost-effective minimum energy efficiency requirements in new buildings, additions and major rennovations that offer energy savings (e.g., improvements on building envelope, lighting, electrical power, and HVAC systems) (NRCan, 2009b).

[6] Proposed greenhouse gas target prior to a revised target of 80% below 2005 levels by 2050 documented in the Calgary Climate Change Accord October 8, 2009.

For a typical 10,000 $m^2$ residential high-rise using approximately $9.00/Gigajoules (GJ) natural gas and $0.10/kilowatt*hour (kwh) electricity, the economics show that a new building designed for 50% less energy than the MNECB at $22/$m^2$ incremental capital would result in a rate of return of 15% with 0% net energy inflation (versus Consumer Price Index) and a 5 year simple payback (Canadian Urban Institute, 2008). The energy savings would be 0.318 GJ/$m^2$/yr with a greenhouse gas reduction of 0.038 Tonnes/$m^2$/yr (Canadian Urban Institute, 2008).

With the same energy prices as stated above, a typical existing residential high-rise 10,000 $m^2$ retrofitted to 25% less energy use than the MNECB at $17/$m^2$ retrofit capital would realize a rate of return of 9% with 0% net energy inflation (versus Consumer Price Index) and a 6 year simple payback (Canadian Urban Institute, 2008). The energy savings would be 0.193 GJ/m2/yr with a greenhouse gas reduction of 0.0234 Tonnes/$m^2$/yr (Canadian Urban Institute, 2008).

What is illustrated by this study is that there are untapped potential energy savings to be had from implementing energy efficiency and conservation technologies in residential high-rises. However, many risks and barriers specific to the building sector (to be discussed in Chapter Two) impede the adoption of energy reduction measures, making policies and energy reduction programs necessary.

### 1.1.2 Challenges of Residential High-rise Buildings

Energy reduction measures in residential high-rises are not easy for developers and building owners to address without the proper assistance because of challenges associated with this building type. Residential high-rises are very different from single-family home construction and have specific building

codes and challenges. The challenges include: multiple thermal zones in heating or cooling based climates (IEA, 2008; Stein, Reynolds, Grondzik and Kwok, 2006); differences in centralized or modular heating, ventilation, and air conditioning systems tailored to the type of building and number of suites (Stein et al., 2006); building envelope design; high electrical demands for common spaces, lighting, elevator motors, pumps, and fans (CMHC, 2001a); and varied ownership structures and diversity of stakeholders involved (DeCicco et al., 1994).

Many residential high-rises have a number of different zones that are influenced by occupant activity (function), periods of occupancy or vacancy (scheduling), and exposure to daylight, sun, and wind (orientation) (Stein et al., 2006). Some high-rises not only have residential dwellings but can also have a combination of other spaces such as recreation rooms, exercise rooms, pool areas, meeting areas, lobbies, storage areas, underground parking, mechanical and electrical rooms, offices, and retail spaces. All of these spaces have differences in function and scheduling, and depending on the orientation of the building, differences in exposure to daylight, sun, and wind. Consequently the energy demands for these spaces will vary and the types of energy reduction measures implemented in a high-rise with multiple zones will require an understanding of the occupants and much more sophisticated building design and energy modelling and analysis techniques.

Heating, ventilation, and air conditioning (HVAC) systems for residential high-rises can also add complexity to building energy performance because they can either be centralized, localized, or a combination, depending on the original and intended design of the building. Centralized systems have the advantage of being easy to isolate from other zones and easy to access for maintenance and repair, but the disadvantage of a central system is that it can lead to inefficient

use of energy when it has to be activated as an entire system to serve one zone (Stein et al., 2006). Localized HVAC systems can accommodate multiple zones and scheduling issues more effectively, and require less sophisticated control systems (Stein et al., 2006). The disadvantages of localized HVAC systems are increased operation and maintenance as a result of separate systems and missed opportunities for centralized waste heat recovery (Stein et al., 2006). Then there could be a combination of HVAC systems in the form of centralized heating/cooling and local air distribution (Stein et al., 2006). Residential high-rises can have any number of different HVAC configurations at different locations. To complicate it further, they can also have varying fuels for heating such as fuel oil, natural gas, electricity, or alternative energy that determine the kinds of energy reduction measures that could be implemented. Additionally, it is critical to have the HVAC systems running properly for better energy efficiency. Many systems fail to perform satisfactorily because of problems related to the function of building envelope-related wind and stack effect induced airflow, or the sizing, control, installation, or maintenance of mechanical systems (CMHC, 2001a).

The design of the building envelope is critically important for the energy performance of a high-rise, where its basic components comprise of windows, doors, floors, walls, roofs, and foundations (CMHC, 2001b; Stein et al., 2006). The building envelope separates the interior of a building from the exterior and if poorly designed and constructed can result in not only increased energy costs, but occupant discomfort, indoor air quality issues, and deterioration of interior and exterior materials (CMHC, 2001a). According to the CMHC (2001a), poor performance is usually due to a lack of continuity of the air barrier system, inadequate thermal resistance of envelope components (i.e., the building code does not require much in way of insulation), thermal bridging to the exterior (locations that allow heat flow directly to the exterior), selection of materials and

components only based on low cost, and poor installation and quality control. For high-rises in Canada and especially in heating-based climatic areas where more energy is required, the greatest contributor to poor energy performance is because of heat losses through the windows, heat losses through unintended air leakage, insulation levels that only address health and safety issues as opposed to enhanced energy heating and cooling performance, and little focus on thermal bridging (CMHC, 2001a). Consequently, the need for professional services and more attention to proper building design.

High-rises can have very large electrical loads due to common area equipment and lighting, which ultimately impacts a building's energy performance. Common areas can include equipment such as elevator motors, pumps, fans, and security cameras, while lighting requirements may be needed in amenity rooms, offices, hallways, stairwells, vehicle parking areas, storage areas, garbage areas, and other common spaces. As a result, finding and installing the most energy efficient equipment and lighting and alternative energy technologies, in addition to adopting energy reducing practices will be required to improve the overall energy performance of the building.

Ownership structures vary in the residential high-rise sector leading to very different economic decision-making practices and choices regarding building energy reduction measures (ERMs). Ownership structures may involve small, corporate, or public building owners; developers that construct buildings to own and lease; developers that construct buildings to sell; condominium corporations with individual owners; co-operative housing where individuals own shares in the corporation that owns the building; and commercial and residential owners in mixed use buildings. These different ownership structures have people with differing values, motives and views on the purpose of the building. Consequently, the choices and decisions made about capital spending on energy performance

improvements in their new or existing buildings will differ. For example small, corporate or public building owners may or may not care to spend any capital on improving the energy performance of their buildings as energy costs can be passed on to their tenants, creating the misplaced incentive or split incentive[7] (DeCicco et al., 1994; IEA, 2007; Ürge-Vorsatz et al., 2007a and 2007b). Developers who build to sell the building may want to minimize their capital costs and would not necessarily spend extra capital for energy reducing technologies. By contrast, developers who build to own long term may be more inclined to spend the capital on energy performance improvements to reduce operating costs. Condominiums and co-operatives have quite involved decision-making processes with the majority of owners required to agree to the capital expenditures for energy reduction measures. The high-rise multi-unit residential sector is by no means homogenous and people's options, choices and decisions will vary.

In addition to the different ownership structures, residential high-rises can have many other stakeholders involved in a building energy reduction project. First there are the developers and end users (e.g., developer-owners, building owners, condominium or co-operative boards, building managers, tenants, unit owners). Second there are the professional services (e.g., architects, engineers, building scientists, design teams), suppliers and manufacturers, and construction or renovation trades required to carry out the work. Third there may be involvement by building/facility managers, building superintendents, janitorial staff, building maintenance contractors for a building's mechanical, electrical, and plumbing requirements, elevator maintenance contractors, and management corporations. Fourth there may be involvement by financial lenders, multiple EEAE program agencies, utility companies, government regulators, certification

[7] Misplaced incentives or split incentives occur when the participants have different goals or incentives in an economic transaction (IEA, 2007).

bodies, and legal counsel. All of the different relationships between these stakeholders make implementing energy reduction measures on residential high-rises much more involved, challenging and complicated when compared to the single family home.

### 1.1.3 Affordable Living for Renters

There are many renters living in Canadian high-rise dwellings. The four provinces with the most high-rise dwellings are Ontario, Quebec, British Columbia, and Alberta with the percentage of renters being approximately 75%, 78%, 58%, and 75%,[8] respectively. Both renters and owners of high-rise units are faced with escalating energy prices. However, according to a CMHC (2008) study done in conjunction with Statistics Canada on the dynamics of housing affordability, renters have lower median household incomes when compared to owners and have a higher probability of paying 30% or more of their household income for shelter.[9] As a result renters are a group that can least afford to pay for escalating energy prices and would benefit that much more from improved building energy performance. However, sector specific risks and barriers and the lack of focus on energy reduction measures in the residential high-rise sector in general has not allowed renters to reap the benefits.

### 1.1.4 Minimizing Future Costs, Establishing Baselines, Transition to Alternatives

Acting on residential high-rise energy efficiency and conservation measures through a program sooner rather than later will minimize future costs of retrofitting high-rises, help to obtain better information on energy profiles for

[8] 75% is an average for Alberta renters spread equally between Calgary and Edmonton high-rise dwellings, which account for 96% of the province's high-rise dwellings (Statistics Canada, 2006).
[9] According to the CMHC (2010a), housing is defined as not affordable if the cost of adequate shelter exceeds 30% of household income.

high-rises through building energy performance analysis, and help in the transition to alternative energy technologies.

Retrofitting high-rises is a much more costly venture than doing it right during initial construction, so it is important to start addressing energy reduction measures in new residential high-rise construction before the building is complete and becomes an existing building that requires retrofitting. Action on energy reduction measures for residential high-rises is especially important in a rapidly growing sector. Addressing energy performance in residential high-rises through an energy reduction program could also provide an opportunity to establish energy profiles or characterize the energy use of these types of buildings for use in benchmarking and understanding the potential of energy reduction measures. Finally, transitioning or switching to alternative technologies such as solar photovoltaics, solar heating, wind, and geoexchange, is best achieved by addressing energy efficiency and conservation measures in high-rise buildings to lower overall energy demand in the buildings before sizing and installing these types of alternative energy technologies.

### 1.1.5 Research Motivation and Question

For many Canadians, renting subsidized apartments is done out of economic necessity while owning a condominium is a personal choice made for reasons such as lifestyle, convenience and preference. The motivation for research on energy reduction in residential high-rises originates from experiential knowledge gained from serving on the board of directors and living and owning a condominium unit in a 15-storey high-rise in one of Alberta's largest urban centres (Calgary). Escalating condo fees are always on the minds of the owners with a particular interest in trying to reduce utility costs, which contribute to the fee escalation. The last annual energy bill (gas and electricity) amounted to approximately 40% of our total expenses for 141 units, not including residence

electricity that is individually metered and paid for by owners. It is a challenge for many condominium boards to find ways to reduce energy use to address rising energy prices. In trying to address energy reduction measures for our condominium, it soon became apparent that it would be very difficult to find the necessary information and resources to assist us. It has been difficult to determine how inefficient our building is compared to other residential high-rises, to find whom to contact to obtain information and assistance with energy reduction measures, to determine what energy reduction measures would be appropriate for our building, to find those that have the expertise to conduct an energy audit and implement the energy reduction measures, to determine all the possible benefits of energy reduction measures, to find out how much would it cost and where we would get the financing. Ultimately, it has been difficult to determine whom we could trust given the potentially large capital expenditure for energy savings that are not guaranteed. Finding the answers to all these questions is a very daunting task for any building owner, condominium corporation, or co-operative and can definitely stall the process of taking action. In order to begin to answer some of these questions, the task started with searching for assistance, which naturally led to searching for any kind of federal, provincial, or local program addressing energy efficiency, energy conservation, and alternative energy measures for the residential high-rise sector. What was found was a “void” as there are very few to no programs offered across Canada. Consequently the search widened to include leading North American Multifamily programs that assist building owners and their occupants in improving energy performance in their buildings. It was this “void” that led to the research question: How to design an energy reduction program for new and existing Alberta residential high-rise buildings?

## 1.2 Overview of Position and Research Objectives

Given all the challenges and personal dealings with residential high-rise living described in sections 1.1.2 and 1.1.5, it is not difficult to understand why the residential high-rise sector has been neglected by owners and builders. It is not easy addressing the residential high-rise sector and although energy efficiency and conservation measures have been shown to be cost effective, the market for them remains weak. Consequently, policies and programs are needed to intervene in the market and to help address the issues that prevent us from realizing the potential for more responsible energy management.

The objectives of the research are to:

1. Identify the risks and barriers that impede the adoption of energy reduction measures.
2. Identify program interventions, used to address the risks and barriers, from a literature review.
3. Review two North American energy reduction programs (precedent programs) recognized for successfully advancing energy reduction in multifamily housing. Evaluate the precedent program interventions according to the outputs (early indicators of success) and/or outcomes. Identify key features based on the evaluation.
4. Compare and contrast the precedent program approaches, interventions and key features.
5. Recommend a design for an energy reduction program for new and existing Alberta residential high-rise buildings (to be subsequently referenced throughout this report as the Alberta energy reduction program or energy reduction program for Alberta), which builds on the learning from the precedent programs.

## 1.3 Organization of the Report

The thesis is organized into eight chapters. This chapter explains the purpose and rationale for the research. Chapter Two explains the background of traditional energy efficiency programs, novel programming theory, and the guiding principles of program design. Chapter Three explains the overall research strategy, scope of the research, data collection methods, and research limitations. Chapters Four and Five detail the precedent programs and their approach to advancing the adoption of energy reduction measures in the multifamily sector. Chapter Six is a comparative analysis of the precedent programs describing the similarities and differences between them. Chapter Seven describes the Alberta context and what features from the precedent programs have been modified, adapted, and applied to an Alberta energy reduction program. The final chapter summarizes general recommendations, reflections on theory and methodology and any future research.

## Chapter Two: Theory and Relational Model

To design an energy reduction program for residential high-rises, it is necessary to understand the guiding principles of energy reduction program design. In this chapter, six program design topics and the guiding principles for each topic are discussed. The topics include the type of programming; stakeholders involved in programs; program administration; where to intervene; evaluation and research; and program impact. The chapter will conclude with a section discussing what theory does not reveal about novel programming.

### 2.1 Traditional Programming

To understand the origins of energy efficiency initiatives and programs in North America one has to look to the United States during the 1970's oil crisis when rising energy prices and concerns over energy security gave rise to active energy policy and initiatives. To address the crisis, efforts initially focused on a policy of energy conservation or reducing consumption (doing with less), but the focus gradually turned to state regulated least-cost utility planning and demand-side management or resource acquisition strategies (Blumstein, Goldman and Barbose, 2005; Blumstein, Goldstone and Lutzenhiser, 2000). These strategies involve increased use of energy efficient technologies as a low cost option of supply rather than building new high cost utility generation facilities (Blumstein et al., 2000; Eto, 1996; Gellings, 1996). In other words, saving energy is cheaper than building a facility to produce energy.

Electric utilities became the leading sponsors of demand-side management program strategies in many regions of the United States and Canada[10] (Nadel, 1992). Demand-side management programs operated by regulated utilities not only provided a low cost option of supply, but offered a

[10] Nadel (1992) indicated that: "In Canada, utilities in British Columbia and Ontario are particularly active."

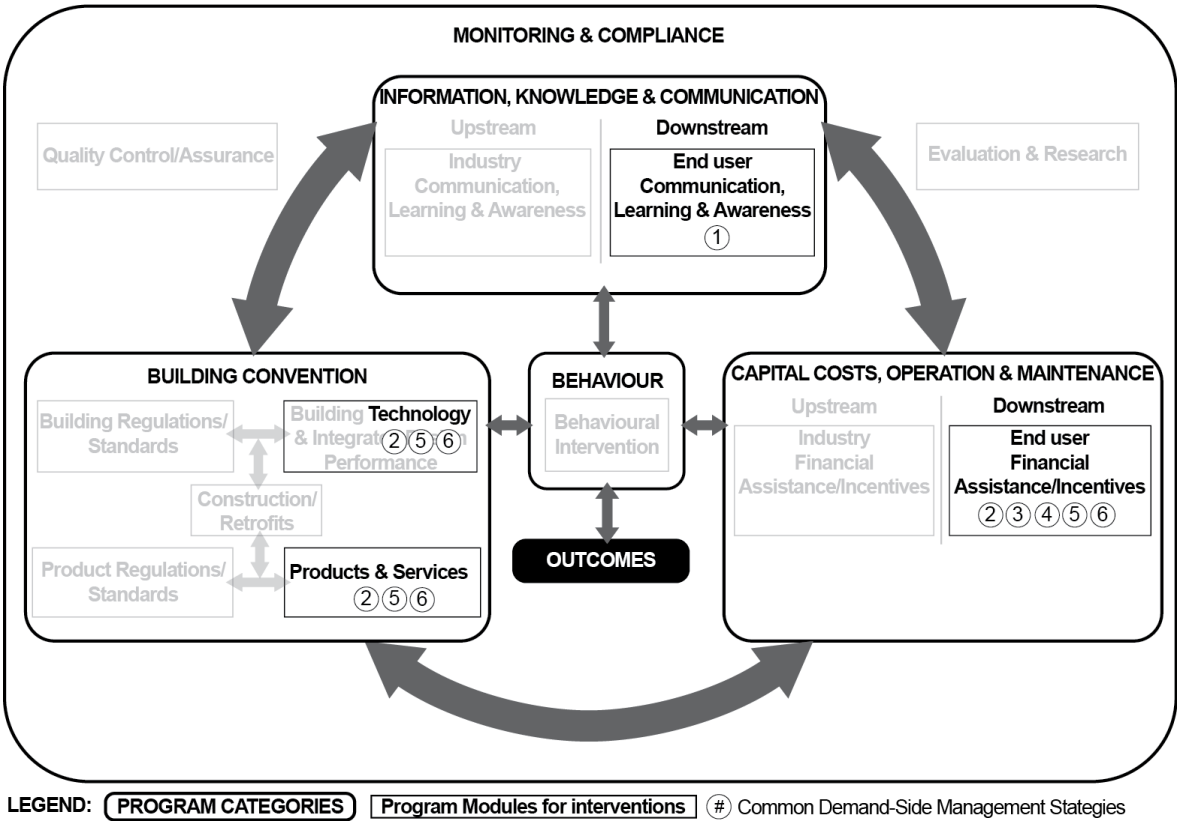
unique public-policy response to a perceived deficit in energy service markets, and from a customer's view point, a non-coercive way to promote energy efficiency (Eto, 1996). The most common categories of demand-side management program strategies documented by Eto (1996) and Nadel (1992) include:

1. Information programs involving educational brochures or energy audits to increase customer awareness, participation, and energy savings;
2. Rebate programs that offer a financial incentive for the purchase of efficient devices or technologies;
3. Zero interest loan programs offered by utilities for energy efficient technologies or conservation improvements;
4. Performance contracting programs that rely on energy service companies (ESCOs) to contract with the utility and customer to guarantee energy performance;
5. Comprehensive direct installation programs that provide audits, arrangements for direct installation of measures, financial assistance, and sometimes operation, maintenance and follow-up services;
6. Load management programs where utilities offer customer financial incentives in return for controlling the customer's use of certain energy consuming devices (e.g., air-conditioners, water-heater cycling) or whereby incentives or lower rates are offered to those customers who agree to reduce their demand during peak periods (e.g., interruptible rates, time-of-use rates, real-time pricing).

The demand-side management (DSM) program strategies employed tend to focus on consumer energy use and techno-economic fixes with more efficient devices/machines into both new and existing building designs and production processes (Blumstein et al., 2000). As Figure 2.1 shows, the traditional DSM programs listed above limit program interventions to information,

financial assistance or incentives, technologies, and products and services for the end user (energy consumer).

*Figure 2.1*. Demand-Side Management Program Model




In a review of DSM programs, Nadel (1992) found that the average program was far from achieving savings of 10% or more in the long term because of problems such as:

- an over-reliance on information, rebate and load management programs that have low participation rates and savings per customer;
- lack of long-term program planning and operation;
- lost opportunity measures at the time of new construction, renovation, and equipment replacement;

- lack of co-ordination between utility programs and government regulations and standards (e.g., building codes, efficiency standards);
- poor co-ordination between the different utilities;
- shortage of skilled labour and equipment;
- inadequate program evaluation;
- inattention to energy savings persistence; and
- regulatory processes that impede program implementation.

While traditional DSM programs have undoubtedly achieved energy savings in the era prior to deregulation and restructuring of the utility industry, they have failed to achieve the types of energy savings targets that are possible and needed.

Restructuring of the utility industry began in the mid 1990s with the belief that state-regulated utilities would not be necessary because market outcomes would be better than outcomes from plans developed by utilities and regulators (Blumstein et al., 2005). The expectation was that a competitive wholesale electricity market would provide the right balance of supply and demand (Blumstein et al., 2005). Restructuring weakened the rationale for DSM program or resource acquisition strategies and resulted in no one firm or organization responsible for assuring supply and no obligation on the part of utilities to provide energy efficiency programs in a competitive retail market (Blumstein et al., 2005; Eto, 1996). Utilities were no longer motivated or responsible to provide energy efficiency programs (i.e., as a low cost option for energy supply), however, Eto (1996) and Blumstein et al. (2005) indicated that restructuring did not eliminate the rationale for public policies to promote energy efficiency and address the environmental consequences or externalities of conventional energy generation. Consequently, public support for energy efficiency programs continued and what followed is a need to look to other program administrators (e.g., non-utilities, non-profits, government agencies) and a new program strategy referred to as “market

transformation" (Blumstein et al., 2005). Market transformation program strategies try to bring about lasting changes in the market for energy-consuming goods and services (Blumstein et al., 2005; Blumstein et al., 2000; Eto, Goldman, and Nadel, 1998; Keating, Goldstein, Eckman and Miller, 1998).

## 2.2 Novel Programming – Market Transformation Approach

Many of our current efforts in policy and programs aimed at increasing the adoption of energy reduction measures still largely rely upon traditional program strategies of technological innovation and economic analysis. Lutzenhiser et al. (2009) describes the physical-technical-economic model (PTEM) as an engineering view of the world with its energy efficiency potential that is foundational and deeply rooted in formal paradigms and models, and regulatory policy and practice for accountability and prudent expenditure. However, the problem with this model is that it does not help explain the workings of the market for energy reduction measures and the various interactions between the market players. After three decades of energy policies and programs, what still remains is the "energy efficiency gap" or unrealized potential energy savings discussed in Chapter One. What is the reason for the inertia? Brown (2001) points to flaws in the way that markets operate or market failures (e.g., misplaced incentives, distortionary fiscal and regulatory policies, unpriced costs, unpriced benefits, insufficient and inaccurate information), in addition to obstacles (e.g., low priority of energy issues, capital market barriers, incomplete markets for energy efficiency) that inhibit the adoption of energy efficiency measures that contribute to the "energy efficiency gap." Furthermore, many energy efficiency program initiatives have failed to understand and address what influences energy-use behaviour and choice (Stern, 2008). For instance, Lutzenhiser et al. (2009) indicates that the state of California, the US leader in

encouraging energy efficiency improvements in homes,[11] has slowed the rate of growth of residential energy demand and had large overall impacts with a number of energy efficiency interventions through modest incremental improvements in buildings and technologies. However, Lutzenhiser et al. (2009) indicate that to realize much larger net energy reductions requires a better understanding of consumer behaviour and technology choice to meet the state's ambitious greenhouse gas reduction targets. Consequently, what is needed is a novel approach to programming.

With competitive restructuring, the traditional energy efficiency program approaches lack the tools to address challenges in identifying targets, understanding the markets for energy reducing goods and services, and intervening in them (Blumstein et al., 2000). The approach that has evolved is one of "market transformation" which requires a broader understanding of the market and attention to the various interactions between participants on the supply and demand sides (Blumstein et al., 2000).

What does "market transformation" mean, and what does it involve? The literature describes market transformation (MT) and market transformation programs as follows:

- "[A]n MT program's benefits are lasting (in the sense of not requiring continuing intervention in the market) and the value of the program's benefits exceed its costs" (Blumstein et al., 2000, p. 137).
- "Market transformation programs are specifically designed to bring about *lasting* changes in energy-related decision making, by reducing or eliminating market barriers to efficient practices so that various market

[11] California was ranked first across the United States for encouraging its citizens to improve efficiency in their homes according to the American Council for an Energy-Efficient Economy (Molina et al., 2010).

actors have a self-interest in making efficient decisions" (Meyers, Hastie and Hu, 1997, p. 36).

- "Market transformation means a reduction in market barriers due to a market intervention, as evidenced by a set of market effects, that lasts after the intervention has been withdrawn, reduced or changed" (Eto, Prahl and Schlegel, 1996, p. xii).
- Market transformation is a process whereby energy-efficiency innovations are introduced into the marketplace and over time penetrate a large portion of the eligible market. Market transformation involves ongoing and lasting change, such that the market does not regress to lower levels of efficiency at some later time (Geller and Nadel, 1994, p. 302).

What can be taken from these statements implicitly is that there needs to be an understanding of the market and explicitly is that transforming the market involves an intervention, lasting change after removing the intervention, and reducing or eliminating barriers. However, not all of the issues that impede uptake of energy reduction measures are barriers, but are real or perceived risks. For instance, there can be real or perceived risks in obtaining energy savings associated with energy reduction measures (e.g., an energy efficient appliance that does not perform as well as its less efficient counterpart). Real or perceived risks and barriers that impede the adoption of energy reduction measures will be discussed in detail in section 2.5.1.

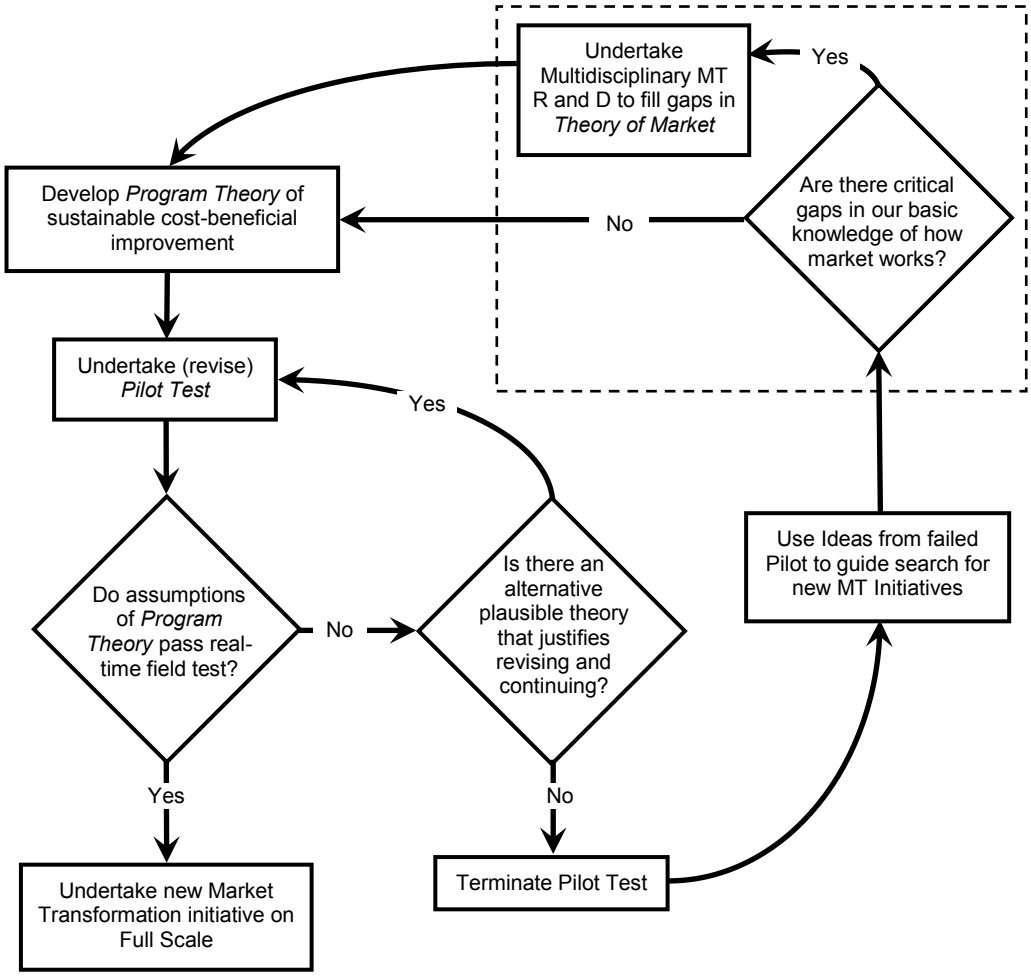
Integrating the themes from the above statements, a market transformation program involves understanding the market for energy reducing goods and services (upstream and downstream), intervening (without prolonged intervention) to bring about lasting changes by reducing or eliminating risks (perceived or real) and barriers associated with the market.

How does one design the proper market transformation program? One approach suggested by Blumstein et al. (2000) is a theory-based approach to market transformation. A central feature of this approach is grounding in plausible theory to identify opportunities, design program initiatives, guide testing of program assumptions, and contribute to the advancement of knowledge of how markets for energy goods and services work and might be improved (Blumstein et al., 2000, p. 139). The approach not only draws upon available theory from past program experience and scientific sources, but looks to test and extend it (Blumstein et al., 2000). The goal of this approach is to have an iterative process of learning and adapting to new knowledge; well targeted strategic market interventions that are based on formal and experiential knowledge; pilot testing; real-time monitoring and evaluation with feedback loops; and research to develop new knowledge about the market and the various arrangements that govern behaviour of actors[12] in the markets (Blumstein et al., 2000; Lutzenhiser et al., 2009). Figure 2.2 shows the overall structure of the market transformation (MT) approach.

[12] Market actors include those involved in the transactions of energy reducing goods and services.

*Figure 2.2.* Theory-based Market Transformation Approach

Source: adapted from Blumstein et al. (2000, p. 140)




Once a program approach and the theoretical assumptions have been developed, pilot testing is used to maximize learning and minimize risk before looking to full-scale implementation of a market transformation initiative (Blumstein et al., 2000). Piloting helps to uncover the flaws in the approach, provide a better understanding of the market for energy reduction measures and the actors, and allow for program “fine-tuning” (Blumstein et al., 2000).

Programs to address energy use in buildings began with traditional DSM utility programs focused on demand-side techno-economic fixes. However, traditional programming approaches are not sufficient given the need for more long-term energy reducing solutions. Consequently, the approach to programming has evolved to one of market transformation which includes strategies that are adaptive and help increase the market for energy reducing goods and services.

## 2.3 Stakeholders Involved in Programs

As discussed in section 1.1.2, the number of potential stakeholders involved in energy reduction projects for the residential high-rise sector is diverse. Some of the key stakeholders can include:

- government regulators or program oversight representatives;
- program administrators (e.g., government, utilities, or non-profits) and associates (e.g., implementers, evaluators, quality control/assurance contractors, advisors);
- energy service providers (e.g., energy management firms, engineering consultants, architectural firms, building scientists);
- financial lenders;
- private companies (e.g., product suppliers, manufacturers, contractors, legal counsel, building operation and maintenance contractors);
- developers;
- end users (e.g., developer-owners, building owners, condo or co-operative boards, building managers, tenants, and unit owners).

Traditional demand-side management programs typically only involve the utility that administers the program with the audience of the program interventions being the energy consumer or end user. Whereas novel market transformation programs are not limited to utility administered programs, can include all of the stakeholders listed above working towards improving the market for energy

reducing goods and services, and have targeted program interventions for any combination of the upstream (e.g., energy service providers, financial lenders, private companies, developers) or downstream (e.g., end users) market actors.

## 2.4 Program Administration

As discussed earlier, with deregulation of the utility sector, there is no one firm or organization responsible for assuring supply and no obligation on the part of utilities to provide energy reduction programs in a competitive retail market (Blumstein et al., 2005). Consequently programs can be run by any number of utilities, government agencies, or non-profits. It really depends on the regulatory structure of utilities, the policy environment and program strategy (Blumstein et al., 2005). What is important for a program administration is that it is credible, operates under a mandate with specific energy reduction goals and operates under what Blumstein et al. (2000) calls “good governance.”

A credible or trustworthy program administration can have a dramatic impact on program participation (Stern et al., 1985) and the way a message is received (McKenzie-Mohr and Smith, 1999). A credible or trustworthy program administrator is more likely to reach a larger program audience if it is also impartial. Having a credible and impartial program administrator would make it easier to bring together stakeholders that may not have otherwise come together to discuss energy reduction related issues and solutions.

Mandated energy reduction goals or energy specific policies can be issued by different levels of government (e.g., municipal, provincial, federal) and will influence the level at which a program is administered. For instance in the U.S., energy efficiency policy goals are mostly determined at the state level and consequently decisions about energy efficiency program administration are mostly made at the state level (Blumstein et al., 2000).

Good governance includes legitimacy, accountability, and adaptability (Blumstein et al., 2000). Legitimacy in an administration occurs by the way in which it is established, so that it is not prevented from acting and is either legislated or formed from consensus amongst stakeholders (Blumstein et al., 2000). Program administration accountability includes ways to evaluate or review and correct the program administration's performance, while adaptability involves quick adaptation to changes in policies and procedures (Blumstein et al., 2005).

## 2.5 Where to Intervene

A market transformation program involves understanding the market for energy reducing goods and services and intervening to bring about lasting changes by reducing or eliminating perceived or real risks and barriers associated with the market. Determining where to intervene requires identifying the perceived or real risks and barriers to energy reduction in buildings, understanding the types of interventions used to reduce or eliminate the risks and barriers, and how they relate to one another. This is summarized schematically in a relational model that illustrates important program categories and modules in which to intervene and their interrelationships.

### 2.5.1 Perceived or Real Risks and Barriers to Energy Reduction

Many risks and barriers to energy reduction measures exist and have been identified in the literature, but only those identified through precedent program interviews and pertaining to buildings will be discussed. These risks and barriers are categorized into market failures, financial hurdles, behavioural constraints, and hidden costs and benefits (Carbon Trust, 2005; Ürge-Vorsatz et al., 2007a; Ürge-Vorsatz et al., 2007b).

(i) Market Failures

Market failures are flaws with respect to market operation and violate neoclassical economic assumptions of an ideal market for products and services such as rational behaviour, costless transactions, and perfect information (Brown, 2001). The market failures discussed include the division of responsibilities in the building design process, misplaced incentives, regulatory barriers, and lack of quality information and training (Ürge-Vorsatz et al., 2007a).

Division of responsibilities in the building design process often contribute to suboptimal results because minimizing energy use in buildings requires addressing the building system including its form, orientation, building envelope, windows, and mechanical and electrical systems (Ürge-Vorsatz et al., 2007a). To construct or retrofit a residential high-rise building, there are many different contractors and professionals (e.g., architects, engineers) involved and often conduct their work in isolation, giving rise to problems (CMHC, 2001b). Hence the need for more collaborative integrated whole building designs for the residential high-rise sector.

Misplaced incentives or split incentives occur when the participants have different goals or incentives in an economic transaction (IEA, 2007). For instance, developers constructing high-rise condominiums do not want to spend incremental capital to install energy efficient products or technologies because they want to keep their costs down and stay competitive in a market with other condominium developments. Another example is when landlords do not spend capital for installing items such as energy efficient appliances in suites because there is no benefit to install them if the renters pay for the utility bills.

Regulatory barriers to energy efficient products will vary depending on jurisdiction, but can include regulations, standards, or bylaws passed by the

different levels of government. In Alberta for instance, lighting in public stairwells and hallways are bound by the 2006 Alberta Building code, which require minimum lighting 24/7 therefore prohibiting occupancy sensor lighting.

Insufficient and inaccurate information can result in suboptimal investments in energy reduction measures (IEA, 2007, p.25). In many instances this is a result of information asymmetries between the supply and demand sides of the market (Lützkendorf and Speer, 2005). Information asymmetry occurs when one party has access to more information than the other (Lützkendorf and Speer, 2005). Consumer demand side decision-making regarding energy reduction measures are negatively affected if the information they receive with regards to quality, cost/benefits, performance, and service is not trustworthy; is difficult or time consuming to obtain and comprehend; and is or is perceived to be too general and inadequate (Gates, 1983; Lützkendorf and Speer, 2005; Stern, 2008). One very specific example of information inadequacy is a building owner's understanding of the economics for energy reduction measures. The return on investment after tax of many common energy efficiency and conservation measures is often double those of stocks, bonds, money market funds, and real estate, but activity levels are not consistent with these high yields (Gates, 1983). The low activity in investing in energy reduction measures is not only a result of a lack of reliable information, but also of perceived risk (Gates, 1983).

The last market failure to be discussed is the lack of training for workers in the energy reduction industry. Those working to increase adoption of energy reduction measures in the residential high-rise sector require very specific knowledge and skills. In many instances the demand for energy reduction measures for residential high-rises is not sufficiently large to support the development of a skilled labour pool. The result is a lack of resources and

insufficient training of those in the building industry on new technologies, new standards and regulations, and best practices (Ürge-Vorsatz et al., 2007a).

(ii) Financial Hurdles

The next category of risks and barriers are financial hurdles. Five financial hurdles that will be discussed include limited access to capital, limited availability to capital for low income housing and financial motivation; subsidized conventional energy; not-true-cost energy pricing; and economies of scale for financial borrowing (Ürge-Vorsatz et al., 2007a).

First, a common financial hurdle is limited access to capital for building owners to undertake energy reduction measures that generally have higher upfront costs, but lower operating costs when compared to business as usual (Ürge-Vorsatz et al., 2007a). Financial lending for energy reduction projects has not been readily available to building owners. Second, financial circumstances alter the decisions made on energy reduction measures. Low income earners do not have the capital, while high income earners can afford to live with energy expenditures that appear small relative to their disposable income and do not have the time to undertake energy performance related investments (Ürge-Vorsatz et al., 2007a). Third, in a lot of cases conventional energy is subsidized, creating a disincentive to undertake energy reduction measures (Ürge-Vorsatz et al., 2007a). Fourth, electricity and natural gas pricing does not reflect true cost in that there is no accounting for externalities associated with environmental damage and with the generation, production, and consumption of energy (Ürge-Vorsatz et al., 2007a). These price distortions are preventing people from taking action (Gates, 1983). Fifth, small projects for energy performance improvements are not attractive to financial lenders (Ürge-Vorsatz et al., 2007a). For financial lenders there are economies of scale – they would rather lend money for larger projects, where the capital loans are larger, than for smaller projects, where the

loans are smaller and the transaction costs to administrate them is disproportionately higher (Ürge-Vorsatz et al., 2007a).

(iii) Behavioural Constraints

Behavioural constraints are another important category under risks and barriers. The influences over behaviour and the choices of individuals and groups, communities, or organizations affect energy use in our homes. According to the works of Hackett and Lutzenhiser (1991), Lutzenhiser (1992 and 1993), Schipper et al. (1989), and Shove et al. (1998) as cited in Stern (2008), variations in energy consumption amongst homes with similar physical attributes can be affected by non-physical factors by as much as 3:1. Therefore, identifying and understanding influences on energy-use behaviour and choice will help in realizing much larger energy reductions. According to a quote by Edward Vine, an energy-efficiency expert, in the Science magazine article by Charles (2009), "We cannot assume, if we have a great technology, that people will rush to stores and buy it. We need to find out how people behave, how they make decisions, how they use energy, and we need to work with them."

Another commonly cited behavioural barrier is the 'rebound' or 'takeback' effect. 'Rebound' is an increase in demand for energy services because improving energy efficiency lowers the cost of energy therefore making it more affordable for more energy services (Herring, 2006; IEA, 2005; Khazzoom, 1980). Herring (2006) indicates that the rebound effect can be indirect or direct. An indirect rebound effect occurs when the consumer has a little more money to spend on all goods and services because of a reduction in the cost of energy services (Herring, 2006). A direct rebound effect occurs when there is increased use of energy services because of a reduction in price due to greater efficiency (Herring, 2006). There is debate about how large the rebound effect is, but there is empirical evidence that it can erode energy savings (Herring, 2006; IEA, 2005;

Ürge-Vorsatz et al., 2007a), complicating program evaluation techniques and program cost-effectiveness. However, the fact that the rebound effect occurs is no reason to abandon the adoption of energy efficiency technologies, but suggests again that program interventions need to go beyond energy efficient technologies and integrate behavioural research (i.e., understand what influences consumer behaviour and their choices) in program design.

(iv) Hidden Costs and Benefits

Hidden costs and benefits are concerned with real or perceived costs or risks not represented directly in financial flows (Carbon Trust, 2005; Ürge-Vorsatz et al., 2007a). The examples given by Ürge-Vorsatz et al. (2007a) referencing Carbon Trust (2005) include performance issues for the user when there are potential incompatibilities of energy efficient equipment with existing infrastructure or benefit to the user when advanced energy efficient equipment is adopted, but added cost to the user when the equipment is less reliable or more difficult to get serviced.

In summary, the risks and barriers that impede the adoption of energy reduction measures in buildings include:

- market failures such as division of responsibilities in the building design process, misplaced incentives, regulatory barriers, and lack of quality information and training;
- financial hurdles such as limited access to capital, financial capacity, subsidized conventional energy, not-true-cost energy pricing, and economies of scale for financial borrowing;
- behavioural constraints;
- real or perceived costs or risks not represented directly in financial flows.

### 2.5.2 Interventions to Reduce or Eliminate the Risks and Barriers

A wide range of policies and program interventions are being used to overcome the risks and barriers that hinder the adoption of energy reduction measures, but what has been recognized is a need for change from an almost exclusive focus on techno-economic interventions on the demand side to a wider understanding of the market and attention to the various interactions between participants on the supply and demand sides (Blumstein et al., 2000). Market transformation programs are challenging to design because of limited experience in these types of programs and incomplete knowledge of how the markets for energy-using goods and services work (Blumstein et al., 2000). As a result, it will be important to review and learn from past policies and programs and test program strategies when designing a suitable program.

Ürge-Vorsatz et al. (2007a and 2007b) conducted an appraisal of policy instruments for reducing CO2 emissions in buildings. In their research a review of twenty of the most important policy tools/instruments or interventions used in buildings had been evaluated to try to understand the effectiveness of these various policy instruments in the building sector. The policy instruments were categorized either as control and regulatory mechanisms; economic and market-based instruments; fiscal instruments and incentives; or support, information, and voluntary action (refer to Table 2.1) (Ürge-Vorsatz et al.; 2007a and 2007b). The authors provided an overview of which policy instruments are used to overcome the categories of risks and barriers discussed in the previous section.

Table 2.1 *Policy Instruments Per Risks and Barriers Category*
*Sources: adapted from Ürge-Vorsatz et al. (2007a and 2007b)*

| | |
|---|---|
| **Market failures**<br>Control and Regulatory Mechanisms:<br>• Appliance standards; Building codes; Procurement regulations; Energy efficiency obligations and quotas; Mandatory DSM programs; Mandatory labelling and certification programs<br><br>Economic and Market-based Instruments:<br>• Energy performance contracting; Cooperative procurement; Energy-efficiency certificate schemes; Kyoto Protocol flexible mechanisms<br><br>Support, Information, and Voluntary Action:<br>• Voluntary certification and labelling; Voluntary and negotiated agreements; Public leadership programs; Awareness raising, education, information campaigns; Mandatory audit and energy management; Detailed billing and disclosure programs | **Financial hurdles**<br>Control and Regulatory Mechanisms:<br>• Procurement regulations; Energy efficiency obligations and quotas; Mandatory DSM programs<br><br>Economic and Market-based Instruments:<br>• Energy performance contracting; Energy-efficiency certificate schemes; Kyoto Protocol flexible mechanisms<br><br>Fiscal Instruments and Incentives:<br>• Taxation (on CO2 or fuels); Tax exemptions/reductions; Public benefit charges; Capital subsidies, grants, subsidized loans |
| **Behavioural constraints**<br>Control and Regulatory Mechanisms:<br>• Mandatory labelling and certification<br><br>Support, Information, and Voluntary Action:<br>• Voluntary certification and labelling; Voluntary and negotiated agreements; Public leadership programs; Awareness raising, education, information campaigns; Mandatory audit and energy management; Detailed billing and disclosure programs | **Hidden costs and benefits**<br>Control and Regulatory Mechanisms:<br>• Appliance standards<br><br>Economic and Market-based Instruments:<br>• Energy performance contracting<br><br>Support, Information, and Voluntary Action:<br>• Public leadership programs |

Their overall comparison of the policy instruments and conclusions are:

- All the policy instruments reviewed can achieve significant energy and CO2 emissions savings, but at different costs (Ürge-Vorsatz et al., 2007a, p. 393).
- Control and regulatory mechanisms are generally effective, but can have limited cost-effectiveness because of high enforcement costs (Ürge-

Vorsatz et al., 2007a, p. 393; Ürge-Vorsatz et al., 2007b, p. 463). However, regulatory instruments were generally more effective as well as being more cost-effective than any other category of tools (Ürge-Vorsatz et al., 2007b, p. 474).

- Economic and market-based instruments are relatively new, with the exception of energy performance contracting, so evaluations with universal lessons are still scarce (Ürge-Vorsatz et al., 2007b, p. 469).
- Fiscal instruments and incentives indicated very diverging results (Ürge-Vorsatz et al., 2007b, p. 472).
- Information/education/awareness-raising can effectively enhance the impact of most other policy instruments (Ürge-Vorsatz et al., 2007b, p. 472).
- No single policy instrument can capture the entire energy efficiency potential in buildings, there needs to be a diverse portfolio of policy instruments properly combined to overcome the barriers (Ürge-Vorsatz et al., 2007b, p. 473).
- Combining all the instruments maximizes the impact and helps to reduce drawback effects (Ürge-Vorsatz et al., 2007b, p. 474).

Given the complexity of the market, what appears to follow naturally from the results of the research conducted by Ürge-Vorsatz et al. (2007a and 2007b) is that there needs to be a diversity of interventions to address the risks and barriers to energy reduction in the building sector, but tailored to meet the local economic, social, political, and cultural criteria in which the program operates.

### 2.5.3 Relational Model and Program Interventions

There are a number of program interventions as indicated in the previous section, so determining which ones to include in a program is unclear. Consequently, a review of the literature on energy policies and programs was

conducted to identify the key elements or components of a successful multifamily program, the various policy instruments or interventions employed in energy reduction programs, and contextual factors (DeCicco et al., 1994; Hammarlund, 1991; Stern, 2008; Ürge-Vorsatz et al., 2007b). The review helped inform the development of a relational model and its program categories, program modules in which to intervene, influencing factors, and the interactions between them. The relational model was developed with the intent to help illustrate energy reduction programs, understand the relationships and interactions between the market actors, and show possible points of intervention. The model also reflects the complexity of programs in that interventions in one category and module may affect another category and module, leading to one or more outcomes. The literature, as it informs the development of the relational model, is described in the following paragraphs. As part of the discussion, refer to Table 2.2 and Figure 2.3 (program categories and/or modules illustrated in Figure 2.3 are indicated below in quotation marks).

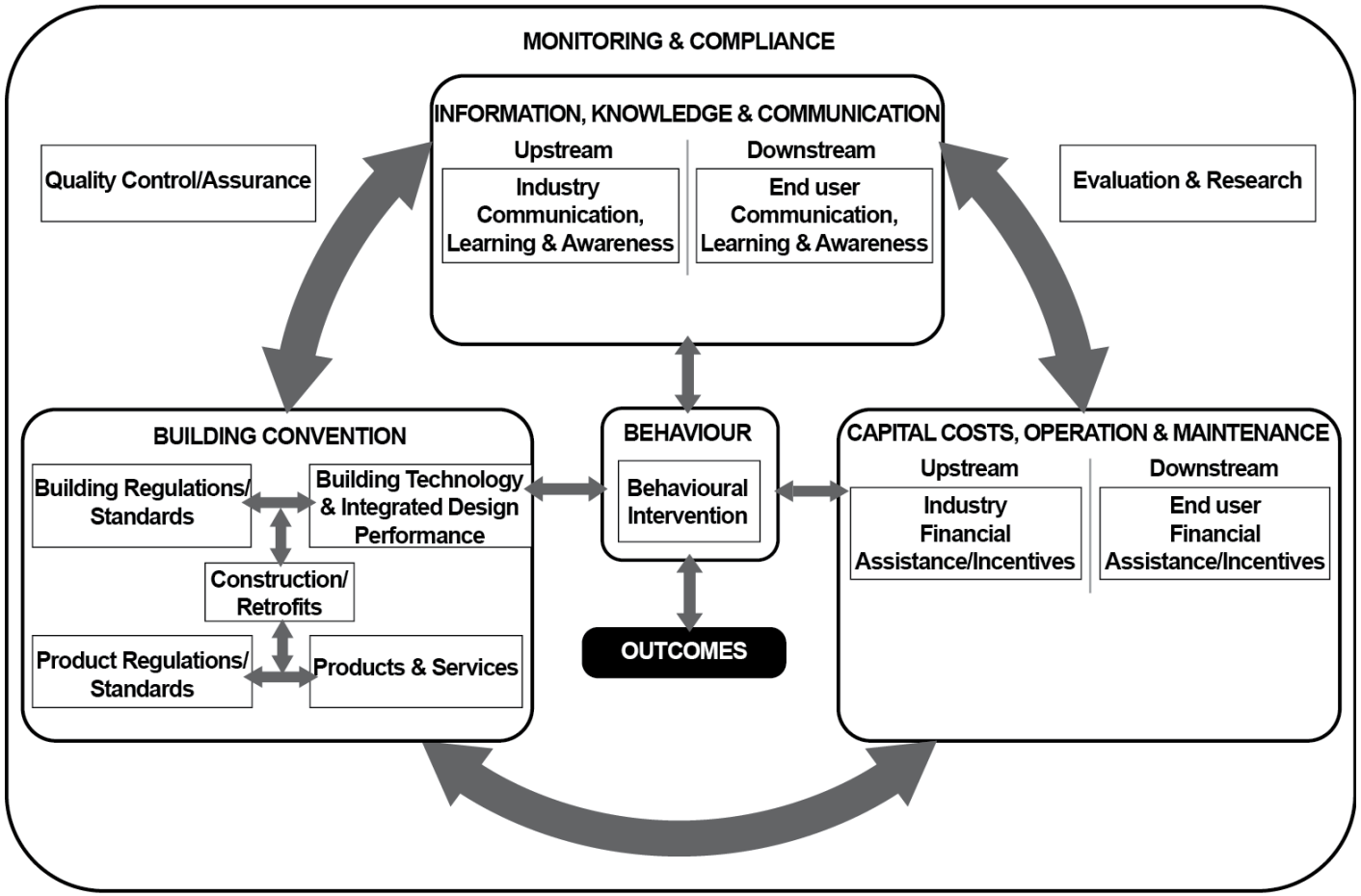
Table 2.2 *Relational Model Program Categories and Modules*

| Relational Model | | Sources | | |
|---|---|---|---|---|
| Program Category | Program Module in which to Intervene | DeCicco et al. (1994) key elements of success | Hammarlund (1991) components of the perfect multifamily program | Ürge-Vorsatz et al. (2007b) policy instruments assessed in study |
| Information, knowledge and communication | Industry communication, learning and awareness | • Targeted program marketing<br>• Information provision<br>• Thorough energy and cost analysis<br>• Education of tenants, staff, and management | • Aggressive tailored marketing,<br>• Personal one-stop service<br>• Emphasize benefits (energy and non-energy) of energy efficiency<br>• Financial counselling, assistance with applications<br>• Providing operations and maintenance support on mechanical systems | • Awareness raising, education, information campaigns<br>• Detailed billing and disclosure programs<br>• Voluntary and negotiated agreements<br>• Public leadership programs |
| | End user communication, learning and awareness | | | |
| Capital costs, operation and maintenance | Industry financial assistance/ incentives | • Financial incentives | • Attractive financial incentives from utilities, government, or other sources (option of rebates and loans) | • Energy performance contracting<br>• Taxation on fuels<br>• Tax exemptions<br>• Capital subsidies, grants, subsidised loans |
| | End user financial assistance/ incentives | | | |
| Building Convention | Building regulations/ standards | - Performance standards and other regulatory tools | | • Building codes<br>• Mandatory or voluntary labelling and certification<br>• Appliance standards<br>• Procurement regulations |
| | Product regulations/ standards | | | |
| | Construction/retrofits | | - Inspections | |
| | Building technology and integrated design performance | - Technical assistance | - Free onsite energy audits or site visits, technical services<br>- Providing operations and maintenance support on mechanical systems | • Mandatory audit and energy management requirement<br>• Co-operative procurement |
| | Products and services | | | |
| Monitoring and compliance | Evaluation and research | - Monitoring, evaluation, follow-up | - Performance monitoring | |
| | Quality control/assurance | | | |
| Behaviour[1] | Behavioural intervention | | | |

Note. [1]Behaviour is assumed to be influenced by all the other program modules.

*Figure 2.3.* Relational Model for an Energy Reduction Program

Sources: adapted from DeCicco et al. (1994); Hammarlund (1991); Ürge-Vorsatz et al. (2007a and 2007b)




Notes. PROGRAM CATEGORIES: INFORMATION, KNOWLEDGE, AND COMMUNICATION; CAPITAL COSTS, OPERATION AND MAINTENANCE; BUILDING CONVENTION; MONITORING AND COMPLIANCE; BEHAVIOUR. Interventions can be applied at any of the program modules under each program category; for simplification of the model products include lighting, appliances, electronics, equipment, technologies.

DeCicco et al. (1994) indicates that multifamily conservation program key elements of success include targeted program marketing; information provision; thorough energy and cost analysis; technical assistance in retrofit planning; performance standards and other regulatory tools; financial incentives; education of tenants, staff, and management; monitoring; evaluation; and follow-up.

As shown in Table 2.2, targeted program marketing, information provision, thorough energy and cost analysis, and education of tenants, staff and management are related to information, knowledge and communication (i.e., program category “INFORMATION, KNOWLEDGE AND COMMUNICATION” illustrated in Figure 2.3). As an example of a potential program intervention, targeted program marketing can be aimed at upstream market actors or industry such as energy service providers (i.e., program module in which to intervene – “Industry Communication, Learning and Awareness” in Figure 2.3) or downstream market actors or end users such as building owners (i.e., program module in which to intervene – “End user Communication, Learning and Awareness” in Figure 2.3) in order to inform them to act on, for instance, installing energy efficient lighting (i.e., influencing the “BEHAVIOUR” and resulting in an “OUTCOME” such as increased energy efficiency lighting installations). Also included under this category are interventions related to collaboration, meetings, and information sharing amongst stakeholders to advance energy reduction initiatives.

Financial incentives relate to “CAPITAL COSTS, OPERATION AND MAINTENANCE.” For example financial incentives can be provided to industry (e.g., energy service provider) or the end user (e.g., building owners) in the form of financial training incentives (i.e., program modules “Industry Financial Assistance/Incentives” and “End user Financial Assistance/Incentives”). The financial training incentives can then motivate them to change their

“BEHAVIOUR” through comprehensive energy auditing (i.e., improved skills in executing energy audits by energy service providers – “OUTCOME”) or maintaining building control systems (i.e., improved building maintenance by building managers – “OUTCOME”). Interventions under this category involve financial assistance and/or incentives to assist industry and end users with capital costs, operation and maintenance.

Performance standards or other regulatory tools relate to the “BUILDING CONVENTION.” For example there can be mandatory minimum energy efficiency building codes and program set performance standards (i.e., program module “Building Regulations/Standards”) which require technical assistance by energy service providers to conduct integrated building analysis (i.e., program module “Building Technology and Integrated Design Performance”). Then there are minimum energy efficiency standards for appliances and potential voluntary energy efficiency appliance standards such as ENERGY STAR (i.e., “Product Regulations/Standards”). The result is a high-rise built with certain energy efficiency standards which ultimately affects how energy is used by occupants in the building (i.e., “BEHAVIOUR”) and what energy savings are achieved in the building (i.e., “OUTCOME”).

Finally monitoring, evaluation and follow-up relate to “MONITORING AND COMPLIANCE.” For example an energy reduction program could deploy quality control inspectors (i.e., “Quality Control/Assurance”) and require comprehensive evaluation techniques (i.e., “Evaluation and Research”) to ensure real energy savings from program projects or to make improvements to a program (i.e., “OUTCOMES”).

Hammarlund (1991) outlined a number of components for a good multifamily program including: attractive financial incentives from utilities,

governments, or other sources with the option of rebates, loans or a combination; aggressive tailored marketing approaches; emphasizing energy and non-energy benefits of energy-efficiency; having a one-stop package of services to make the process as easy as possible; free onsite energy audits (i.e., comprehensive audits) or site visits as well as providing technical services; financial counselling; assistance with applications and other paperwork; inspections; performance monitoring; and providing operations and maintenance support on mechanical systems.

As shown in Table 2.2, aggressive tailored marketing approaches; emphasizing energy and non-energy benefits of energy-efficiency; having a one-stop package of services; financial counselling; assistance with applications; providing operations and maintenance support on mechanical systems deal with "INFORMATION, KNOWLEDGE AND COMMUNICATION." Financial incentives relate to "CAPITAL COSTS, OPERATION AND MAINTENANCE." Inspections, free onsite energy audits or site visits as well as providing technical services, and providing operations and maintenance support on mechanical systems relate to "BUILDING CONVENTION." Lastly, performance monitoring relates to "MONITORING AND COMPLIANCE." Most of these components can similarly illustrate the program categories and modules such as those key elements outlined by DeCicco et al. (1994), so examples will not be described. The only example not discussed are inspections (i.e., an intervention under program module "Construction/Retrofits"), which can be a requirement in a program for new and existing high-rises as a way to address proper implementation of energy reduction measures (i.e., "MONITORING AND COMPLIANCE") in the buildings, which ultimately affects how energy is used by occupants in the building (i.e., "BEHAVIOUR") and what energy savings are achieved (i.e., "OUTCOME").

As discussed in section 2.5.2, Ürge-Vorsatz et al. (2007b) conducted an appraisal of policy instruments for reducing CO2 emissions in buildings, which have also been tabulated in Table 2.2 to inform the development of the relational model and its program categories and modules. Awareness raising, education, information campaigns; detailed billing and disclosure programs; voluntary and negotiated agreements; and public leadership programs fall under the category of "INFORMATION, KNOWLEDGE AND COMMUNICATION." For example, a government program administrator may work on agreements with product manufacturers for securing a supply of energy efficiency light bulbs (i.e., "Industry communication, learning and awareness") which in turn affects the "Products and Services" available under "BUILDING CONVENTION," resulting in a building owner purchasing more of these light bulbs (i.e., change in purchasing "BEHAVIOUR"), installing more light bulbs and saving more energy in the building (i.e., "OUTCOMES").

Energy performance contracting; taxation on fuels; tax exemptions; capital subsidies, grants, and subsidised loans relate to "CAPITAL COSTS, OPERATION AND MAINTENANCE." For example, some energy service providers may also be energy service companies who enter into a performance contract[13] with a building owner (i.e., "End user Financial Assistance/Incentives") who will not need to worry about the capital for installing the energy reduction measures, which are left to the energy service company to install and maintain (i.e., "BUILDING CONVENTION" and "BEHAVIOUR") in order to realize energy savings and make an economic return on the energy savings (i.e., "OUTCOMES").

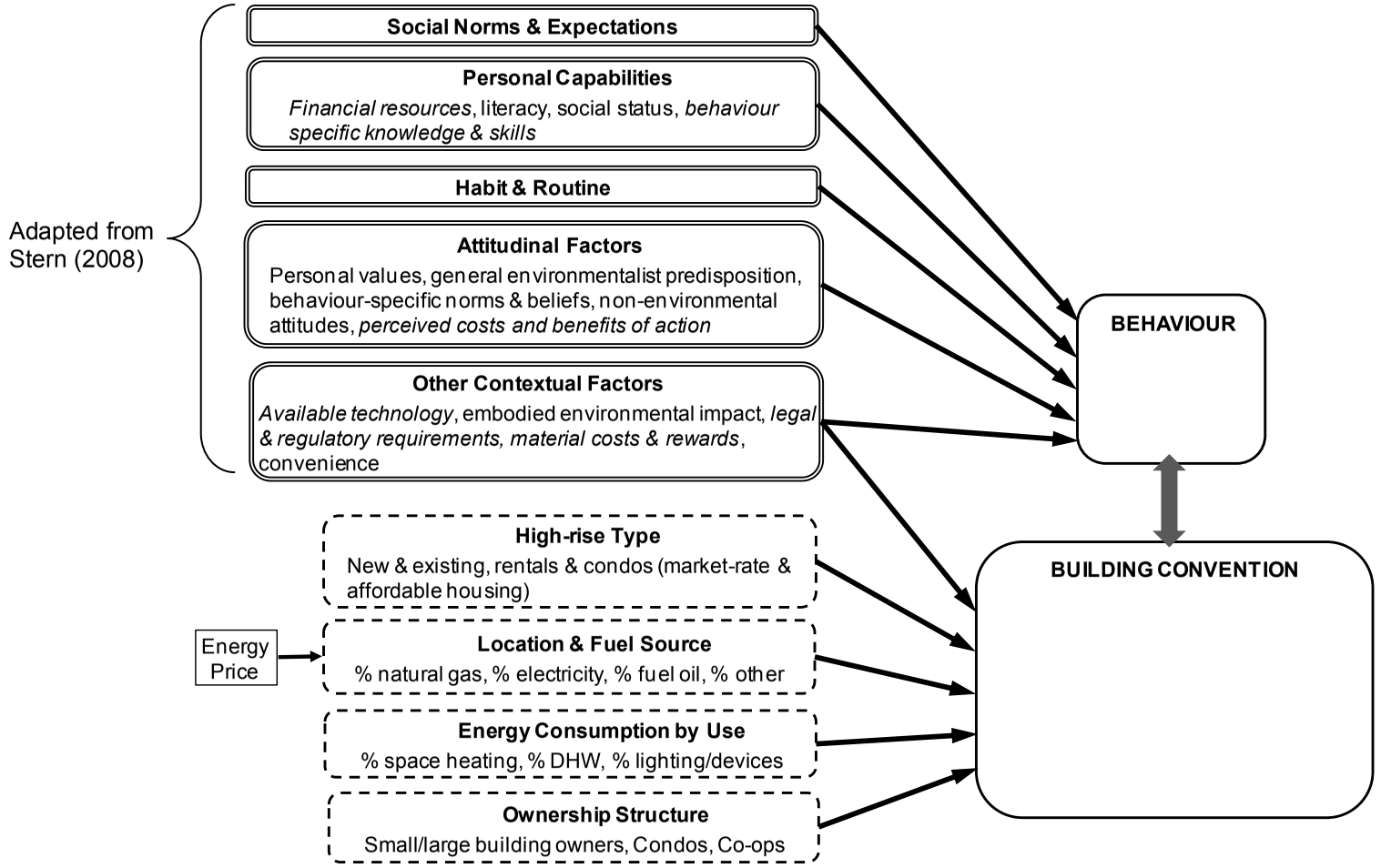
[13] Performance contracting refers to arrangements in which payment for energy-related improvements depends on the energy costs savings resulting from the improvements and the building's energy consumption "performance" is guaranteed by the energy service company (DeCicco et al., 1994).

Building codes; mandatory or voluntary labelling and certification; appliance standards; procurement regulations; mandatory audit and energy management requirement; and co-operative procurement relate to “BUILDING CONVENTION.” For example a program may require labelling and certification such as ENERGY STAR New High-rises, which requires a very specific building performance standard (i.e., “Building Regulations/Standards”) and ongoing verification of energy savings (i.e., “Evaluation and Research”) to receive and maintain its certification (i.e., “OUTCOME”).

Influencing factors and the relationships to the program categories were also inferred using existing literature from DeCicco et al. (1994), Hammarlund (1991), and Stern (2008). According to DeCicco et al. (1994) and Hammarlund (1991), the physical building type, fuel price and use, geography, and ownership structure should be considered when enhancing energy conservation in multifamily housing or improving multifamily program design (refer to Figure 2.4). These particular influencing factors affect the “BUILDING CONVENTION.” For instance, the “Building Technology and Integrated Design Performance,” under the category “BUILDING CONVENTION,” will be affected by the energy reduction measures implemented, which depend on the type and age of residential high-rise, location and fuel source, building’s energy consumption by use, and ownership structure. Other influencing factors affect energy use “BEHAVIOUR” directly. Stern (2008) indicates that social norms and expectations, personal capabilities, habits and routines, attitudinal factors and other contextual factors, influence energy use behaviour and that patterns of influence vary greatly over behaviours and places and should not be generalized. Figure 2.4 is a continuation of the relational model that shows these influencing factors on “BUILDING CONVENTION” and “BEHAVIOUR.”

*Figure 2.4.* Influencing Factors

Sources: adapted from DeCicco et al. (1994); Hammarlund (1991); Stern (2008)




Notes. Influencing Factors on behaviour have not been addressed in entirety for precedent program case study analysis. A more comprehensive analysis is required outside the scope of this design study. Influencing factors on behaviour shown in italics overlap in Figure 2.3.

Based on all the information described above a general relational model was developed in order to show the possible interactions or relationships between the stakeholders, program categories, program modules in which to intervene, and influencing factors (refer Figures 2.3 and 2.4). The relational model is capable of representing any energy reduction program and was used to:

1) Develop initial interview questions for precedent program respondents, as listed in Appendix I, and guide data collection as discussed in Chapter Three Table 3.1;
2) Identify key program categories and modules in which the precedent program interventions were focused on;
3) Illustrate the comparison between the precedent programs and the Alberta program design.

Overall, it is important to understand that the relational model is not limited to illustrating interventions for end users, but can illustrate interventions involving a number of upstream and downstream actors under multiple categories and modules.

## 2.6 Evaluation and Research

This section explains some of the principles that characterize the market transformation approach, specifically the disciplines involved, evaluation techniques, responsiveness and feedback, and research.

Traditional policies and evaluation strategies dominate current practice – mostly focused on technical problems in engineering and building science, economics, and almost exclusively on quantifying energy impacts (Blumstein et al., 2000; Lutzenhiser et al., 2009; Vine, 1994). Yet, the literature indicates that the focus on technology and economic rationale for energy reducing products and services is insufficient in the development and evaluation of policies and programs (Blumstein et al., 2000; Lutzenhiser, 1993; Lutzenhiser et al., 2009;

Stern, 1985; Vine, 2008). Human condition literature considers some social and behavioural research on the influences or motivations, attitudes, and actions of energy consumers (Lutzenhiser, 1993; McKenzie-Mohr and Smith, 1999; Stern 2008; Stern et al., 1985). However, traditional programming fails to integrate the disciplines and the work done to date on program research and evaluation and behaviour is not sufficient to inform the development of market transformation programs, which require a broader understanding of the market for energy reducing goods and services (Blumstein et al., 2000). Consequently, novel programming requires integrating the disciplines in program design, evaluation and research (i.e., an interdisciplinary approach to evaluation and research, or program grounding in behavioural science as well as technology and economics) (Blumstein et al., 2000; Lutzenhiser, 1993; Lutzenhiser et al., 2009; Stern, 2008; Vine, 1994).

To determine the most effective programs and their interventions and to understand how to obtain lasting benefits, programs need to be developed with a better understanding of the influences of energy use behaviour and choice that Stern (2008) outlined in his work on environmentally significant behaviour in the home, and non-energy benefits. Stern (2008) states that it is not enough to just focus on single disciplinary analysis of economic, psychological, or social factors to determine what causes environmentally significant behaviour[14] such as reducing energy use in the home (p. 15.4). Establishing interventions will have to be based on information obtained through a more interdisciplinary approach to understanding the full range of causes of behaviour and their interactions (Stern, 2008, p. 15.4). Consequently, there clearly needs to be a change from traditional programming centred on the energy benefits (i.e., energy cost savings) of energy

[14] Environmentally significant behaviour is defined either by environmental impact or environmental intent (Stern, 2008).

reduction measures, to novel programming that accounts for non-energy benefits.

Non-energy benefits include societal gains (e.g., jobs, tax-funded public services) and personal benefits (e.g., improved comfort, health, safety) (Knight, R. L., Lutzenhiser, L. and Lutzenhiser, S., 2006). According to Knight et al. (2006) and Amann (2006) there is anecdotal evidence, which suggests homeowners pursued whole-house retrofit services more for non-energy benefits such as comfort than for energy cost savings. This preliminary evidence suggests that perhaps our efforts to focus on the value of energy cost savings in marketing energy reduction measures are misplaced. If homeowners value non-energy benefits more or just as much as energy cost savings, program designers should place more effort into identifying and understanding what the non-energy benefits are when developing program interventions. For example, if installing an energy efficient heating system does not meet the comfort expectations of occupants, you may find them plugging in a number of space heaters and ultimately increasing energy loads in the building. Installing energy efficient technology alone without understanding the implications of the technology on energy use behaviour and occupant need is not the solution to persistent energy reduction in our homes.

To determine whether market interventions are successful or effective and lasting, we need to incorporate broader evaluation techniques and research. Blumstein et al. (2000) states that the limited work to date on program evaluation and consumer behaviour is not sufficient to inform the development of market transformation programs with a clear focus on markets (p. 139). Evaluation should be conducted with an integrated team of program practitioners and evaluators from the beginning and incorporate qualitative and quantitative assessment of energy and non-energy aspects from the perspective of key

market actors and going beyond quantifying the benefits of energy savings (Blumstein et al., 2000). For an evaluation to be useful there needs to be a collaborative integrated team (i.e., program implementers, evaluators, regulators) making evaluation results more specific and relevant to program needs (Vine, 2008). Evaluations are to be used to improve programs with timely feedback of results that can be used in the planning, design, and operation of programs (Vine, 2008). Hence the adoption of real-time monitoring and evaluation feedback loops.

Traditional programming often fails to conduct any monitoring, let alone real-time monitoring and evaluation feedback for program improvement. According to Vine (2008) evaluation results are not always used to improve the performance of their programs and typically come in at the end as an audit function. However, he indicates that the use of evaluation results can be facilitated by having:

- collaborative work teams amongst implementers, evaluators, and regulators throughout the program;
- conducting evaluability[15] assessments;
- tracking how evaluation recommendations are used by implementers;
- having evaluators make evaluation results more specific and relevant to the program;
- having real-time feedback for implementers (i.e., establishing forums for sharing evaluation information);

He goes on to add that in cases where a regulator is involved, regulators must:

- require program implementers respond to evaluation recommendations;
- provide sufficient resources for evaluators;

[15] Vine (2008) talks about a program being evaluable when program goals and priority information needs are well defined, the program goals are plausible, performance data can be obtained cost effectively, and intended users of the evaluation results agree on how the information will be used.

- require utilities support their energy savings based on evaluation studies;
- create performance measures that go beyond energy savings and include non-energy benefits, customer satisfaction, and market effects.

The theory-based market transformation approach also suggests an agenda for research to develop knowledge on the dynamics and interactions of the market, which govern the behaviour of people in the market for energy reducing goods and services (Blumstein et al., 2000). The most productive approach to understanding and influencing energy use behaviour is an interdisciplinary one, which seeks to understand the full range of causes of behaviour and their interactions (Stern, 2008). There needs to be interdisciplinary market transformation research that goes beyond the “barriers problem” to help develop new knowledge and advance practical knowledge of the market for energy reducing goods and services (Blumstein et al., 2000).

In summary, a market transformation approach involves interdisciplinary teams in program design to develop new knowledge through expanded research, real-time monitoring and evaluation feedback incorporating qualitative and quantitative assessments of energy and non-energy benefits. This approach involves interventions targeted at multiple stakeholders, not just the end users, to help achieve more lasting market effects (i.e., energy reduction initiatives become the norm).

## 2.7 Program Impact

Many traditional demand-side management programs usually save energy in the short term (Blumstein et al., 2000; Nadel and Latham, 1998). For example, once funding is depleted for rebates on a specific energy efficient product, so too does the interest in the product and consequently the associated energy savings. The objective of market transformation is to change the market

and have lasting benefits even after the program interventions are removed. To having lasting market effects, there needs to be persistence without prolonged intervention and what Nadel and Latham (1998) refer to as a transitioning to a self-sustaining market or “exit strategy.” Nadel and Latham (1998) indicate that market transformation takes time, over several years, until the objective of the intervention is achieved and when removal does not result in backsliding. They go on to indicate that common exit or transition strategies include:

1) Barriers being successfully removed so that any particular energy efficiency and conservation measure (EECM) is adopted by industry as common practice;
2) Having manufacturers adopt an EECM that becomes the industry standard;
3) Enacting new building codes or standards that make the measures the new minimum performance level (Nadel and Latham, 1998).

Much of the funding for traditional programs (e.g., rebate programs) is to help pay for energy reduction measures, which cannot be sustained indefinitely with public funding. Therefore a market transformation approach to programming involves allowing the market for energy reducing goods and services to prosper without prolonged program intervention (e.g., proving innovative financial models that eventually lead to private sector financing). Unlike the short-term impacts of traditional programs, market transformation programs are designed to change the market for energy reduction goods and services long-term (i.e., energy savings persist).

## 2.8 Guiding Principles of Program Design

Market transformation does not exclude or uniquely identify energy efficiency programs (i.e., traditional demand side management programs can transform the market by introducing energy efficient products such as compact fluorescents) (Eto, et al., 1996; Nadel and Latham, 1998), but there are

significant differences as discussed in the previous sections. Table 2.3 is a summary of the guiding principles discussed and shows the major differences between traditional and novel programming.

Table 2.3 *Guiding Principles of Program Design*

*Sources: Blumstein et al. (2005); Blumstein et al. (2000); Lutzenhiser et al. (2009)*

| | Traditional Programming | → Novel Programming |
|---|---|---|
| 1. Type of Programming | Demand-side Management | Adaptive Market Transformation |
| 2. Stakeholders Involved | Limited (e.g., Utilities, consumers) | Diverse (e.g., gov't, industry, end-users, financiers, legal counsel, etc.) |
| | Audience: Demand-side (purchaser of energy goods and services) | Audience: Upstream (industry) and downstream (end users) actors |
| 3. Program Administration | Utilities: specific energy policies, credible, legitimate, accountable | Gov't, utilities, non-profits: specific energy policies, credible, legitimate, accountable, adaptable |
| 4. Where to Intervene | Techno-economic interventions (fitting or retrofitting energy efficient devices/machines) | Behavioural-socio-techno-economic interventions (diversity of interventions) to address market risks and barriers |
| 5. Evaluation and Research | Cost-benefit tests (quantifiable energy benefits, under-valued non-energy benefits); no research | All benefits for key market actors (qualitative and quantitative assessment-energy and non-energy); research integral |
| Responsiveness and Feedback | Ex-post energy savings measurement (evaluation not typical) | Real-time monitoring and evaluation feedback loops |
| Disciplines Involved | Siloed (engineering, economics, psychology, sociology, anthropology) | Interdisciplinary (engineering, economics, psychology, sociology, anthropology) |
| 6. Impact | One instant in time/ short-term impact | Lasting/ persistent impact without prolonged intervention |

Note. Government (gov't).

Overall, market transformation programs in contrast to traditional programs are designed to be adaptable; involve a diverse number of stakeholders; incorporate an interdisciplinary approach to program design, evaluation and research; incorporate diverse interventions for both upstream and downstream actors; and try to achieve long-lasting impacts.

## 2.9 What Theory Does Not Reveal About Market Transformation

While the market transformation approach shown in Figure 2.2 describes the generic steps involved in the development of an energy reduction program, it does not provide guidance on the design content. Upon researching the market transformation approach for this thesis a number of questions arose:

1) What are the priority risks and barriers that need to be addressed first and consequently what program intervention(s) should one start with?
2) Who should intervene?
3) How realistic is real-time monitoring and evaluation feedback?
4) At what scale should pilot testing begin and how scalable are market transformation programs when applied to a smaller residential high-rise building sector?
5) How will the energy reduction measures be evaluated to determine their persistence in the market?
6) What criteria should be used to determine the effectiveness of a program (e.g., market transformation interventions cannot always be quantitatively assessed and outcomes assigned to any one intervention).

The first question is at the heart of this research. As discussed in sections 2.5.1 and 2.5.2, there are a number of identified risks and barriers, and policy instruments or interventions in the building sector, yet no definitive or universal conclusion as to which risks and barriers and interventions should be addressed first in a pilot program. Ideally, one would like to identify and address all the risks and barriers at once, however realistically and practically, due to resource limitations, it may not be possible. To get at this answer, a relational program model was developed (as described in section 2.5.3) and shows possible points of intervention for any energy reduction program and was used in understanding where the precedent programs have chosen to focus their efforts, and the rationale or considerations behind those choices. Comparative case

study analysis and semi-structured interviews were integral in answering this question.

The second question is really a question about the roles of the key stakeholders? Given we are trying to transform the market for energy reduction measures in the residential high-rise sector, it seems logical to have the market actors for energy reducing goods and services involved in developing the solution. In conducting semi-structured interviews as part of data collection for this research, the various roles and levels of involvement of the stakeholders for the precedent programs were determined.

Third, how realistic and practical is real-time monitoring and feedback by a program evaluation team? After installing a number of ERMs, a program evaluation team can conduct a billing analysis to determine what was achieved in actual energy savings, but is it really their role to continue to monitor and follow-up on whether those savings have persisted? Unfortunately neither precedent program has successfully and completely adopted real-time monitoring and evaluation with feedback loops, and no practical examples were found in the literature. Therefore this aspect of novel programming remains somewhat theoretical. This calls into question whether a program and its evaluation team can cost-effectively conduct real-time monitoring and feedback in a funding restricted environment. Perhaps the answer rests with empowering the market actors to take on this responsibility (i.e., end users monitoring and evaluating their energy use, especially if it is in their best interest to obtain persistent energy savings).

The fourth question is about how to decide on the scale of the pilot and the scalability of an existing market transformation program when applied to a smaller residential high-rise building sector. How many residential high-rise

buildings need to be part of the pilot? Again no literature outlines the appropriate size of a pilot, but practically what has been learned from the New York Energy $mart Multifamily Performance Program (NYE$ MPP) confirms trying to minimize risk and increase chances of success.[16] Therefore, the selection of the number of participants and buildings will ultimately come down to how much funding can be obtained and how many experienced energy service providers can provide the necessary expertise. Can an existing market transformation program be just as effective when applied to a smaller residential high-rise building sector and do the interventions for the program need to change according to the scale? When the economic, social, political, and environmental conditions between locations are similar but the size of the building stock differs, it is important to understand if a minimum building stock size is required for program feasibility. For instance with a smaller residential high-rise building stock will the market transformation program be cost prohibitive; will private financial lenders, energy service providers and the building industry be interested in serving a smaller market; and will private organizations and/or public institutions provide the necessary resources to train and educate the market actors? Additionally, would the interventions need to change? For example, with a smaller residential high-rise building stock, would providing government financing be more effective than having private financing? The research conducted for this thesis does not answer the question of market transformation program scalability.

The fifth question, about knowing when the market has been transformed (i.e., persistence of energy reduction measures and savings in the market), is difficult to determine especially in the case of retrofitting existing residential high-rises. Transforming a market for specific energy efficient products can easily be introduced and market share tracked, but how will whole building analysis with a

[16] Respondents from the NYE$ MPP indicated that the program may have expanded too quickly with inexperienced energy service providers, which increase program administrative time and costs.

number of ERMs be tracked over time? Nadel and Latham (1998) talked about adoption of new minimum efficiency standards or building codes as an effective exit strategy. Perhaps then mandatory renovation codes, minimum performance or mandatory or voluntary labelling requirements that incorporate ongoing monitoring to maintain the label such as ENERGY STAR® could be introduced to determine the impact on the market – a strategy that the NYE$ MPP has introduced for its new buildings component.

The sixth question regarding evaluation of the program for purposes of accountability raises the issue of what criteria should be used? There are many cost-effectiveness tests used by utilities and regulators to determine the cost-effectiveness of energy efficiency programs outlined by Amann (2006), but the market transformation literature suggests that the non-energy benefits are undervalued and a more robust methodology is required to account for the non-energy benefits. However, even if non-energy benefits could be somehow valued and included in cost-benefit tests there is an issue of attribution (i.e., instances where there is no definitive one-to-one relationship between an intervention and the outcome) and whether cost-effectiveness or cost-benefit tests should be the criteria to determine program effectiveness. Clearly what will be needed in program development is a collaborative effort by an interdisciplinary program team to develop qualitative and quantitative program performance metrics and to decide on the criteria for determining or evaluating a program's effectiveness.

The theory on market transformation does not provide definitive answers to what program interventions and risks and barriers should be addressed first, who does the intervening, how large the pilot should be, how to determine when the market has been transformed, and what criteria should be used to evaluate or determine the effectiveness of a market transformation program? These questions are explored through case studies of two well recognized programs,

and the answers used to inform the design of a program for Alberta. What cannot be answered by this research is how practical real-time monitoring and feedback are and if large scale market transformation programs are scalable to smaller residential high-rise building sectors.

## 2.10 Summary

Demand-side management programs have dominated traditional programming strategies for energy efficiency, but with deregulation and restructuring of the utility sector and the need for greater net energy reductions and long-term energy reduction solutions, the approach has evolved to one that looks to transform the market for energy reducing goods and services. Traditional programming has not resulted in the amount of energy savings expected and impacts are short term. Its focus is limited to an engineering perspective and techno-economic fixes for the purchaser of energy goods and services and quantifying energy benefits. In contrast, the characteristics of a market transformation approach is differentiated from traditional programming in that it requires program adaptability to a changing market; an interdisciplinary approach to program design, research and evaluation; diverse program interventions to address issues that impede the adoption of energy reduction measures; looking to evaluate energy and non-energy benefits; adopting real-time monitoring and evaluation feedback loops; and looking to achieve lasting effects without prolonged intervention.

The program for high-rise energy reduction in Alberta will be based on the novel programming approach. A study of precedent programs in Toronto and New York State are used to provide additional insight into more specific implementation questions overlooked by theory. The next chapter describes the approach used to collect, analyze and apply this information to the design of the Alberta program.

## Chapter Three: Methodology

This chapter details the research methodology including the overall research strategy, scope of the research, data collection methods and analysis, and validity, reliability, and limitations to the research.

### 3.1 Overall Research Strategy

The overall research strategy is a program design study that draws on precedent case studies. A design study is used to "make sense of things" before the design exists (Krippendorff, 1989; Wylant, 2009) and in this case, the design of an Alberta energy reduction program. The reason for using case-based design is because referencing precedent programs allows for a more comprehensive understanding of how and why these programs work (Yin 2009) within the context of two northern North American cities; what significant program modules make-up a program; what program approaches and interventions are used in the programs; and how the interventions were developed and used by major stakeholders within the programs to address the issues and achieve certain outputs and outcomes.

### 3.2 Scope of the Research

Precedent program cases are bound by space, time and context in that two operating programs in North America, the Toronto Atmospheric Fund (TAF) TowerWise Program (TWP) for the City of Toronto, and the New York Energy $mart Multifamily Performance Program (NYE$ MPP) for New York State, have been selected for precedent case study review and comparative analysis. These programs have been selected for a few reasons. The first reason is that Toronto and New York City have the highest concentration of residential high-rises in North America (Canadian Apartment Magazine, 2009; E.R.A. Architects Inc., 2010; LeBlanc, 2009) making the programs that address multifamily high-rise

energy performance important to these cities. Secondly, Toronto and New York City have similarities to Alberta cities in that they are in cold or heating-based climates for purposes of building code valuation (IEA, 2008) and determining appropriate energy reduction measures; are major urban centres with a relatively large concentration of high-rise dwellings in buildings with five or more stories; have an aging high-rise building stock; are active in new high-rise construction in Canada and the U.S. according to Emporis.com (2009). Thirdly, the NYE$ MPP and the TAF TWP target the multifamily building sector specifically and their program initiatives have been recognized in the United States and Canada, respectively (C40Cities, 2009; TAF, 2008; York, Kushler and Witte, 2008), making these ideal programs from which to learn.

## 3.3 Data Collection Methods

The design study involves understanding and describing the Alberta context; primary and secondary data collection on the precedent programs; explaining “how” precedent program outputs and/or outcomes resulted from program interventions used to overcome specific issues impeding the adoption of energy reduction measures; comparing and contrasting the precedent programs on the basis of program approaches, interventions and key features; and recommending an energy reduction program design for Alberta.

### 3.3.1 Alberta Context Review

The local economic, social, political, and cultural context in which a program is to operate is important to understand. In order to understand the Alberta context, secondary and primary data was collected. Secondary data includes descriptive statistics on residential high-rises, surveys reflecting attitudes and motivations regarding energy use in Alberta, and information on regulatory and institutional frameworks in Alberta. Descriptive statistics are based on 2006 Canadian Census data and 2008 Natural Resources Canada (NRCan)

energy use data for high-rise dwellings. The 2006 Census data is important in determining the inventory, age, and ownership structure of high-rise dwellings in Alberta. The NRCan energy use data provides information for high-rise dwellings in Alberta and Canada by major fuel source (e.g., natural gas, electricity) and use (e.g., spacing heating, lighting). The energy use data reveals the types of energy reduction measures implemented. Information on existing Canadian energy efficiency and alternative energy programs and climate change initiatives, surveys on the attitudes and motives of energy use by Albertans, and residential energy performance issues were obtained from sources such as websites and publications from different levels of government, non-profit organizations, industry associations, and journals.

Primary data collection included conducting semi-structured interviews with potential program administrators in Alberta and those in the industry that would influence or could be involved in a future energy reduction program design for Alberta residential high-rises. Interviews provided additional insight or validated secondary data on the local economic, social, political, and cultural context in which a program would need to operate in Alberta. Interviewees were selected by obtaining contact names, email addresses and phone numbers through personal contacts or corporate receptionists and government or program online directories. The respondents were emailed and phoned to request participation in an interview either in person or by phone. Of the 12 individuals contacted, 10 responded to the interview questions: 8 in person or by phone interviews, 2 by written responses. Interview questions are included in Appendix I.

The combined data described above helped identify specific needs and important features to consider in the design of an Alberta energy reduction program.

### 3.3.2 Secondary Data Collection on Precedent Programs

Collection of secondary data involving a detailed literature and grey literature[17] review helped identify influencing factors, key program categories and modules, policy instruments or interventions, the potential perceived or real risks and barriers associated with typical energy efficiency or conservation programs, and the outputs and/or outcomes of interventions. The secondary data includes Canadian or U.S. national census and energy data on residential high-rises, journals, and many other documents from the Internet. Canadian or U.S. national census and energy databases contain information on inventory, age, ownership structure, and energy consumption by major source and use in residential high-rises. A literature review of recent journals (i.e., regarding energy policy, social science and human behaviour) and a grey literature review was conducted with website documents containing local government policy and regulatory documents, public service commission (PSC) reports, third party program surveys or evaluations, technical reports, and white papers. These documents provided an initial understanding of what important modules, program approaches, policy instruments or interventions and relationships are considered in programs, what potential risks and barriers need to be overcome to increase adoption of energy reduction measures, and the outputs and/or outcomes. A relational model described in section 2.5.3, was developed to illustrate and understand the possible interactions or relationships between key stakeholders, program categories, program modules, and influencing factors, but also to develop the protocol for data collection as shown in Table 3.1.

[17] Grey literature is published and unpublished material that cannot be found through usual bibliographic methods and include materials from websites, academic theses and dissertations, newspaper and magazine articles, editorials, business and trade journals, reports, and publications from clubs and societies (Gray, 2009).

Table 3.1 *Data Collection Summary*

| 1. Program Module/Issues | 2. Relationship | 3. Interviews | 4. Respondent Categories | 5. Primary Field Case Documents | 6. Secondary Documents |
|---|---|---|---|---|---|
| Building Regulations/ Standards (BRS) | BRS used to set targets for residential high-rise building and retrofitting | Verify regulations and standards used in the program and if they are used to set program energy savings targets | Program administrator and associates, gov't regulators/program oversight reps., developers, energy service providers | Program orientation manual, guidelines, website documents | Gov't regulatory documents, PSC reports, white papers |
| Product Regulations/ Standards (PRS) | PRS influence the types of products and services available | Determine what regulations and standards are being used for the program | Program administrator and associates | Program orientation manual, guidelines, website documents | Gov't regulatory documents, PSC reports |
| Building Technology and Integrated Design Performance (BTID) | BTID influences project energy reduction measures (ERMs), costs and outcomes | Obtain knowledge on building analysis techniques, verify ERMs and impacts | Program administrator and associates, energy service providers, developers, building owners | Program orientation manual, guidelines, website documents | Technical reports, white papers, PSC reports |
| Products and Services | Accessibility to products and services affects outcomes | Obtain perspectives on ease or difficulty obtaining energy-related products and services | Program administrator and associates, energy service providers, developers, building owners | Program orientation manual, guidelines, website documents | |
| Financial Assistance/ incentives (FAI) | FAI can potentially increase program participation<br><br>Capital costs of projects affect participation | Verify types of FAI, and obtain facts and perspectives on applying and qualifying for them<br><br>Obtain motives for developer and building owner participation; Obtain facts and opinions regarding *economic indicators | Program administrator and associates, gov't regulators/program oversight reps., energy service providers, developers, building owners<br><br>Program administrator and associates, energy service providers, developers, building owners | Program orientation manual, guidelines, website documents<br><br>Online program case studies | Gov't regulatory documents, PSC reports, energy policy journals |
| Behavioural Intervention | Behaviour of stakeholders can affect program process and outcomes<br><br>The choice of energy reduction measures affects the outcomes | Obtain motives for stakeholder participation and opinions and perspectives on program process<br><br>Understanding the motivations and developer and building owner choices of energy reduction measures | Program administrator and associates, energy service providers, developers, building owners<br><br>Energy service providers, developers, building owners | | Third party process evaluations, social science and human behaviour journals, energy policy journals |
| Communication, Learning and Awareness (CLA) | CLA or feedback amongst stakeholders can lead to program success or failure | Obtain perspectives on what and how information and knowledge are communicated | Program administrator and associates, gov't regulators/program oversight reps., energy service providers, developers, building owners | Brochure, meeting agenda, website documents | Third party process evaluations |
| Outcomes | Energy savings or other benefits from program participation | Obtain facts and perspectives on outcomes | Program administrator and associates, energy service providers, developers, building owners | Online case studies | Third party evaluation reports, PSC reports |
| Evaluation and Research (Feedback mechanisms) | Feedback from evaluations can be used to improve the program | Obtain facts on whether feedback mechanisms are in place | Program administrator and associates, energy service providers, developers, building owners | Presentation | Third party evaluation reports, PSC reports, energy policy journals |
| Risks and Barriers | Risks and barriers can negatively affect program performance | Obtain perspectives and opinions on program challenges and barriers | Program administrator and associates, gov't regulators/program oversight reps., energy service providers, developers, building owners | | Third party process evaluations, white papers, energy policy journals |

Notes. Public service commission (PSC); government (gov't); representatives (reps.); *Economic indicators include payback period, rate of return. Building owners: developer-owners, building owners, condo or co-operative owners and their representatives.

### 3.3.3 Primary Data Collection on Precedent Programs

Primary data includes documents on the precedent programs collected from field visits or program websites and interviews. During the months of March and April 2010, field visits were conducted in Toronto and New York to obtain primary data sources in the form of interviews or any supplied field program documents. Field program documents for document analysis included a program brochure, program guidelines, a program orientation manual, a meeting agenda, a presentation, and sample case studies. Field documents were collected to obtain missing facts or augment primary data documents on the precedent programs obtained from program websites on the Internet (refer to Table 3.1 columns 1, 2 and 5).

Interviews were used to verify information, obtain missing information, and explore the motives, perspectives, and opinions of major program stakeholders. The relational model described in section 2.5.3, was used to determine which respondent categories should be interviewed regarding specific program modules as shown in Table 3.1 columns 1, 2, 3, and 4. The interview questionnaires for each respondent category are attached in Appendix I.

Interviews were used as a method to collect data, because they would help to identify key program modules and their relationships, interventions and issues with program operation or impeding the adoption of energy reduction measures. More specifically, semi-structured interviews were conducted over structured interviews because they allow for omission, addition or re-direction of questioning when new issues arose (Gray, 2004). Consequently, the questions attached in Appendix I, may have been omitted, modified, or new questions added during the course of the interviews. The primary focus of the interviews was to gather information on program stakeholder roles, responsibilities, and motives; program strengths and challenges and barriers; program regulations

and standards; building technology, products and services; program funding; financial assistance and incentives; information, knowledge and communication strategies. All interviews were conducted either in person or by phone.

The respondents have been purposively selected on the basis that they are major stakeholders that are intimately involved with the program through their roles in program oversight, administration and implementation, funding, and services or as program applicants. Respondent categories for those interviewed included government regulators or program oversight representatives (e.g., public service commission staff, board of directors), program administrators and associates (e.g., implementers, quality control (QC) or quality assurance (QA) contractors, advisors), energy service providers, developers, and building owners.

Interviews with government regulators or program oversight representatives and program administrators and associates from each precedent program were conducted as these individuals are involved in one or more of the following: overseeing the program, funding the program, administering the program, and implementing the program. The respondents were recruited by obtaining the contact names, email addresses and phone numbers through a corporate receptionist or government or program online directories, and emailed and phoned to request participation. For the TAF TWP, 6 individuals were contacted but only 4 (1 program oversight representative, 2 program administrators, 1 advisor) participated. For the NYE$ MPP, 11 individuals were contacted but only 6 (3 program administrators, 2 implementers/QC contractors, 1 QA contractor) participated. A program oversight representative for the NYE$ MPP was unable to participate. As a result, a contact from the American Council for an Energy-Efficient Economy (ACEEE) was provided by the New York

Department of Public Service. A representative with the ACEEE made contact and subsequently an interview was conducted.

Energy service providers, involved in working with program participants to implement energy reduction measures, were recruited by email and phone when their contact information was provided by program administrators and associates or from the program website. Energy service providers that work on new and/or existing multi-unit residential high-rises in the program were selected. For the TAF TWP, 5 individuals were contacted but only 2 participated and for the NYE$ MPP 20 individuals were contacted but only 10 participated.

Developers, building owners/managers, condominium or apartment association representatives were recruited by email and phone when their contact information was obtained from case studies, provided by the program administrators and associates, or located on the program website. For the TAF TWP, of the 4 individuals contacted, only 1 developer participated; and for the NYE$ MPP, 6 of the 9 individuals contacted participated. Table 3.2 summarizes the number of respondents contacted and interviewed.

Table 3.2 *Summary of Precedent Program Interviews*

| Respondent Category | TAF TowerWise Program | | NYE$ Multifamily Performance Program | |
|---|---|---|---|---|
| | Contacted | Interviewed | Contacted | Interviewed |
| Government regulators/ Program Oversight Representatives | 2 | 1 | 2 | 0 |
| Program administrators | 3 | 2 | 5 | 3 |
| Program Associates | 1 | 1 | 4 | 3 |
| Energy Service Providers | 5 | 2 | 20 | 10 |
| Developers and Building Owners | 4 | 1 | 9 | 6 |
| Other (alternate to government regulator) | - | - | 1 | 1 |
| Totals | 15 | 7 | 41 | 23 |

The collection of field documents and interview responses were used to identify the precedent program interventions, the issues (risks and barriers) that program administrators needed to address, and the outputs and/or outcomes resulting from the interventions.

## 3.4 Data Analysis & Design

The design study used comparative analysis, which involves comparing and contrasting program approaches, interventions and key features of the precedent cases. However, the design study also drew upon case study analysis techniques, such as explanation building and time-series analysis (Gray, 2009; Yin, 2009). The explanation building involves building an explanation about how and why the precedent program outcomes resulted from specific program interventions. While the time-series analysis is incorporated in explaining the cases only from the perspective of how the programs changed over time-from program start-up to the end of the research period. The final design of the Alberta energy reduction program is based on the comparative analysis, builds on the learning from the precedent programs, and is tailored to the Alberta context.

### 3.4.1 Precedent Program Explanation Building

Explanation building involves building an explanation about the precedent program approach and its interventions and involves a series of iterations in the process (Yin, 2009). The series of iterations have included (Yin, 2009):

- making an initial statement about the program approach;
- comparing the findings of the program against the statement;
- revising the statement;
- comparing other details of the case against the revision;
- comparing the revision to the facts of another case;
- repeating the process.

All interviews were transcribed. Primary and secondary data were compiled for each of the precedent programs and the information used to identify the interventions and evaluate them based on the outputs (early indicators of success) and/or outcomes. The idea behind a market transformation approach, as discussed in detail in Chapter Two, is that it involves understanding the market for energy reducing goods and services, intervening (without prolonged intervention) to bring about lasting changes by reducing or eliminating risks (perceived or real) and barriers in the market. Therefore, building an explanation on each precedent program required determining the context in which the programs were developed and identifying the program's approach to market transformation. Explanation building also required identifying the key features from the evaluation of the interventions used to address specific issues (including the risks and barriers). The precedent program key features that were identified (discussed in Chapters Four and Five) are:

(A) Working with industry to advance energy reduction.
(B) Having a program point person.
(C) Demonstrating and proving energy reduction to the market.
(D) Using experienced energy service providers.
(E) Having energy service provider (ESP) training outside of program.
(F) Having reliable energy reduction measures for long-term energy savings.
(G) Having effective communication/education strategies.
(H) Targeting the audience.
(I) Having proper building owner training/education for long-term energy savings.
(J) Understanding the market.
(K) Understanding behaviour and choice.
(L) Identifying non-energy benefits.
(M) Evaluation and research to improve program and verify energy savings.

(N) Having a program administration that is trusted, independent, and mandated to reduce energy in high-rise buildings, operates with good governance, and builds relationships.
(O) Improving program clarity and ease of use.
(P) Establishing a baseline of energy use profiles for residential high-rises.
(Q) Analyzing the whole building for energy reduction measures.
(R) Addressing energy efficiency and conservation measures before implementing alternative technologies.
(S) Having diverse financing tools for upfront capital costs.

The final analysis and results for each program are illustrated in the relational model to show what program interventions were implemented in order to achieve certain outputs and outcomes, leading to eventual transformation of the market for energy reduction measures.

### 3.4.2 Comparative Analysis and Program Design

Understanding the Alberta context in relation to design of an energy reduction program required using the secondary data and semi-structured interviews as described in section 3.3.1.

Comparative analysis involved taking the results from each of the precedent programs; comparing and contrasting program approaches to market transformation, interventions and key features; and modifying, adapting, and applying what was learned from the precedent programs to Alberta's context. The final Alberta energy reduction program was designed on the basis of the comparative analysis, but tailored for the Alberta context.

## 3.5 Validity, Reliability and Limitations to Research

The discussion in this section covers validity and reliability and limitations of the research. Internal validity is concerned with trying to explain how and why

one event led to another that is – how and why an intervention used to address certain risks or barriers led to any given output(s) or outcome(s) (Yin, 2009). Reliability, on the other hand involves trying to minimize errors and biases in a study (Yin, 2009). Data triangulation of documents and interview responses was used to address both internal validity and reliability.

Different program respondents as discussed in section 3.3.3 were interviewed to provide multiple perspectives on the programs. The TAF TowerWise program has only been in operation for a few years and thus fewer than expected energy service providers, developers and building owners were interviewed either because of availability or limited experience with the program specifically. Consequently, triangulation was predominately limited to document analysis and interview responses with those who were interviewed. However, certain features were corroborated amongst the different respondents (e.g., demonstrating and proving energy reduction to the market – refer to section 4.3.1). The NYE$ MPP is well developed and formed through the amalgamation of multiple legacy programs. Consequently, many more participants were available for interview and triangulation of interview responses with documents collected is more comprehensive. Third party process evaluations involving interviews with multiple program participants conducted by New York State Energy Research and Development Authority's (NYSERDA is the program administrator for the NYE$ MPP) contract evaluators also corroborated some of the features discussed in section 5.3. In addition, comparative analysis found recurrent features in both programs although the details varied.

A limitation in the design study, and in market transformation programs generally, is attribution, i.e., multiple interventions or influences may in fact lead to one or more outcomes. However, crediting any one intervention or influence to an outcome may not be possible or erroneous. In addition, as the design study

was somewhat exploratory in nature, it became apparent over the course of collecting information how important an understanding of the influences of energy use behaviour is in program design. Stern (2008) has indicated that there are a number of variables influencing "environmentally significant behaviour"[18] including contextual factors; social norms and expectations; personal capabilities; habit and routine; and attitudinal factors (shown in Figure 2.4). It was beyond the scope of this study to cover the influencing factors on behaviour in its entirety. However, research findings point to incorporating behavioural research in program design, which has been recommended in the final energy reduction program design for Alberta.

[18] According to Stern (2008) energy use in our homes is one of the most important environmentally significant behaviours.

## Chapter Four: Toronto Atmospheric Fund TowerWise Program

The Toronto Atmospheric Fund (TAF) TowerWise Program (TWP) is the first program of two selected for case study analysis. This chapter discusses the program's background, administration context, approach and interventions. It concludes with a summary of the key or defining features of the program, and an assessment of the extent to which this case meets the theoretical novel programming ideal.

### 4.1 Background

The City of Toronto has a population of 2.5 million people with approximately 480,000 housing units in the residential high-rise (5 or more stories) sector according to 2006 Statistics Canada census data. The City of Toronto is ranked first in Canada and second in North America with the most high-rise buildings (Emporis.com, 2009). Toronto's greenhouse gas emissions were approximately 24 million metric tons in 2004 with 25% from the residential sector (City of Toronto, 2007). Toronto's residential high-rise sector produces approximately 40 percent of Toronto's residential emissions with aging buildings using up to 20% more energy per square meter than a typical single family home (Toronto Atmospheric Fund [TAF], 2009a). As a result, addressing energy use in these buildings is the key to reducing the city's residential emissions (TAF, 2009a).

In 1991 Toronto city council established the Toronto Atmospheric Fund (TAF), which backs pioneering programs and technology applications to help achieve Toronto's greenhouse gas reduction targets and improve air quality (TAF, 2010a). One such program developed by TAF is the TowerWise Program aimed at addressing the residential high-rise sector and has received recognition by the C40 Cites Climate Leadership Group and the Globe Foundation for its

initiatives and innovative financing product, “Green Condo Loan” (C40Cities, 2009; TAF, 2008).

### 4.2 Program Administration Context

The context in which a program and its administration is established and operates is important in understanding its success. Three important contributing factors to the TAF TowerWise Program’s success are:

1. Its administration is independent, neutral and trusted by program participants and stakeholders with an interest in the high-rise building sector.
2. It works under specific energy policy and good governance, which includes legitimacy, accountability and adaptability (Blumstein et al., 2005).
3. It was developed and operates with industry partnerships.

TAF is a self-supporting funding agency that became operational with a $23 million City endowment obtained in 1992 from the sale of a city property (Langstaff Farms) (City of Toronto, 2009a, p. 8). TAF operates with a degree of independence or at arms-length under a city council-defined framework, which allows for a more autonomous grants process; ensures city financial assets are dedicated to initiatives that improve air quality and reduce greenhouse gas (ghg) emissions; allows investment opportunities not available to municipalities; and allows special expertise and community involvement through board decision-making (City of Toronto, 2009a, p. 8). Two program administration staff and an energy service provider (ESP) when interviewed indicated that maintaining independent or arms-length has given TAF credibility and allows them to be able to bring different stakeholders to the table.

The City of Toronto has specific plans and policies in which to address Climate Change. In July 2007 city council unanimously adopted greenhouse gas reduction targets for the Toronto urban area outlined in the Climate Change,

Clean Air and Sustainable Energy Action Plan June 2007. The greenhouse gas reduction targets are 6% by 2012, 30% by 2020, and 80% by 2050 below 1990 levels which were 27 million tonnes (City of Toronto, 2009b). One key strategy in addressing the aggressive environmental framework aimed at reducing Toronto's greenhouse gas emissions is the Toronto Green Standard (TGS) that came into effect Jan 31, 2010. The Toronto Green Standard addresses environmentally friendly site design and buildings that will result in improvements to air and water quality; increased energy and water efficiency, and solid waste diversion rates; reducing greenhouse gas emissions; and enhancing ecology and the natural environment (City of Toronto, 2010a). The Toronto Green Standard aims to have energy efficiency addressed for new mid- to high-rises (four or more storeys) by setting a mandatory minimum energy performance standard of 25% improvement over the 1997 Model National Energy Code for Buildings (MNECB) or 13% over the Ontario Building Code 2006. They have also instituted a voluntary level of enhanced performance aiming for 35+% better than the 1997 MNECB, installed in-suite smart meters in residential units, and best practice commissioning (City of Toronto, 2010b, p. 6-7). In this case, the policies and decisions are made at the same level as the TAF program, i.e., the municipal level, making initiatives for the TAF TowerWise program more locally based. The focus for TAF is to work with key stakeholders (e.g., developers, building managers and residents) to improve building performance and implement the energy reduction measures in both newly built structures and existing buildings in the City of Toronto. This level of administrative engagement makes sense in this case because people are engaged with their associations at this level as opposed to provincially (TAF Program Manager, pers. comm., March 9, 2010).

TAF was legitimized in the passing of the Toronto Atmospheric Fund Act 2005 and the small program staff is accountable to an administrative and financial board made up of 4 members of Council and 7 citizen members (City of

Toronto, 2009a, p. 6, 11, 16). The TAF staff is tasked with employing grants, loans, and direct programming, one of which is the TowerWise program (TAF, 2010a). TAF activities include receiving financial contributions to augment the original endowment fund; managing the fund; providing grants and loans and establishing projects that support TAF's objectives; conducting mandate-related research; co-operating with others to provide public education; and administering and managing TAF's operations (City of Toronto, 2009a, p. 9). According to the TAF Program Manager:

> The TAF board oversees the program and the staff reports to the board annually with a business plan for the organization including a plan for each of the program areas and at the end of the year TAF reports against the stated objectives on the business plan, (personal communication, March 9, 2010).

TAF is adaptable in that it is flexible to change and is a self-supporting funding agency that obtains its funding from the City endowment, sponsorship, and/or partnerships. According to the TAF Associate Director, Mandate Related Finance (TAF Associate Director), who is instrumental in developing the financing models for the TWP, the board of directors allows $8 million of the city's $23 million endowment to be invested in the stock/bond market and to be allocated to be invested in/lent to any private or non-profit organization that TAF staff feels has merit (pers. comm., February 22, 2010). Funding adequacy depends on the initiatives being driven forward and the approach is to leverage TAF's money with somebody else's in the form of sponsorship (TAF Associate Director, pers. comm., February 22, 2010). TAF recognizes that $8 million or the entire endowment of $23 million is really not enough to directly finance a transformative change across the city, so the focus is on proving a financing model that other financial institutions will take up (TAF Program Manager, pers. comm., March 9, 2010).

The TowerWise program has also shown flexibility in that it can re-direct funds to other initiatives depending on the needs. TAF Associate Director has indicated that TowerWise is a flexible market responsive program and TAF has found ways to raise capital to address new issues by respecting partners in the market place (pers. comm., February 22, 2010). In an example provided, he indicated that:

> The incentives advisor [position] was an add on – not a budgeted position but, in a meeting of the stakeholders one of them recommended the need for increased uptake of energy efficiency programs and therefore TAF TowerWise funds for marketing were re-allocated and financial contributions from other stakeholders were combined to help establish the new position, (pers. comm., February 22, 2010).

TAF was able to act on the initiative relatively quickly. The TowerWise website was launched in December 2008 and within a nine month period the need for the TowerWise Conservation Incentives Advisor was identified and the service was launched (TAF, n.d.a).

An important aspect in how the program was developed and operates has much to do with its credible independent reputation and being able to reach out to the community and bring important stakeholders together. In November 2007, TAF held the first ever energy efficiency summit for Toronto's residential high-rise sector, bringing together building owners and managers, industry associations, tenant associations, government representatives, suppliers, etc., which eventually led to the creation of the TowerWise Energy Education Action Committee (TEEAC) – a 40+ stakeholder group working together to advance energy efficiency in the residential high-rise sector (TAF, n.d.b). This meeting was the genesis of the TowerWise program (TAF, n.d.a). According to the TAF Associate Director, some of the main reasons for success are:

> We [TAF] did not decide that the program would be designed right at the beginning; Acknowledged that we could not design the program on our own; Reached out to community – brought people from the sector that

> understood the barriers to help overcome the barriers and what would be required in the program – relied on community experts to assist us; Brought people with diverse backgrounds together that wouldn't have necessary been sitting at the table together (tenant associations, suppliers, non-governmental, business owners, independent group support); TAF TowerWise worked hard to maintain an image of being an independent resource not tied to anyone (only have sponsors); Developed a body of knowledge over time and haven't overstepped their own experience; Brought a lot of tools together to the table that have not been used in the same combination before, (pers. comm., February 22, 2010).

TAF is committed to building relationships with industry to identify the issues and finding the right solutions.

### 4.3 Program Approach and Interventions

This study focuses on identifying common strategies of both precedent programs, informing and informed by the program relational model developed in Chapter Two, while allowing for variation in the details (Yin, 2009). In general both program administrators are looking to transform the market by intervening in it and addressing the issues (e.g., correcting market failures). However, each program has adopted a different approach and market interventions because of different assumptions and context specific issues. In spite of these differences, they share a number of common features, discussed later in the Chapter Six.

Based on the information collected, the program approach that best describes and distinguishes the TWP from the NYE$ MPP is:

> A program that transforms the market by collaborating with others to remove risks and barriers in the market and providing education, resources and various tools to improve energy performance in residential high-rises.

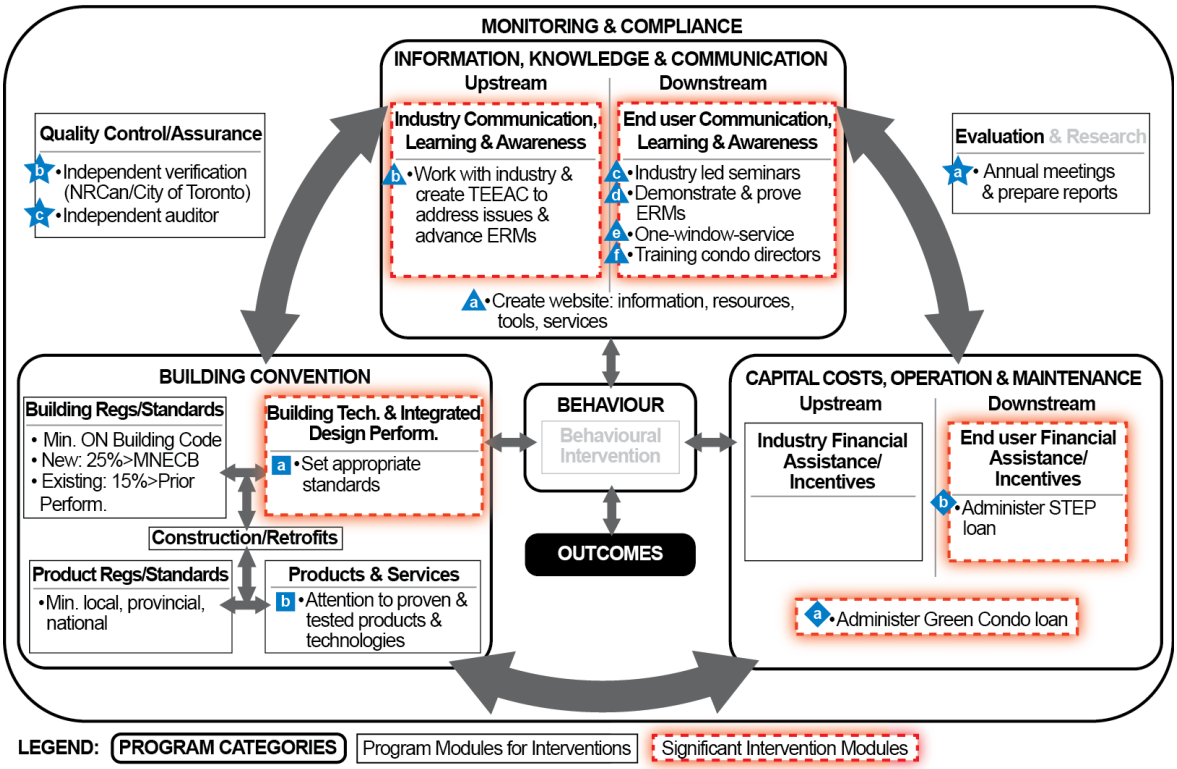
To achieve their goal, the program has three main focus areas: 1) providing sector-specific information about energy efficiency and renewables; 2) maximizing impact of programs; 3) working with financial sector professionals to

deploy specialized financing products (TAF, n.d.a and n.d.b). In the following subsections there will be a discussion of how TAF has addressed these focus areas, what issues were identified, what kinds of relationships and interactions occur between the market actors (upstream and downstream), and how they intervened.[19]

The TowerWise program interventions have been organized into the four relational model categories developed in Chapter Two – information, knowledge and communication; capital costs, operation and maintenance; building convention; and monitoring and compliance (refer to Figure 4.1). The last category, behaviour, does not have any interventions of its own; rather energy use behaviour is an expected result of the other interventions. Details about the program interventions along with the issues (risks and barriers) and results (outputs and/or outcomes) are discussed below. The category of policy instruments or interventions, as discussed in section 2.5.2, include support, information, and voluntary action (e.g., awareness raising, education, information campaigns); control and regulatory mechanisms (e.g., appliance standards, building codes); and fiscal instruments and incentives (e.g., loans). The final model for the TAF TowerWise Program is illustrated in the following Figure.

[19] Note that other program interventions might exist, but were not discovered during data collection.

*Figure 4.1.* TAF TowerWise Program Model




Notes. 1997 Model National Energy Code for Buildings (MNECB); ERMs - Energy reduction measures; Regs - Regulations; Min. Minimum; ON - Ontario; Perform. - Performance; Tech. - Technology.

For reference, all program interventions, the issues addressed, outputs, expected outcomes and results have been summarized, tabulated and included in Appendix II.

### 4.3.1 Information, Knowledge and Communication

As shown in Figure 4.1, there are six program interventions addressing issues of information, knowledge and communication. Interventions a (creating a website) and c (having industry led seminars) are intended to address the lack of understanding of energy reduction measures by developers and building owners, and poor building operation and maintenance practices.

The lack of understanding energy reduction measures by building owners is one of the barriers identified by five of the interview respondents. Respondent comments varied but include:

- inaction by building owners because payback (time it takes to recover the initial capital investment with the incremental savings generated by the initial investment) periods are too long (TowerWise Conservation Incentives Advisor, pers. comm., March 11, 2010);
- unrealistic notions of payback and using payback as an inappropriate indicator in the decision to invest in energy reduction measures (ERMs) (TAF Associate Director, pers. comm., February 22, 2010);
- building owners finding it hard to understand the reasons for upgrading the building envelope with the mechanical system (GRG Building Consultants Operations Manager, pers. comm., March 22, 2010);
- building owners do not see the long-term benefits and intangible returns (City Councillor/TAF Board of Directors, pers. comm., March 8, 2010);
- building owners are sceptical that ERMs pay and see ERMs more of a cost than an investment that pays off (TAF Program Manager, pers. comm., March 9, 2010).

In addition to a lack of understanding of energy reduction measures, there is an issue of poor building operation and maintenance. In larger high-rises, with more technically sophisticated control systems for HVAC, one of the biggest challenges is having building owners and maintenance staff trained to operate the mechanical systems properly. Poor operation and maintenance can affect overall energy savings. One respondent indicated that:

> [O]nce the equipment goes in I don't know who runs the thing, I don't know if it runs well. So from a capability standpoint I think that is really, really weak. The people that own the buildings they have got superintendents that have no training on how to run a sophisticated system. Condos have supers that maybe have a little more training, but really they rely on their

> contractors to run this piece of equipment. There is no monitoring on this kind of stuff, (TowerWise Incentives Advisor, pers. comm., March 11, 2010).

The first intervention to address the above issues is creating a website with information, resources, tools, and services (a). The TowerWise website was officially launched in December 2008 (TAF, n.d.a). Some examples of information and resources on the TWP website are a step-by-step guide to plan and execute a quality energy retrofit, free advice from the TowerWise Conservation Incentives Advisor, and information on courses for condominium managers and facility managers regarding building systems and maintenance issues. There are also links to other resources, a list of energy service providers, calculation and financing tools, information on TowerWise initiatives and other programs, and relevant YouTube videos, webinars, seminars or events, and presentations. Most of the material targets end users (downstream actors) and website interactivity is limited to comments regarding seminars or events.

Having a website is important in providing resources for building owner training and addressing the general lack of understanding of energy reduction measures by informing upstream and downstream actors. The website contains resources on matters such as what measures can be taken, how to calculate your returns properly, what the benefits are, what financing options and other programs there are, how to go about initiating projects, and how to maintain the savings with proper building operation and maintenance.

The second intervention c is working with industry and having industry led seminars or events, which are also aimed at building owners to improve their knowledge of energy reducing measures. Having industry led seminars or events is an added strength because it reaches a wider audience. As stated by the TAF Program Manager:

> [C]o-organized events with Greater Toronto Apartment Association (GTAA) and TAF increases access and attendance of those who are more closely associated with GTAA (without the partnership a government organization [they] may not get the same turnout). Creation of public-private partnerships increases access to those in associations like the GTAA where there is legitimacy and trust within the sector association, (pers. comm., March 9, 2010).

According to interviews[20] with program administration these interventions (a and c) have seen results in the form of positive feedback from seminar or event attendees and an increase in the number of unique hits on the website, time spent on the website, and number of seminar or event attendees. When asked about what effect the program has in encouraging building owners to move forward on energy reducing measures, the TAF Associate Director stated:

> It is a combination of actions that makes a difference – hands on educational outreach program, links to other sites with additional information, diversity and number of educational seminars, support from someone on the ground like an incentives advisor [...] a trusted and independent source of information on the website, (pers. comm., February 22, 2010).

Given the information available and the newness of the program, however, it was not possible to ascertain whether interventions a and c will have a real long-term impact by increasing upstream (e.g., developer) and downstream (e.g., end user) actor knowledge of energy reducing measures and influencing building operation and maintenance practices.

Intervention b involves working and consulting with industry and creation of the TowerWise Energy Education Action Committee (TEEAC) to identify and address barriers, and advance energy efficiency. In 2007, TAF hosted an annual forum focused on energy efficiency for multi-unit residential buildings (MURBs), which brought together stakeholders in the residential high-

[20] 2 respondents.

rise sector such as representatives of the development, building construction and property management sectors, the energy efficiency and utility sector, organized labour, industry associations, tenant associations, and government representatives (TAF, 2010c). The event was the genesis of the TowerWise Energy Education Action Committee, which consists of a voluntary group of more than 40 stakeholders that meet quarterly working to advance energy efficiency in the residential high-rise sector (TAF, n.d.a and n.d.b). The idea behind this intervention is to help in the development of the program and identify and address any risks and barriers impeding uptake of energy reducing measures in the sector. TAF and the industry have collaboratively identified and are working together on issues associated with stakeholder needs, regulatory barriers, developers not wanting to pay for the incremental cost of ERMs in new construction (developer/condominium owner split incentive), lack of financing options, and no guarantee of energy savings. The TAF Program Manager explains the value of this approach:

> TowerWise Energy Efficiency Action Committee (TEEAC) has a broad range of stakeholders (apartment owners, property managers, condo sectors, energy management firms, government representatives) and has helped keep the program targeted at the kinds of activities and information that people in that group thought would be really useful, (pers. comm., March 9, 2010).

For instance, one industry organization recognized the need to increase participation in other energy reduction programs outside of the TowerWise program, which resulted in the creation of an incentives advisor position. The position was an add on and not budgeted for by TAF, but funds for marketing were re-allocated and other industry stakeholders contributed to help fund the position (TAF Associate Director, pers. comm., February 22, 2010).

TAF's collaborative work extends to meeting with government and industry representatives to find solutions in correcting market failures and

financial hurdles. For example during an interview, the TAF Program Manager indicated that they were meeting with the City to work at changing the Toronto property standards that prevent motion sensor lighting in hallways and parking areas (pers. comm., March 9, 2010). Recent news on their website has indicated success with the changes. TAF also teamed up with a major developer in Toronto to find the solution to the developer/condominium owners split incentive. The collaboration resulted in an innovative financing model to address the split incentive (the Green Condo loan discussed in section 4.3.2), so that developers can invest in energy reduction measures and condominium owners who benefit from the lower operating costs will pay back the loan (TAF, n.d.b). According to TAF's annual reports, a number of Green Condo loans have been transacted. In addition, TAF is continuing to work with the financial sector and industry to address an insurance product and other financing options such as a new loan product (STEP loan) (TAF, n.d.b). The STEP loan is structured so that the carrying costs of longer payback measures do not compromise immediate cash flow gains from the retrofit (TAF, n.d.b). TAF has been successful in working with others to advance energy efficiency, but two respondents indicated that the lending industry is still not mature (i.e., it is not the norm for private financial institutions to lend for energy reduction projects).

The fourth intervention (  ) is demonstrating and proving that energy reduction measures work through case studies or providing the proper information. All seven interviewees indicated the importance of having case studies or providing the proper information in order to highlight the benefits and prove to industry (which includes the financial institutions) that energy reducing measures work. Some comments specific to case studies include:

> [T]here are no good case studies showing the benefits [of energy efficiency] [...]. We are trying to put together case studies that would help others to be able to take those case studies and also to plug numbers in so it is easy for them to come up with their own case studies as to how much the benefits

> would be, (City Councillor/TAF Board of Directors, pers. comm., March 8, 2010).
>
> Case studies will help in getting verifiable third party information that validates energy savings potential and payback on projects, (TAF Program Manager, pers. comm., March 9, 2010).

Development of case studies or providing information on energy reduction projects is important in demonstrating the advantages of energy reduction in residential high-rises and overcoming uncertainty and the lack of understanding by end users and financial lenders. Ensuring the case studies are relevant and targeted to reach the right audience is equally important. As stated by the TowerWise Incentives Advisor:

> My target really was the people who own ten or less buildings and there are very few cases studies that don't involve projects over a quarter million dollars [...] in my presentation comments were made – that stuff only works for big companies but it won't work for me because I only own two buildings or I only own three buildings, (pers. comm., March 11, 2010).

TAF publishes many case studies from different programs for residential high-rises in the Toronto area. Approximately twelve case studies are highlighted on the TowerWise website as downloadable documents or one in the form of a YouTube video. They generally include short descriptions of the buildings, their use and history, reasons for upgrades, types of energy reduction measures, capital costs and paybacks, energy savings, and greenhouse gas emission reductions. It is indeterminate how these case studies have affected building owner confidence and the uptake of energy reducing measures.

Intervention  is the creation of a TowerWise Conservation Incentives Advisor – a "one-window-service" for the purposes of addressing low participation/building owner inertia[21] and unclear rules in many of the other programs outside of TowerWise program. Other programs outside of TWP

[21] 1 respondent.

available to building owners such as the Enbridge energy audit and retrofit programs; City toilet replacement, washer rebate, and buyback programs; Better Buildings Partnership Multifamily Energy Efficiency Rebates; NRCan ecoEnergy Retrofit Incentive for buildings and Renewable Heat. A TowerWise Conservation Incentives Advisor aims to improve use of Toronto's incentive programs by providing a one-window service for access to all residential high-rise incentive programs and assisting in maximizing benefits and planning comprehensive retrofits (TAF, n.d.b). The TowerWise Conservation Incentives Advisor helps to identify the incentives that fit a building owner's needs and explains the potential level of support available and how to apply (TAF, 2009b). The appeal to building owners is that service is free of charge and the incentives advisor is independent in that the position is supported by a number of parties including the Greater Toronto Apartment Association, TAF TowerWise, Enbridge Gas Distribution, Toronto Water, and the Better Buildings Partnership (TowerWise Incentives Advisor, pers. comm., March 11, 2010). Since the introduction of the independent TowerWise Conservation Incentives Advisor the number of website hits has quadrupled over the past year and there is increased amount of time spent on the website, number of seminar attendees, and number of participants going through the incentives advisor for advice (150 people applying for other programs that would not have without the incentive advisor) (TAF Associate Director, pers. comm., February 22, 2010).

The last intervention in this category,  (training for condo directors), addresses the growing condominium market by introducing training for condominium directors. Interviewees[22] have indicated a challenge with the condo ownership structure and that marketing energy reduction measures specifically to condominiums is an issue. The condo sector is particularly challenging because it is not a homogenous market place – for example, there are different structure

[22] 2 respondents.

of boards and level of sophistication, varying restrictions in the condo act on use of funds for energy efficiency and renewables versus replacement goods, and challenges of acquiring majority ownership votes to proceed on projects (TAF Associate Director, pers. comm., February 22, 2010). As a result, TAF is working to offer training and empower condominium directors to champion energy efficiency and renewable energy in their buildings (TAF, n.d.b).

In Toronto, there is a large older rental building stock and a growing condominium market. Over 70% of the existing dwellings in apartment buildings with 5 or more stories were constructed between 1960 and 1990, 75% of which are rented rather than owned (Statistics Canada, 2006). More recent activity is in the condominium market and according to the Canada Mortgage and Housing Corporation (2010b), over 90% of 2009 dwelling completions in Toronto that fall under the category of “Apartment and Other” are condominiums. As a result concentrated efforts are needed in both new construction and retrofitting existing residential high-rises. Much of TAF’s efforts are focused on market rate rentals and condominiums because the older affordable and public sector housing is being addressed by a separate City of Toronto initiative (Tower Renewal) to revitalize communities surrounding these aged towers.

Overall, the key features that characterize these interventions, as summarized in Table 4.1, are working with industry to advance energy reduction, having a point person, demonstrating and proving energy reduction to the market, having effective communication/education strategies, targeting the audience, having proper building owner training/education for long-term energy savings, and improving program clarity and ease of use.

Table 4.1 *TWP Key Features of Information, Knowledge and Communication Interventions*

| TAF TowerWise Program (TWP) Key Features | Program Category: Information, Knowledge and Communication |
|---|---|
| (A) Working with industry to advance energy reduction | b c |
| (B) Having a point person | e |
| (C) Demonstrating and proving energy reduction to market | c d |
| (G) Having effective communication/education strategies | a b c e |
| (H) Targeting the audience | d f |
| (I) Having proper building owner training/education for long-term energy savings | a c |
| (O) Improving program clarity and ease of use | e |

### 4.3.2 Capital Costs, Operation and Maintenance

Two interventions a and b in the capital costs, operation and maintenance category involve the administration of loans for developers and building owners (refer to Figure 4.1). The first of the loans administered by TAF is the Green Condo loan (intervention a), which was discussed previously, addresses the split incentive between developers and condominium owners. A Green Condo Loan is an innovative financing tool that helps pay for energy reduction measures in new condominium developments. It is structured so that the developer can install energy reduction measures in the building, but does not have to pay for the incremental cost of the measures because the condominium corporation and unit holders, who will benefit from energy-related cost savings, pay back the loan with the energy savings (8 to 9 year amortization). Specifics of the loan are described by the TAF Associate Director as follows:

> [A] developer only recovers the incremental capital for energy efficiency measures from the Green Condo loan, which is paid back by the energy savings that benefit the condo owners through the condo corporation (cash flow neutral). [The] developer spends all the money upfront and the condo corporation goes to TAF to get money for the green initiatives to pay the

> developer for the incremental capital for energy efficiency measures on closing – no out of pocket dollars for the owners. The Green Condo loan is paid back by the condo corporation from the energy savings. Interest rate of the loan is negotiated with the developer before turn over to the condo corporation. Standard rate is 4% greater than the relative Canada benchmark bonds, (pers. comm., February 22, 2010).

During the interviews it was mentioned that a major developer in Toronto transacted three Green Condo loans with an additional six more being worked out. Five Green Condo loans valued at approximately $3.2 million have been transacted between 2004 and 2009 according to TAF annual reports (Green Condo Loan existed prior to TWP launch). The current status of the loans was not mentioned.

The second type of loan to be offered by TAF is the STEP loan (intervention  ). The STEP loan is for high-rise energy retrofits and is three loans (short, medium, and long term) packaged to make it easier to perform a comprehensive retrofit without compromising cash flow and the hassle of multiple loan applications and approvals (TAF, 2010b). Details were not available during data collection as TAF was still in the process of developing the initiative.

Access to capital, lack of maturity by mainstream financial lenders, and uncertainty in energy savings are barriers for the market of energy reduction measures. With innovative loan options for new and existing residential high-rise projects, TAF is providing different financing options to building owners and at the same time acting as a small “bank” (TAF, 2010b) to prove the financial models. TAF recognizes that $8 million or the entire endowment of $23 million is not enough to directly finance a transformative change across the city. The focus is on proving a financing model, so that the private sector will take it up (Program Manager, pers. comm., March 9, 2010).

The key features derived from these interventions are the importance of demonstrating and proving energy reduction to financial lenders in the market and offering diverse financing loan options (refer to Table 4.2).

Table 4.2 *TWP Key Features of Capital Costs, Operation and Maintenance Interventions*

| TAF TowerWise Program (TWP) Key Features | Program Category: Capital Costs, Operation and Maintenance |
|---|---|
| (C) Demonstrating and proving energy reduction to market | a b |
| (S) Having diverse financing tools | a b |

### 4.3.3 Building Convention

Two interventions a and b in this category involve regulations/standards and building technology, products and services (refer to Figure 4.1). Intervention a is setting the appropriate building standards or performance targets for the program. The issue is to set standards in a program that can reasonably achieve cost-effective long-term energy savings. In setting the appropriate standards, TAF consulted and worked with the experts, promotes comprehensive retrofits, and recommends energy efficiency and conservation before implementing alternative energy measures.

TAF consulted the experts and those already involved in energy efficiency projects in order to set appropriate standards for its Green Condo and STEP retrofit loan programs. The TAF Associate Director indicated that the original Green Condo loan standards were established on energy efficiency engineering retrofit data, which indicated that a 20-25% energy reduction is possible on a building that is only two years old (pers. comm., February 22, 2010). He also stated that a public-private partnership was established between TowerWise TAF staff and a major developer to decide on the standard and that

other developers confirmed that 25% is achievable. In the case of existing buildings, information from a number of energy efficiency engineers and case studies completed under the Better Buildings Partnership program indicated that a 15% energy reduction is an achievable target (TAF Associate Director, pers. comm., February 22, 2010). TAF is in the process of reviewing their performance standards in light of the newly issued Toronto Green Standard (see section 4.2 Program Administration Context), requiring all new high-rises to perform 25% better than the 1997 Model National Energy Code for Buildings (MNECB).

TAF promotes a comprehensive retrofit. A building is a complex system that requires examining the opportunity to install a significant number of different measures (blending opportunities) as opposed to installing only short payback measures that have an immediate cash flow benefit. If you leave measures with long payback periods requiring eventual replacement, paying for them in the future will be harder as long payback measures are expensive to install and require long lending terms (TAF Associate Director, pers. comm., February 22, 2010). Blending short and long payback measures makes the overall energy reduction project more economic as short payback measures help subsidize the cost of other items. The idea behind a comprehensive retrofit is to combine short payback items (e.g., lighting) with medium (e.g., HVAC equipment) and long (e.g., building envelope) payback measures. Doing comprehensive retrofits is advantageous because:

- bundling a range of energy efficiency measures with different paybacks creates a more economic and significant energy performance package (TAF, 2009c);
- of synergies that increase the benefit, such as improvements to the building envelope and installing a smaller more efficient HVAC system (TAF, 2009c);

- of opportunities to improve overall building energy performance, address the need of future replacements or upgrades, and produce a cash flow to help offset the straight expense of other building repairs (TAF, 2009c).

The type of measures implemented by a program will vary according to the climate or location, source of energy, fuel end use, and energy prices – influencing factors discussed and shown in Figure 2.4. Toronto's measures are tailored to a 'cold / without dry season / warm summer' climate;[23] natural gas and electricity energy sources (accounts for 63% and 32% of Ontario's apartment energy use respectively [24]); and a building energy consumption profile that is dominated by space and water heating (77% of total apartment energy demand), followed by appliance and lighting (21%), then space cooling (2%) (NRCan, 2010; Peel, Finlayson and McMahon, 2007). TAF has listed some measures, as shown in Table 4.3, from a large condominium retrofit project in Toronto that do not include extraordinary measures and can be applied in many buildings in Toronto (TAF, 2009d). What is illustrated is the benefit of the overall project energy performance package on long payback measures and confirmation of the energy use patterns mentioned above, as space and water heating and lighting measures top the list with respect to annual savings.

[23] According to Köppen-Geiger climate classification system.
[24] Apartments defined by Natural Resources Canada (2010). Percentages based on Ontario apartment energy use by source and use.

Table 4.3 *Common Energy Efficiency and Conservation Measures*
*Source: adapted from TAF (2009d)*

| Energy Efficiency and Conservation Measure | Annual Savings $ | Capital Cost $ | Payback years | $CO_2$ Tonnes |
|---|---|---|---|---|
| Heating, Ventilation, Air Conditioning (HVAC) | 56,448 | 180,000 | 3.2 | 337 |
| High efficiency heating boiler | 24,976 | 85,000 | 3.4 | 117 |
| High efficiency domestic hot water (DHW) boiler | 11,609 | 61,000 | 5.3 | 54 |
| Carbon monoxide system | 6,984 | 27,000 | 3.9 | 67 |
| Booster pumps variable frequency drive (VFD) | 6,457 | 18,800 | 2.9 | 62 |
| Cooling tower fan motor VFD | 1,922 | 26,000 | 13.5 | 18 |
| Existing chiller motor VFD | 7,600 | 85,000 | 11.2 | 72 |
| Chilled water temperature reset | 1,000 | 5,000 | 5.0 | 9 |
| Building automation system | 5,923 | 70,000 | 11.8 | 45 |
| Whirlpool and pool covers | 771 | 3,500 | 4.5 | 4 |
| Lighting retrofit | 13,068 | 42,096 | 3.2 | 125 |
| Lighting retrofit: suites | 8,488 | 6,000 | 0.7 | 81 |
| Low flow showerheads | 8,762 | 2,261 | 0.3 | 26 |
| Pool heating | 8,122 | 31,000 | 3.8 | 99 |
| Training and education | 6,613 | 5,000 | 0.8 | 45 |
| Total | 168,743 | 647,657 | 3.8 | 1,161 |

To obtain even deeper savings, additional work, such as installation of low-e windows, high-efficiency appliances, and alternatives such as a geothermal heat-exchange system or a solar hot water system, can be considered (TAF, 2009d). However, TAF staff and the energy services providers interviewed push energy efficiency and conservation ahead of installing alternative technologies. Energy efficiency is the simplest to pursue and is cost-effective. Therefore, their approach is to do the appropriate whole building energy efficiency first and layer on alternative energies later (TAF Associate Director, pers. comm., February 22, 2010). However, specific energy reduction measures are not required to qualify for the Green Condo Loan, as long as the building is built to the program

performance target – 25% better than MNECB (TAF Associate Director, pers. comm., February 22, 2010). In communications with building owners, the TowerWise Incentives Advisor indicated that it is difficult to sell building owners on moving forward with whole building or comprehensive retrofits (pers. comm., March 11, 2010).

Intervention b involves drawing attention to proven and tested products and technologies. Installing unreliable or poor energy performing products and technologies will compromise energy savings. TAF does not promote any devices and technologies, but draws attention to independently verified devices and technologies and lets the energy service providers (ESPs) make the recommendations. TAF's approach is to let experienced ESPs tell their clients what the best practices are; however TAF recommends checking products through a number of different energy service providers (i.e., peer to peer reference) (TAF Associate Director, pers. comm., February 22, 2010). The energy service providers interviewed stressed how important it is to use products and technologies that perform well in the field. As the GRG Building Consultants Operations Manager states:

> When it comes to building performance standards we tend to be very picky about specifying very low conductance materials because we know the importance of heat loss and its effects on the overall building systems. Then when we get to the equipment itself, that is providing heat or cooling or hot water, we will look very carefully at the – what is known as the seasonal energy efficiency ratings as opposed to any other number like energy rating or ENERGY STAR […]. We are pretty good about establishing performance requirements based on true physics rather than marketing sales, (pers. comm., March 22, 2010)

The key features of these interventions, shown in Table 4.4, are the importance of working with industry to advance energy reduction, demonstrating and proving energy reduction to the market, using experienced energy service providers, having reliable energy reduction measures for long-term energy

savings, adopting a whole building approach, and addressing energy efficiency and conservation measures ahead of any alternative energy measures.

Table 4.4 *TWP Key Features of Building Convention Interventions*

| TAF TowerWise Program (TWP) Key Features | Program Category: Building Convention |
|---|---|
| (A) Working with industry to advance energy reduction | a |
| (C) Demonstrating and proving energy reduction to market | b |
| (D) Using experienced energy service providers | a |
| (F) Having reliable energy reduction measures for long-term energy savings | a b |
| (Q) Whole building approach | a |
| (R) Addressing energy efficiency and conservation measures before alternatives | a |

### 4.3.4 Monitoring and Compliance

The last program category to be discussed involves three interventions a, b, and c (refer to Figure 4.1). Intervention a, conducting annual meetings and preparing reports, is clearly needed to address program accountability and effectiveness. The City of Toronto (2009a) relationship framework states that TAF staff are accountable to TAF's board of directors.[25] With respect to oversight and performance measures, the TAF Program Manager stated that:

> The TAF board oversees the program. TAF staff reports to the board annually with a business plan for the organization including a plan for each of the program areas and at the end of the year TAF reports against the stated objectives on the business plan. Specific targets, example doubling amount of traffic on TowerWise website for 2009 – this was successful. The TAF board looks at the metrics developed by the TAF staff, (pers. comm., March 9, 2010).

[25] Board responsibilities include matters such as holding regular annual meetings that are open to the public; approving and monitoring of budgets and expenditure; developing long-term strategic plans and priorities; establishing funding priorities; approving grant allocations and loan agreements; approving business plans; complying to city requests for information.

One aspect not addressed by the TowerWise program is cataloguing and posting energy profiles, pre and post installation, of energy reduction measures. One of the energy service providers complained that there is not a baseline or benchmark available against which to assess energy use in residential high-rises. He goes on to state that:

> I keep on harping that one of the greatest benefits that TowerWise could bring to the industry is a benchmarking tool. So that if I say 1000 kwh/unit/month someone can verify that independently and say 'wow we are using triple the normal' [...]. No one knows what typical is, (Operations Manager GRG Building Consultants, pers. comm., March 22, 2010).

Intervention b is obtaining independent verification of the work conducted by the energy service providers on new buildings and intervention c is deploying an independent auditor (i.e., qualified engineer) to audit retrofit projects done by energy service providers. Both interventions address the issues of ensuring quality work and obtaining confidence in actual energy savings. TAF Associate Director stated:

> For new buildings (green condo loan), developers provide information to Natural Resources Canada (NRCan) to run energy efficiency models for qualification. Independent experts with the City of Toronto will also verify information from developer's pre and post installation. For retrofits, the Better Buildings Partnership (BBP) has an authorized list of energy service providers/management firms (long history) and modellers, which are qualified, (pers. comm., February 22, 2010).

TAF does not currently have an independent auditor to oversee retrofits and work alongside the Incentives Advisor, but a TAF program administrator indicated that they would like to see one deployed in the future.

The key features derived from these interventions (see Table 4.5) are the importance of good governance (accountability) in program administration, quality work to get reliable energy reduction measures for long-term energy savings, and establishing a baseline of energy use in residential high-rises.

Table 4.5 *TWP Key Features of Monitoring and Compliance Interventions*

| TAF TowerWise Program (TWP) Key Features | Program Category: Monitoring and Compliance |
|---|---|
| (F) Having reliable energy reduction measures for long-term energy savings | b c |
| (N) Program administration: good governance | a |
| (P) Establishing a baseline | a |

### 4.3.5 Behaviour

The TWP does not have any interventions under this category. It is assumed that interventions under the other program categories and modules affect energy use behaviour and ultimately the outcomes.

## 4.4 TowerWise Program Key Features and Theory Differentiation

Key features of the TowerWise program from all of the interventions above are summarized in Table 4.6. To facilitate comparison between the cases, a common summary table of key features is used in both cases. As a result, there are categories and features listed in the table for which TowerWise has no interventions. Specifically, these are the “Behaviour” category and Features (E) – Having ESP training outside of the program, (J) – Understanding the market, (K) – Understanding behaviour and choice, (L) – Indentifying non-energy benefits, and (M) – Evaluation and research to improve the program and verify energy savings.

Table 4.6 *Key Features of TAF TowerWise Program*

| TAF TowerWise Program (TWP) Key Features | Program Categories and Interventions | | | | |
|---|---|---|---|---|---|
| | IKC | COM | BC | MC | B |
| (A) Working with industry to advance energy reduction | b c | | a | | |
| (B) Having a point person | e | | | | |
| (C) Demonstrating and proving energy reduction to market | c d | a b | b | | |
| (D) Using experienced energy service providers | | | a | | |
| (E) Having ESP training outside of program | | | | | |
| (F) Having reliable energy reduction measures for long-term energy savings | | | a b | b c | |
| (G) Having effective communication/education strategies | a b c e | | | | |
| (H) Targeting the audience | d f | | | | |
| (I) Having proper building owner training/education for long-term energy savings | a c | | | | |
| (J) Understanding the market | | | | | |
| (K) Understanding behaviour and choice | | | | | |
| (L) Identifying non-energy benefits | | | | | |
| (M) Evaluation and research to improve program and verify energy savings | | | | | |
| (N) Program administration: trusted/independent/mandated/good governance/relationship builder | Refer to Section 4.2 Program Administration Context (A) addresses relationship building, a | | | | |
| (O) Improving program clarity and ease of use | e | | | | |
| (P) Establishing a baseline | | | | a | |
| (Q) Whole building approach | | | a | | |
| (R) Addressing energy efficiency and conservation measures before alternatives | | | a | | |
| (S) Having diverse financing tools | | a b | | | |

Notes. IKC-Information, Knowledge and Communication; COM-Capital Costs, Operation and Maintenance; BC-Building Convention; MC-Monitoring and Compliance; B-Behaviour. TAF TWP has no interventions for Behaviour and no features relating to (E), (J), (K), (L), (M).

When compared to the novel programming ideals discussed in Chapter Two, the TowerWise program shares many of the guiding principles, particularly in the area of program administration. TAF's program administration is guided by specific energy policies, trusted, legitimate, accountable and adaptable. TAF's strength is being known to be an independent, credible, and self-sufficient entity capable of making relatively quick changes to arising issues (e.g., creation of the TowerWise Incentives Advisor position described in section 4.3.1). TAF has also been successful in collaborating with industry to address sector specific issues (e.g., meeting and working with a developer to find a solution to the developer/condominium owner split incentive).

Aspects of the theoretical novel programming that the TAF TowerWise program does not address are:

1) Broader market interventions: TAF is primarily focused on the traditional techno-economic paradigm and many of its interventions are founded upon traditional engineering and economic rationale with an implied assumption that the interventions will affect the energy use behaviour of end users.
2) An interdisciplinary approach to program design, research and evaluation, in order to gain a wider understanding of the market and broader evaluation techniques including performance metrics that capture the non-energy benefits and factors outside of technology and economics that influence energy use behaviour and choice: TAF has no integrated evaluations team to determine all the benefits to the different market actors including the non-quantifiable benefits.
3) Real-time monitoring and evaluation feedback to improve program performance, determine market impacts and effects, determine persistence in energy savings, and decide when to exit the market or transition their efforts.

In summary, the most significant theoretical deficiencies for the TowerWise program are that it currently does not incorporate rigorous program evaluation and broad performance metrics to address energy and non-energy benefits or qualitative and quantitative assessment. Without these, it will not be possible to ensure the program is achieving reliable long-term effects. Yet faced with many real life constraints, it may not be a question of choosing not to integrate these attributes into the program design, but limitations imposed by oversight/regulatory bodies providing the funding, apprehension in deviating from traditional programming approaches, human resources and capital constraints, and consequently the need for program administrators to prioritize interventions with limited resources.

## 4.5 Summary

The TAF TWP has many program interventions and features as discussed above, but the highlights for the program are:

- working with industry to identify and find the solutions to the issues impeding the adoption of energy reduction measures;
- concentrating efforts on outreach and educating downstream actors on energy reduction measures;
- trying to prove to downstream actors energy reduction projects save energy (e.g., using case studies and providing proper information);
- trying to prove by example to private financial lenders that these projects can be successfully financed with innovative loan options;
- promoting a whole building approach and comprehensive retrofits.[26]

[26] TAF is not restricting building owners to certain measures – as long as they meet the program performance standard building owners can install EECMs as well as alternative technologies for new buildings (i.e., to qualify for Green Condo Loan). Selling whole building or comprehensive retrofits for existing buildings have been a hard sell to building owners (TowerWise Incentives Advisor, pers. comm., March 11, 2010).

## Chapter Five: New York Energy $mart Multifamily Performance Program (NYE$ MPP)

The New York Energy $mart (NYE$) Multifamily Performance Program (MPP) is the other program selected for precedent case study analysis. This chapter, similar to Chapter Four, discusses the program's background, administration context, approach and interventions. It concludes with a summary of the key or defining features of the program, and an assessment of the extent to which this case meets the theoretical novel programming ideal.

### 5.1 Background

According to the last U.S. Census in 2000, New York State's population was approximately 19 million with 8 million located in New York City. New York City is ranked first in both the United States and North America with the most high-rise buildings (Emporis.com, 2009). Of the State's approximately 1.4 million multifamily units (in structures with 50+ units), 67% of them are located in New York City (Brown and Wolf, 2007; U.S. Census Bureau, 2000). Most recently, 2009 figures have New York City greenhouse gas emissions[27] at approximately 49 million metric tons $CO_2$ equivalent with 35% related to residential buildings (NYC, 2009b).

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation tasked to assist New York State meet its energy goals and dedicated to reducing energy consumption, promoting use of renewable energy sources, and protecting the environment (NYSERDA, 2004a). NYSERDA runs programs and services, which are a means for the State to collaborate with businesses, academia, industry, the federal government,

[27] The total greenhouse gas inventory for the State was approximately 284 million metric tons of $CO_2$ and approximately 55 million metric tons for New York City in 2007 (New York State Energy Research and Development [NYSERDA], 2009a; New York City [NYC], 2009a).

environmental community, public interest groups, and energy market participants (NYSERDA, 2004a). One of many NYSERDA programs is the NYE$ MPP, which is funded by System Benefits Charges (SBC) paid by utility customers in the State of New York, instituted by New York State Public Service Commission (NYS PSC) and administered by NYSERDA under an agreement with the Public Service Commission (NYSERDA, 2007).

The NYE$ MPP began in May 2007 and receives its funding with rate payer utility charges (system benefit charges) from six investor owned utilities (Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York Inc., New York State Electric and Gas Corporation, National Grid, Rochester Gas and Electric Corporation, Orange and Rockland Utilities Inc.) issued from July 1, 2006 through June 30, 2011. NYSERDA merged many of its legacy energy efficiency and alternative energy programs for multifamily building performance into one that provides services for low to moderate income and market rate multifamily buildings in new construction or existing buildings MPP components (New York State Public Service Commission [NYS PSC], 2009a). The consolidated programs included the Assisted Multifamily Program (AMP), Residential Technical Assistance Program (ResTech), Comprehensive Energy Management Program (CEM), New York Energy $mart$^{SM}$ Loan Fund, Multifamily Building Standardized Training Program (MBST), ENERGY STAR Multifamily New Construction Pilot Program, and Energy Efficiency Services (EES) and Research and Development (R and D) programs (Wirtshafter Associates, Inc. and Research Into Action, Inc., 2007 and 2008). In 2007, the American Council for an Energy-Efficient Economy (ACEEE) conducted its 2$^{nd}$ national review of exemplary energy efficiency programs and awarded NYSERDA its "Exemplary Program" Award for the Multifamily Performance Program (York, Kushler and Witte, 2008).

## 5.2 Program Administration Context

NYSERDA's administration is guided by specific energy policies from the state; is legitimate, accountable, trusted, and adaptive; and collaborates with different stakeholders for public benefit.

Both the State and New York City have specific energy plans and policies, but New York State's ratepayer funded energy efficiency programs have primarily been realized through a single provider, NYSERDA (NYS PSC, 2008a). In New York City, the city-wide greenhouse gas emission targets are 30% below 2005 levels by 2030 (New York City, 2009c). While the state targets were set in August 2009, when New York State Governor David A. Paterson signed an executive order establishing a goal to reduce greenhouse gas emissions from all sources in the state 80% below 1990 levels by 2050 and a goal to reduce 45% of New York State's electricity through improved energy efficiency (15%) and clean renewable energy (30%) below projected (forecasted) levels by 2015 (New York State, 2009). To achieve these aggressive goals, NYSERDA, the State's long time program administrator of energy efficiency programs has been joined by utility or other program administrators under Order Establishing Energy Efficiency Portfolio Standard and Approving Programs issued by the NYS PSC in 2008 (NYS PSC, 2008a).

NYSERDA was created in 1975 under Article 8, Title 9 of the State Public Authorities Law through the reconstitution of the New York State Atomic and Space Development Authority (NYSERDA, 2004a). NYSERDA is governed by a 13 member board of directors comprising of the Commissioner of the Department of Transportation, the Commissioner of the Department Environmental Conservation, the Chair of Public Service Commission, the Chair of the Power Authority of the State, and nine Governor appointed members with advice and consent of the Senate (NYSERDA, 2004a). The nine appointed

members include an engineer or research scientist, an economist, an environmentalist, a consumer advocate, an officer of a gas and electric utility, and three at-large members (NYSERDA, 2004a).

In the operation of the MPP, NYSERDA as program administrator has hired and oversees TRC Energy Services (TRC) to act as the program implementer/quality control contractor and Taitem Engineering to serve as the quality assurance contractor. Energy service providers have to pre-qualify to work with NYSERDA and sign contractual agreements to become a NYSERDA "partner." Interviews[28] with program partners, participants and those working with NYSERDA have indicated that the staff is dedicated to improving the program and its credibility, as a public benefits agency and the state's long time energy efficiency program administrator, is what motivates building owners to participate in the program. NYSERDA has also shown its adaptability by changing program requirements, policies, and procedures within a year of orders passed by the NYS PSC in July and December 2009, which required NYSERDA to make substantive modifications to its program (NYS PSC, 2009b and 2009c). According to the NYSERDA Program Manager Multifamily Building Performance (MBP):

> [W]e can be fairly nimble when it comes to making policy changes that do not have to be approved by the state legislator or through a vote or a bond or referendum that has to go in front of the New York State voters. So we [NYSERDA] can make changes and be very flexible, which is good because funding sources change from year to year. We have to be able to anticipate years in advance what the funding is going to be […]. We have to be flexible or we would not get anything done, (pers. comm., March 1, 2010).

The NYSERDA Multifamily Performance Program addresses the multifamily sector by working with developers, building owners and their representatives (NYSERDA, 2009c). The program relies on a network of energy

[28] 5 respondents.

services providers (building performance specialists or partners) who can demonstrate their ability to provide multifamily building performance services (NYSERDA, 2009c). Collaboration and partnerships are essential and as the NYSERDA Associate Project Manager of the MPP, tasked with Energy Reduction Plans (ERPs) and Combined Heat and Power (CHP) projects, commented, “I don't remember which one of our senior management people it was, but they wanted to think of NYSERDA as the hub of the wheel and not necessarily the whole wheel and we need to interact with all these different people” (pers. comm., April 7, 2010).

### 5.3 Program Approach and Interventions

NYSERDA has a different approach from TAF as to how they will transform the market and increase adoption of energy reduction measures. Based on information collected on this program, the program approach appears to be:

> A program that transforms the market by facilitating the demand for energy reduction measures and facilitating the development of a market infrastructure needed to address the demand leading to eventual increased energy performance within multifamily building codes.

NYSERDA’s NYE$ MPP addresses new and existing multifamily buildings in the state with five or more dwelling units and according to its documentation (GDS Associates, Inc., 2007, p. 7; NYSERDA, 2009c, p. 1) is focused on:

1. Creating a market-based network of building performance specialists adept at delivering services to developers, owners, and their representatives.
2. Facilitating access to capital for energy and energy-related improvements to buildings.
3. Reducing the burden of energy consumption and other utility-related costs, with a significant emphasis on providing this benefit to low- to

moderate-income residents while addressing health and safety in multifamily buildings.

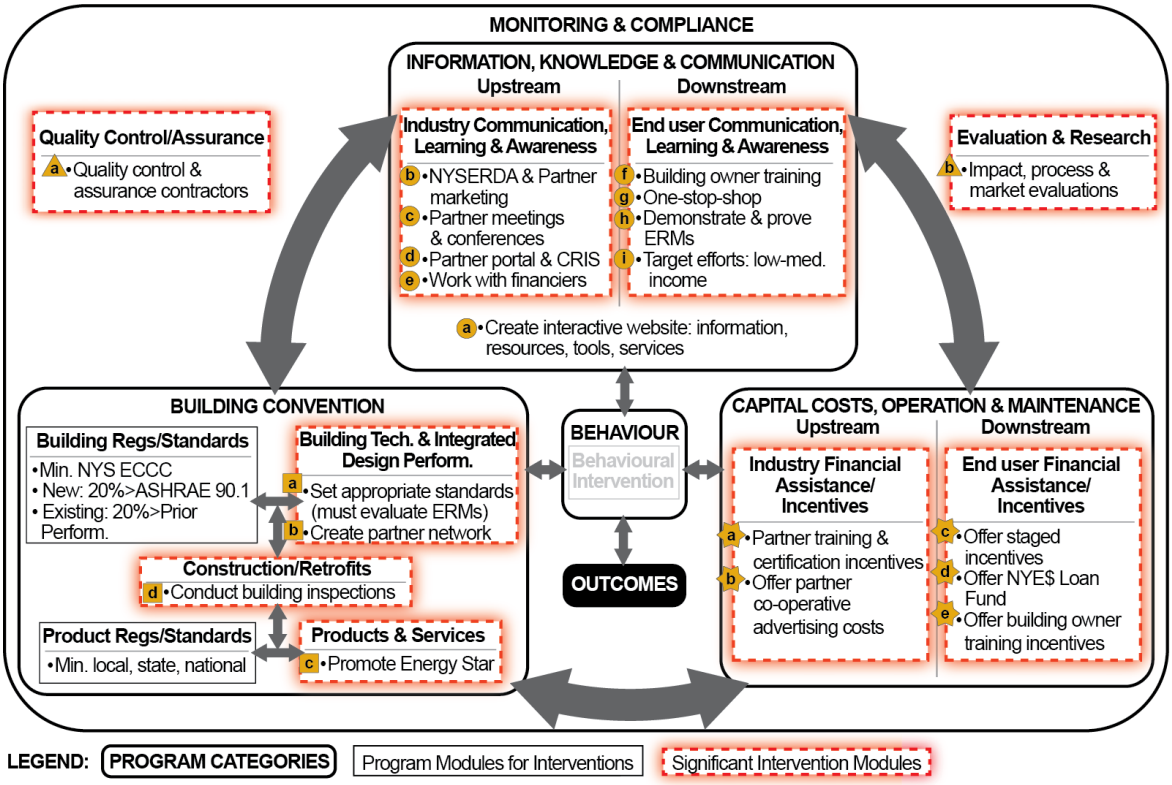
4. Packaging energy efficiency with other types of improvements (i.e., advanced meters coupled with a real-time pricing or time-of-use electricity rate structure, distributed generation, and renewable energy).
5. Reducing the multifamily sector's contribution to the system peak demand.
6. Promoting the ENERGY STAR® label.

In the following subsection, the relational model will be used to discuss the program interventions.[29] The program being reviewed reflects the NYSERDA NYE$ MPP as it was originally conceived and recognized by the American Council for an Energy-Efficient Economy without the required New York State Public Service Commission modifications ordered in July and December 2009 (NYS PSC, 2009b and 2009c).

Program interventions along with the issues (including risks and barriers) and results (outputs and/or outcomes) will be discussed in the categories of information, knowledge and communication; capital costs, operation and maintenance; building convention; and monitoring and compliance (refer to Figure 5.1). The last category, behaviour, does not have any interventions of its own as it is assumed to be affected by other interventions. The key policy instruments or interventions, as discussed in section 2.5.2, include support, information, and voluntary action (e.g., voluntary certification and labelling, voluntary and negotiated agreements, mandatory audit and energy management, awareness raising, education, information campaigns); control and regulatory mechanisms (e.g., appliance standards, building codes); fiscal instruments and incentives (e.g., public benefit charges, grants, subsidized loans). The final model for the NYE$ MPP is illustrated in Figure 5.1 as follows:

[29] Note that other program interventions might exist, but were not discovered during data collection.

*Figure 5.1*. NYE$ MPP Model




Notes. American Society of Heating, Refrigerating and Air-Conditioning Engineers 90.1 2004 (ASHRAE 90.1); ERMs - Energy reduction measures; NYS ECCC - New York State Energy Conservation Construction Code; Min. - Minimum; Tech. - Technology; Perform. - Performance.

For reference, all program interventions, the issues addressed, outputs, expected outcomes, and results have been summarized, tabulated and included in Appendix II.

### 5.3.1 Information, Knowledge and Communication

There are nine interventions that fall under the category of information, knowledge and communication, as shown in Figure 5.1. Intervention (a) is the NYSERDA website which contains information about the program and how to reduce energy consumption; resources and services including lists of ENERGY STAR appliances and retailers; training course locations on energy efficiency and renewable energy in buildings; finding a energy service provider (partner); green or energy-related events; and tools such as educational games, video

demonstrations, virtual tours (NYSERDA, 2009b). The website addresses the lack of knowledge and understanding building owners and energy service providers may have regarding the NYE$ MPP and energy reduction measures. Expected outcomes would be increased knowledge of energy reduction measures, increased program participation and improved practices by building owners and energy service providers. A process evaluation conducted by Wirtshafter Associates and Research Into Action (2008) indicated that most owners (survey of 22 building owners, developers or managers participating in the program and listed in NYSERDA's internal database) used the website and found it useful. In addition to other communication initiatives that will be discussed later, the website helped to keep the partners informed with a portal.

Intervention b is NYSERDA and partner marketing to address low program participation and uptake of energy reduction measures. Program marketing is done both by NYSERDA and the energy service providers (partners). Interview respondents[30] indicated marketing is expected from the partners and has been effective. As stated by the TRC Pipeline Manager for the new construction component of the MPP: "I would say at least 75% of the projects came through the partners themselves, that they went out and actively got the work [...] went out and found the buildings and developers who were interested in doing this and brought them into the program" (pers. comm., April 8, 2010). Approximately 383 applications were approved in the first 10 months of program launch in May 2007 (NYS PSC, 2008b).

Activities, listed under intervention c, conducting partner meetings and conferences, are to resolve any partner issues associated with program process and energy reduction measures and for program evaluation and feedback.

[30] 8 respondents and process evaluation conducted by Wirtshafter Associates and Research Into Action (2008).

NYSERDA conducts monthly partner conference calls with technical tips, has email exchanges and partner meetings. These regularly scheduled group discussions provide an opportunity for those involved to learn from one another and address any technical or program process issues. According to a process evaluation, which surveyed 15 of the 45 partners, partners provided consistent praise on communication (Wirtshafter Associates and Research Into Action, 2008). The attention given to communication amongst NYSERDA, TRC, and the partners has been credited as an important contributor to the program's early success (Wirtshafter Associates and Research Into Action, 2008). Additional interviews[31] conducted during the research confirmed this finding.

Intervention d, the creation of a partner portal and the comprehensive residential information system (CRIS), addresses the needs or requirements of the different parties involved in a project, whether it is submissions of documents relating to energy reduction plans, when incentives are paid out, when or if inspections are needed or completed, when approvals are required, etc. CRIS is a database management system that maintains tracking information on each project and generates automatic email alerts at critical stages in the process that require action and the partner website portal allows partners to see the same information about each of their projects on CRIS (Wirtshafter Associates and Research Into Action, 2008). The CRIS system allows those with access to check on the status of projects and view all the necessary documents related to the project. As stated by the NYSERDA Associate Project Manager, "I don't know how you would do it [communicate] without it [CRIS]. [...] Instantly you have information on a project, […] you can read the latest notes, you can read the status, you can look at the funding, you can look at all that information [...]" (pers. comm., April 7, 2010).

[31] 7 respondents.

A NYSERDA process evaluation and interviews conducted for this research uncovered the need for a building owner's portal and forum. NYSERDA had sponsored Research Into Action and Wirtshafter Associates to conduct a process evaluation that involved surveying building owners in the NYE$ MPP. They identified in their survey that building owners need more information on how the program works and the status of projects once they have decided to participate in the program and consequently recommended a building owners portal. Reliance on the partner to educate and keep building owners up to date and informed on projects is working, but there were times when building owners wanted independent information or answers the partners may not be providing (Wirtshafter Associates and Research Into Action, 2008). The TRC Pipeline Manager for the existing buildings component of the MPP indicated that:

> What we are finding though is that the partners don't necessarily convey information very well to their owners and for multiple reasons […] I think some of it is that these guys are engineers not salesman […]. What we were finding is that owners had some misinterpretations of what the program was and how it worked, (pers. comm., April 8, 2010).

It was also stated by a building owner that it would be good to have a forum for building owners to discuss their experiences. "Looking back on it, it would have been nice to have heard from someone else of things that went good and didn't go so good" (pers. comm., May 24, 2010).

Working with financial lenders (intervention e) to participate in the program is about involving private sector financial lenders and addressing the lack of maturity in lending for energy reduction projects and lack of access to capital for such projects. The objective of such an intervention would be to work with private financial lenders, educate the private lending industry on energy reduction projects and show them that they are economic and can be underwritten. Details on how many financial lenders participated and how many loans were issued to building owners was not uncovered. The NYE$ Loan Fund

was not being offered during data collection. However, it was indicated during one interview that the Loan Fund was successful because it got private financial lenders to loan capital to building owners even without the program.

Intervention f is offering building owner training which addresses poor operation and maintenance in buildings. The Pipeline Manager of Existing Buildings Steven Winter Associates, Inc. indicated that:

> So we often have been to buildings where there are fancy controls, but it's, you know, on manual and has been totally overridden. Those controls work and they can be great for the building manager if they are shown how to use it, (pers. comm., April 20, 2010).

To address this issue, NYSERDA offers builder owner training. Interviewees,[32] however, indicated the need for short not lengthy courses, simple training documents and techniques, more availability across the State, and more education of tenants by building managers/owners.

Intervention g is creation of a one-stop-shop for information and services, which addresses having too many requirements and programs leading to confusion and too much work for program participants. Interview respondents[33] indicated how important it is to have clear program rules and no confusion. In May 2007, NYSERDA established the NYE$ MPP which consolidated the previous programs into one program (Wirtshafter Associates and Research Into Action, 2007 and 2008). One of the goals of the program was to create an infrastructure that would provide financial services, technical support, construction management, and post-program monitoring for developers and building owners (Wirtshafter Associates and Research Into Action, 2007). Based on the NYSERDA process evaluation conducted and issued in April 2008, many partners appreciated the fact that the MPP is easier to work with and

[32] 2 respondents.
[33] 11 respondents.

covers all of the previous programs so that they no longer have to shift from program to program (Wirtshafter Associates and Research Into Action, 2008).

A significant challenge/barrier to energy reduction raised by interview respondents[34] is a lack of understanding about energy reduction measures and knowing what measures work and do not work on the part of building owners. A way to resolve these issues is to demonstrate and prove that energy reduction works with case studies or project reviews (intervention h). NYSERDA is starting to learn a lot from going back to completed projects.[35] A number of general themes from comments made by respondents when asked about completed projects or case studies:

- there needs to be more sharing of information on case study results between partners and amongst building owners;[36]
- case studies/projects should be used to dispel risk in the market place;[37]
- those involved with energy reduction projects need to go back to projects and learn what worked and what does not work and why;[38]
- case studies would make it easier for building owners to participate.[39]

Some of the specific comments from the building owners:

> Looking back on it, it would have been nice to have heard from someone else about things that went good and didn't go so good, (Building owner, personal communication, May 24, 2010).
>
> If somebody else had done that – showed that this building, this is what it was consuming in oil and now that they put a new boiler in, this is what they are saving and this is what the payment is, and the other boiler is 22 years old and now you have a brand new boiler – it would make sense, make it understandable and easier to get involved, (Building owner, pers. comm., April 26, 2010).

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[34] 5 respondents.
[35] 13 respondents.
[36] 9 respondents.
[37] 1 respondents.
[38] 13 respondents.
[39] 1 respondents.

During the data collection phase, one of the objectives was to find the case studies or completed projects. Overall, recent case studies were not as easily accessible as expected. Very few were available and were either posted on the NYSERDA website or on the partner's websites. The majority of case studies were posted on partner's websites. Requests were made to obtain more information from partners, but case studies either had not yet been drafted or the information could not be released without approval from the partners and the building owners. Another reason for there being only a few cases studies was because many of the NYE$ MPP projects had not yet been completed with post evaluation.

The case studies that were available were not unlike those posted by TAF: typically one page outlines with short descriptions of the buildings; the building's use and history; reason for upgrades; types of energy performance improvements; source of funding; capital spent; projected savings and greenhouse gas emission reductions. All this of information emphasizes the technical and economic details with a gloss over other non-energy benefits such as comfort, quality of life, health, and safety. Yet when discussing projects with some of the building owners, the most compelling benefits described by building owners were not strictly related to energy benefits. Building owners described the non-energy benefits that either resulted or motivated them to participate in the program:

> I have been a landlord for 25 years plus. [...] I wanted to be proud of it [my building] and to have some nicer things in it that you would not find in apartments, and [...] renamed it […] after my mother who always supported me. [...] It [the upgrades] benefits the tenants and it benefits the environment, so there are a lot of wins you know. [...] I feel as though little by little the rents are going up because of the talk of the town – everybody knows from people who are living there how efficient it is. So it makes our place more attractive than others. [...] And now [...] I am getting a little better clientele, […] most people have a computer, they have a desktop […] all these gadgets…, (Building owner, pers. comm., May 3, 2010).

> We were able to modernize the property and reduce energy costs and at the same time for us there are additional benefits – we have newer equipment that will last longer before it needs replacing. And hopefully we'll be able to provide better service for the tenants – more even heat and more even hot water, (Building owner, pers. comm., April 26, 2010).

Interviews[40] also revealed that those who have gone through the program and seen the benefits proceeded to complete projects even without the incentives because they saw value in the measures from previously completed projects. Building owners proceeded on their projects even when the program was suspended for modifications by New York State Public Service Commission order:

> [W]hen the pipeline [MPP] was shut-down temporarily we were backing it with a lot of the owners who had already gone forward with construction on certain items because they recognized the value of that information that was provided in their report, regardless of if they got any more incentives. It still made sense to do it, (NYSERDA Associate Project Manager, pers. comm., April 7, 2010).

> Initially it was an issue of getting us educated on why this is better than what we are doing and why what we were doing wasn't as good as it could have been. And then just looking [at] what the projections were on savings [...] it became pretty apparent [to install] [...] a number of these core elements [energy reduction measures] [...]. So whether we have NYSERDA incentive money or not we are doing these things in our buildings because they make sense, (Building owner, pers. comm., April 26, 2010).

The last intervention , target efforts, under this category is addressing a much older building stock and targeting low to medium income tenants. In New York State, close to 75% of housing units in structures with 50+ units were constructed before 1970 with approximately 80% of them rented versus owned (U.S. Census Bureau, 2000). Renters tend to have considerably lower incomes than homeowners and affordable housing programs are particularly important in the United States (Brown and Wolfe, 2007). The New York State Office of the State Comptroller (2010) recently issued a report indicating a decline in the

[40] 4 respondents.

number of affordable rental apartments in New York City with more of the households devoting at least 30% of their income on rent. Hence a more concentrated effort on addressing energy reduction in older existing low to medium income housing. According to NYSERDA, more than 60% of the buildings currently participating in the program are low-income or affordable housing (NYS PSC, 2009d). The NYE$ MPP administration collaborates with the New York State Division of Housing and Community Renewal Weatherization Assistance Program administration to provide joint financial assistance for low-income multifamily housing energy reduction projects. Under the Weatherization Assistance Program regulations, a multi-unit building would need to demonstrate that the benefits of the weatherization work accrue primarily to the low-income tenants (U.S. Department of Energy, 2010). Recent reports to the New York State Public Service Commission indicate that the program has achieved approximately $17 million US of low-income tenant energy savings per year compared to $5 million US of market-rate tenant energy savings per year (NYS PSC, 2009e, p. 4-11).

Different ownership structures are a challenge to addressing energy performance improvements in multifamily housing. Interviews[41] indicate that it is the different decision-making processes and personal motivations associated with the varied ownership structures in multifamily housing that make it a challenge. Building owners with affordable housing are in for the long term, while condos/co-ops have their own unique problems:

> Most affordable housing, which is primarily what we are dealing with, they are in on it for the long haul – they are not just looking for a quick bang for their buck and sell the property, (Program Manager P.E.A.C.E. Inc., pers. comm., April 30, 2010).
>
> Condos and co-ops are kind of a unique problem in their own right because you want to help them you do not want to dictate policy to them. [...] I think

[41] 12 respondents.

> what is important there is that the residents see it [energy reduction measures] as an opportunity and not as a mandate, (NYSERDA Associate Project Manager, pers. comm., April 7, 2010).
>
> Co-ops are this horrible animal – it's board meeting after board meeting and then literally a year down the road they might sign your contract, (Pipeline Manager Existing Buildings Steven Winter Associates, Inc., pers. comm., April 20, 2010).

Furthermore, according to a survey done by Wirtshafter Associates and Research Into Action (2008), several partners indicated it was particularly hard to get condos and co-operatives to cooperate and agree to changes in tenant spaces (although not all were universally uncooperative).

The key features from all these interventions, which are summarized in Table 5.1, are the importance of working with industry to advance energy reduction, demonstrating and proving energy reduction to the market, having effective communication/education strategies, targeting the audience, having proper building owner training/education for long-term energy savings, identifying non-energy benefits, and improving program clarity and ease of use.

Table 5.1 *MPP Key Features of Information, Knowledge and Communication Interventions*

| NYE$ Multifamily Performance Program (MPP) Key Features | Program Category: Information, Knowledge and Communication |
|---|---|
| (A) Working with industry to advance energy reduction | b e |
| (C) Demonstrating and proving energy reduction to market | e h |
| (G) Having effective communication/education strategies | a c d |
| (H) Targeting the audience | i |
| (I) Having proper building owner training/education for long-term energy savings | a f |
| (L) Identifying non-energy benefits | h |
| (O) Improving program clarity and ease of use | g |

### 5.3.2 Capital Costs, Operation and Maintenance

As shown in Figure 5.1, this program has five interventions in the Capital Costs, Operation and Maintenance category, all of which involve some kind of financial assistance or incentive for upstream and downstream market actors. The first intervention a is training and certification incentives for partners to obtain the necessary training to get quality services for energy reduction measures. The idea is to create an industry of building energy performance professionals that can assist developers and building owners through the process of assessing an appropriate mix of energy reduction measures, helping them to secure financing, and overseeing the implementation of the measures (Wirtshafter Associates and Research Into Action, 2008). NYSERDA provides reimbursement of 75% of the cost of training by a NYSERDA-approved training organization and 75% reimbursement for certifications and/or accreditations for members of the partner's consultation team (NYSERDA, 2009e). No information was discovered indicating the number of training courses recommended, certifications obtained and incentives issued by the program, however NYSERDA's 2008 process evaluation indicated an expansion of partners in the program from five initially to forty-five at the beginning of February 2008 and an additional eight to the beginning of April 2008 (Wirtshafter Associates and Research Into Action, 2008). During one interview the respondent indicated that the number of companies involved in the MPP expanded to as high as eighty (up until the program was suspended as a result of the PSC Order).

The second intervention b assists partners with advertising costs. The intervention addresses low participation in the program and involves providing co-operative advertising incentives where NYSERDA will provide up to 25% of co-operative advertising costs to assist in the set-up and funding of advertising for the promotion of the Partner's services for the NYE$ MPP (NYSERDA,

2009e). As indicated in section 5.3.1 intervention b, partner marketing has been successful.

Intervention c targets building owners through the use of staged incentives. Having access to capital for the high upfront costs of energy reduction measures is often a barrier for those wanting to move forward on such initiatives. NYSERDA has developed for the new and existing building components of the program, a staged incentive structure with four separate payments to the building owner over the life of the project. For existing buildings, the structure is designed to encourage completion of projects and not just completion of audits (Wirtshafter Associates and Research Into Action, 2008). The staged incentives for existing buildings involves: 1) a smaller initial payment given to the building owner when an energy reduction plan (ERP) is submitted; 2) a second payment is provided when 50% of the implementation is completed; 3) a third payment is provided at completion; and 4) a final incentive, a sliding-scale payment, is provided when savings are above the 20% minimum savings threshold (Wirtshafter Associates and Research Into Action, 2008). A similar four-payment structure is provided for new construction and incentives are set higher for affordable buildings when compared to market-rate buildings (Wirtshafter Associates and Research Into Action, 2008). Refer to Appendix III for details on staged incentive structure.

Interviews[42] indicated that incentives were set on the basis of past experience with legacy programs and, according to program administration and associates,[43] averaged approximately twenty-five to thirty percent or less of the total cost of the project. Six of the partners interviewed indicated the incentives are attractive with four indicating they were high. However, one partner mentioned that for small multifamily buildings (less than 20,000 square feet or

[42] 5 respondents.
[43] 2 respondents.

1858 square meters) the amount is too low as the cost to conduct a comprehensive building audit and analysis is not proportional to the size of the building.

The incentives motivated building owners to participate in the MPP and the combination of scheduled incentives and loans made it possible for building owners to move forward on building energy performance improvements. The second quarter 2010 program evaluation and status report indicated that there are approximately 105,000 existing multifamily units and approximately 3,000 new multifamily units receiving energy efficiency services (NYS PSC, 2009e). Seven of nine partners and all six building owners interviewed, when asked about their motivation for participation or strengths of the program, indicated that the incentives were very important. One partner mentioned that NYSERDA offers a very transparent schedule of incentives, which was a great improvement over past programming because an owner knew how much money one would get (Director HR&A Advisors, pers. comm., April 14, 2010). The MPP with its incentives and comprehensive building analysis also got participants to move beyond the shallow savings (e.g., changing light bulbs) to putting in measures that would not have been done otherwise. One program administrator, three partners, and two building owners indicated that the incentives in the MPP allowed them to do more comprehensive measures than what would have been done otherwise. According to one building owner:

> I would have done some of it [energy reduction measures], but without the incentives and the grant money, I wouldn't have been able to do it all. So maybe I still would have wanted to do the right thing, but without the funds, I couldn't do it, (Building owner, pers. comm., May 3, 2010).

In addition, participating in the program gives participants added understanding about energy performance improvements not otherwise obtained. Interviews (one partner, three building owners) indicated that the program and incentives helped to get information about what cost effective energy reduction measures work:

> [My] primary motivation was to see what other folks were doing, see what we could be doing better, and also it would turn out to be a good learning experience for us to see what worked and what was cost-effective and what was not, (Building owner, pers. comm., April 26, 2010).

> It [MPP] is a mechanism to not only take advantage of some incentives but get connected with people that really know what they are talking about, (Building owner, pers. comm., May 24, 2010).

Intervention  is the New York Energy $mart Loan Fund where NYSERDA and private financial lenders work together to secure the capital for energy reduction projects for building owners. The NYE$ Loan Fund is a buy down loan that provides interest rate reductions of up to 4% below market rate for loans or leases up to 10 years for cost-effective energy reduction measures (NYSERDA, 2009d). The NYE$ Loan Fund is no longer available, but while it was in effect from September 1, 2007 to October 30, 2009, the existing multifamily buildings loan limit was $5,000 per residential unit, up to $2.5 million per borrower plus an additional $2.5 million (maximum $5.0 million per eligible borrower) for projects with measures aimed at electricity peak-load reduction (NYSERDA, 2009d). For the new multifamily buildings, a loan limit was up to $1 million plus an additional $0.5 million (maximum $1.5 million per eligible borrower) for green building improvements (NYSERDA, 2009d). Transacting a financial loan between NYSERDA, the financial lender, and the building owner addresses the lack of access to capital for energy reduction projects and lack of maturity of private financial lenders in the market.[44] During one interview, it was mentioned that the NYE$ Loan Fund was successful when it was available (before the economic down turn), but preferentially for larger buildings because, with fixed transaction costs, smaller building loans were not as attractive to the lenders. As stated by the Manager of the Energy Division for Power Concepts (a private sector partner for NYSERDA MPP):

[44] 6 respondents indicated there is a lack of maturity by financial lenders.

> The low interest loan fund has totally failed this one market segment for small buildings, which is a big, huge problem because a lot of buildings in New York City are small. But for the larger co-ops, [...] banks are willing to loan them money for energy efficiency programs outside of the Energy $mart Loan Fund which never would have happened. Except that the loan fund existed for several years and banks got comfortable with this idea of – oh yah we can be confident that this loan will be paid back because they are going to get energy savings and have the money to pay us back. So execution was not perfect, but it did transform the market in a very positive way if you ask me, (pers. comm., April 16, 2010).

Having a diversity of financing aids has been successful for NYSERDA's NYE$ MPP to get energy reduction projects not only off the ground, but further along with more comprehensive energy reduction measures. As stated by the NYSERDA Associate Project Manager: "Grants and incentives, whatever, are good but without financing I think a lot of projects that could go forward that are identified to go forward can't make it" (pers. comm., April 7, 2010).

Intervention e, offering building owner training incentives supports efforts to improve building operations and maintenance and reduce uncertainty about energy savings. As indicated in section 5.3.1 intervention f, it is a challenge to ensure energy savings are not eroded by improper building operation and maintenance. Building operator training is promoted by NYSERDA and a training and certification incentive in the amount of $1000/attendee for market-rate housing and $1500/attendee for affordable housing is payable upon receipt of a training completion certificate (NYSERDA, 2009c). The building owner training incentives are important, as stated by the Pipeline Manager of Existing Buildings for Steven Winter Associates:

> I think NYSERDA has done a great job of trying to advertise and push as much training as possible and the fact that they give incentive money for people to go through the training. [...] Otherwise they [building owners] wouldn't do it. Why would they? They don't feel like they need to or that it is a loss of money for them because they have to get their guys away from the

building and into a classroom for a full day or three days, (pers. comm., April 20, 2010).

The key features derived from these interventions, as summarized in Table 5.2, are the importance of working with industry to advance energy reduction, demonstrating and proving energy reduction to the market, using experienced energy service providers, having proper building owner training/education for long-term energy savings, and having diverse financing tools.

Table 5.2 *MPP Key Features of Capital Costs, Operation and Maintenance Interventions*

| NYE$ Multifamily Performance Program (MPP) Key Features | Program Category: Capital Costs, Operation and Maintenance |
|---|---|
| (A) Working with industry to advance energy reduction | b d |
| (C) Demonstrating and proving energy reduction to market | d |
| (D) Using experienced energy service providers (ESPs) | a |
| (I) Having proper building owner training/education for long-term energy savings | e |
| (S) Having diverse financing tools | c d |

### 5.3.3 Building Convention

The next category of interventions include regulations/standards and products, services, and building technology and integrated design performance as shown in Figure 5.1. Setting the appropriate standards for the NYE$ MPP, intervention a, addresses the issue of uncertain long-term energy savings, trying to achieve deep energy savings, and removing divisions in responsibilities of those professions working on the projects. In setting appropriate standards, NYSERDA has conducted pilots, learned from its legacy programs, worked with a multi-stakeholder group, taken a whole building approach, and made it a

requirement for building owners to address energy efficiency and conservation measures before pursuing alternatives.

NYSERDA gained a lot of experience with pilot and legacy programs before the launch of the NYE$ MPP. Incentives for the existing buildings component are received upon a projected minimum performance target of 20% (source energy reduction target) with an entire scope of work having a SIR (savings to investment ratio[45]) ≥1.0 (NYSERDA, 2009c). Energy reduction measures that are not cost-effective (i.e., long payback measures) individually may be included in the overall scope of work as long as the SIR≥1.0 and the first incentive may be available for approved projects that do not meet the 20% projected performance target (NYSERDA, 2009c). For the existing buildings component, analysis of the Assisted Multifamily Program (AMP) and Residential Technical Assistance Program (ResTech) legacy programs and looking at what was achievable based on those audits, NYSERDA felt it was pretty easy to hit 20% in projections (NYSERDA Associate Project Manager, pers. comm., April 7, 2010).

New York State's measures are tailored to a 'cold / without dry season / hot summer' climate;[46] natural gas, heating oil, and electricity energy sources[47] (accounting for 43%, 29%, and 19% of NYS residential energy use respectively); and a building energy consumption profile that is dominated by space and water heating (76% of residential energy use), appliance use and lighting (21%), and space cooling (2%) (Peel et al., 2007; US Energy Information Administration, 2009). For the existing buildings component, a list of measures that must be evaluated and has historically favourable SIRs is shown in Table 5.3 (NYSERDA,

[45] "The present value of the lifetime dollar savings for a measure divided by the cost of the installed measure yields a savings to investment ratio" (NYSERDA, 2009c).
[46] According to Köppen-Geiger climate classification system.
[47] Percentages for energy source by fuel and use are for New York State's residential sector.

2009c). From interviews with program administration and associates,[48] partners[49] and building owners,[50] the most common measures are lighting retrofits, HVAC (e.g., ventilation, boilers) upgrades, air sealing and insulation, and low flow fixtures. The NYE$ MPP stipulates that work scopes for building owners must first address energy efficiency before advanced measures (e.g., combined heat and power, submetering systems, advanced meter, photovoltaics, or other distributed energy measures) (NYSERDA, 2009c).

Table 5.3 *NYE$ MPP Measures*

*Source: adapted from NYSERDA (2009c)*

| **MEASURES THAT MUST BE EVALUATED** |
|---|
| **Lighting and Appliances** |
| Bi-level lighting in Common Areas |
| ENERGY STAR Clothes Washers |
| *ENERGY STAR Dishwashers |
| *ENERGY STAR Refrigerators |
| LED Exit Signs |
| ENERGY STAR CFL Hardwired Fixtures in Common Areas |
| *ENERGY STAR CFL Hardwired Fixtures in Apartments |
| *Replacement of Incandescent Bulbs with CFLs in Apartments |
| Super T8 Bulbs and Ballasts |
| Occupancy Sensors for Select Common Areas (i.e., laundry room) |
| **HVAC Measures** |
| **Combined Heat and Power (CHP) System (buildings with 80+ units) |
| Condensate Reclamation for Steam Systems |
| Conversion from Electric to Gas Heat |
| Decentralization of Central Boiler Plants |
| Energy Management System (including boiler controls associated with exterior and interior temperatures) |
| High Efficiency Boilers (ENERGY STAR where available) |
| High Efficiency Furnace (ENERGY STAR where available) |
| High Efficiency Cooling Systems (ENERGY STAR where available) |
| Outdoor Air Reset for Hydronic Systems |
| Replace #6 Oil with Dual Fuel System (#2 oil and natural gas) |
| Separate DHW Direct-fired Boiler (condensing if gas) |

[48] 2 respondents.
[49] 4 respondents.
[50] 2 respondents.

| MEASURES THAT MUST BE EVALUATED |
|---|
| **HVAC Measures** |
| Insulate Duct Work |
| Thermostatic Radiator Valves |
| Timers on Roof Fans (per code requirement) |
| Heat Recovery from Exhaust Air |
| **Envelope** |
| Air Sealing (including weather stripping) |
| Insulate all Hot Surfaces (condensate tank, steam and HW piping) |
| High Efficiency Windows/Storm Windows (when single-pane windows are present) |
| Insulate Walls |
| Insulate Roof Deck or Attic |
| **Other** |
| **Electric Submetering |
| Elevator Motors and Controls |
| High Efficiency Motors |
| Thermostatic/Smoke driven Louvers and Fans in Elevator Machine Rooms and Stairwells |
| *Low-flow Showerheads and Sink Aerators |
| **Health and Safety** |
| Asbestos Mitigation as part of Boiler and Distribution System Repair |
| Carbon Monoxide Detectors (unless all-electric) |
| Emergency Battery-powered Lighting in Common Stairways and Hallways |
| Installation and/or Repair of Mechanical Ventilation |
| Lead paint Mitigation during Window Replacement |
| Seasonal Dehumidification |
| Repair of Roof and Water Flashings |
| Replacement and/or Repair of Combustion Vents |
| Smoke Detectors |
| Ventilation Duct Repair |
| **Management and Education** |
| Building Operator Training and Certification |
| Owner's Manual |
| Resident Education Program and Materials |

Notes. *These are measures at a minimum must be included in Affordable Housing projects if found to be cost-effective (has an SIR 1.0 or greater) using reasonable cost estimates.

**These are advanced measures for which building owners can obtain additional incentives, but only after the energy efficiency measures have been addressed.

For the new construction component of the NYE$ MPP, NYSERDA began a pilot initiative and assembled a multi-state working group to coordinate with the U.S. EPA in developing a proposal with the criteria for ENERGY STAR

labelled multifamily buildings, which was approved by the U.S. EPA in January 2006 (NYS PSC, 2009a). To receive incentives in the new buildings component of the MPP, a performance rating of 20% better than a model building based on ASHRAE 90.1-2004 Appendix G must be achieved (Beaulieu, Rooney, and Karpman, 2010, p. 2-2; NYSERDA, 2009f).

Additional to the performance targets for the existing and new building components as discussed above, NYSERDA has outlined minimum performance standards to ensure that buildings are built to applicable codes, describe what is required to participate in the program, and promote the installation of ENERGY STAR appliances (NYSERDA, 2006; NYSERDA, 2009c).

According to NYSERDA, the whole building approach identifies energy efficiency measures to reduce energy use as well as addressing water consumption and health and safety measures (NYS PSC, 2009d). The whole building approach looks at achieving greater long-term energy savings by understanding the entire building and any interactive effects when improving energy performance and combines short payback measures with longer payback measures. NYSERDA requires whole building energy modelling for both its new and existing buildings components with measures that try to capture deep energy savings (e.g., changing fixture ballasts, occupancy sensors) that extend beyond shallow savings (e.g., just changing out the light bulbs). For the new buildings component of the MPP, the ENERGY STAR initiative involves ongoing energy monitoring and educating building managers and tenants to achieve long-term or persistent energy savings (NYS PSC, 2009a). Interviews[51] indicate that the whole building approach is successful for reasons such as:

> Without a doubt the advantage is the whole building approach or the fuel neutral approach where we are looking at total energy saved as opposed to just electric or natural gas savings [...]. When you do total, you look at all

[51] 10 respondents.

> opportunities in the building [...]. When we do shallow programs or programs that don't address the whole building [...] there is always missed opportunities out there, (NYSERDA Associate Project Manager, pers. comm., April 7, 2010).
>
> [I]t was an all inclusive comprehensive approach. […] This is the first time you saw a program with such depth as to what is the impact of changing out your windows on your boiler [...], (President Susan Dee Associates, pers. comm., May 5, 2010).

Results indicate that New York State has the most ENERGY STAR labelled multifamily high-rises than any other state (NYSERDA Program Manager Multifamily Building Performance, personal communication, March 1, 2010) with dozens more expected in 2010 (Beaulieu et al., 2010, p. 2-2). For the existing buildings component, an examination of seventeen projects (includes 93 buildings with over 3600 units of housing) that completed construction and performed post-retrofit billing analysis[52] as required by the MPP, indicated an average energy savings per project of 19.7% (Falk and Robbins, 2010).

Intervention b is creating a network of partners that have the knowledge and capability to deliver services to building owners. NYSERDA had expanded its number of partners quite quickly since the start of the program in May 2007 as described earlier in the discussion of partner training incentives (section 5.3.2 intervention a). With the increase of demand through the use of effective marketing and building owner financial assistance and incentives, NYSERDA had to create the infrastructure of building specialists to meet the demand. This was accomplished through an open enrolment process and partner training incentives and assistance. The partner network proved to be a strength of the

[52] At least 12 months but no more than 18 months after construction is complete, 12 months of post-construction utility data for the building is used to determine if the performance target has been met or exceeded before receiving the last scheduled incentive.

MPP.[53] As stated by the Pipeline Manager of the existing buildings component of the MPP:

> I think the strengths have been its [NYE$ MPP] work as a market transformation program in terms of setting up this network of energy efficiency professionals in New York and having a roster of people that you can go to, and expanding that roster of people or roster of firms with expertise, (pers. comm., April 8, 2010).

Although many new partners had been trained to deliver services to building owners, the training appeared to come at the cost of increased quality control and assurance, making the program more administrative and costly to partners. According to Wirtshafter Associates and Research Into Action (2008), there were repeated concerns by partners that there was too much emphasis on the exact details in the Energy Reduction Plan and the benchmarking report and all partners described added costs in redoing work plans or in complying with program requirements. Additional interviews[54] conducted with partners as part of this research corroborate the findings regarding increased time and cost to partners. Three of the program administrators and associates indicated that there were few qualified and experienced energy service providers and the challenge came with training the majority of them that were not experienced and required a lot of hands on assistance. A couple of partners indicated that due to the inexperience of the majority of the partners, the program became more arduous and costly for everyone as more checks and balances were put into place for everyone. “So I think the biggest challenge was that we didn't really have time to educate the market once the flood gates were open” (Senior Engineer Program Manager MPP Quality Assurance, Taitem Engineering, pers. comm., April 27, 2010). NYSERDA recognizes the need to expand the field of energy service providers outside of the MPP and in a 2008 process evaluation,

[53] 5 respondents.
[54] 8 respondents.

recommendations were made to have more hands-on training for program specific requirements (Wirtshafter Associates and Research Into Action, 2008).

One of NYSERDA's goals or focuses is to promote the ENERGY STAR label (intervention c). The ENERGY STAR label is a successful identifier of premium energy efficient products. However, issues with these products and technologies are poor performance and lack of ease of operation and maintenance after installation. According to one partner, the President of Susan Dee Associates, ENERGY STAR established a standard to receive an ENERGY STAR label, but do not require that the appliance/equipment be easy to program or operate (pers. comm., May 5, 2010). She goes on to mention that energy service providers do not always know how products or technologies perform after installation, so it would be useful to have some kind of feedback on the performance and ease of operation and maintenance of products and technologies (President Susan Dee Associates, pers. comm., May 5, 2010). Reliable energy savings will come from good service, and properly performing and easy to operate and maintain products and technologies.

Intervention d, conducting inspections, addresses poor construction practices and improper installation during and after construction. Partners and program administration and associates are involved in conducting building inspections. Responses from the program implementers indicate that for new construction, open wall and As-Built inspections are conducted, and for existing building retrofits, site inspections are conducted (pers. comm., April 8, 2010). Each building is inspected prior to work scope implementation, at 50% completion and final completion (NYS PSC, 2010). NYSERDA staff will also conduct building inspections during the energy reduction plan process to verify existing conditions and provide guidance to the partner and building owner (NYS PSC, 2010). Incentive payments are withheld if the work completed does not

meet or fails program requirements (NYS PSC, 2010). Addressing quality work in buildings addresses program compliance and reliable energy savings.

The key features from these interventions, as summarized in Table 5.4, are the importance of working with industry to advance energy reduction, demonstrating and proving energy reduction to the market, using experienced energy service providers, having training for energy service providers outside of the program, having reliable energy reduction measures for long term energy savings, using the whole building approach, and addressing energy efficiency and conservation measures before alternatives.

Table 5.4 *MPP Key Features of Building Convention Interventions*

| NYE$ Multifamily Performance Program (MPP) Key Features | Program Category: Building Convention |
|---|---|
| (A) Working with industry to advance energy reduction | a b |
| (C) Demonstrating and proving energy reduction to market | c |
| (D) Using experienced energy service providers (ESPs) | a b |
| (E) Having ESP training outside of program | b |
| (F) Having reliable energy reduction measures for long-term energy savings | a b c d |
| (Q) Whole building approach | a |
| (R) Addressing energy efficiency and conservation measures before alternatives | a |

### 5.3.4 Monitoring and Compliance

The NYSERDA NYE$ MPP has extensive monitoring and compliance with interventions related to quality control and assurance and evaluation and research (includes measurement and verification, research) (refer to Figure 5.1). As indicated previously, NYSERDA hired contractors TRC and Taitem Engineering – firms that had successful working relationships with NYSERDA as energy service providers in NYSERDA's legacy programs – as program

implementer[55] and for quality assurance (QA), respectively. Quality control and assurance (intervention a) is needed for program compliance and to ensure projects get constructed or implemented properly to meet the performance targets and deliver actual energy savings. Quality control refers to policies and procedures used by the program implementer (TRC) and partners to ensure quality work performance by partners and contractors, while quality assurance (QA) is performed by Taitem Engineering to evaluate whether quality control policies and procedures work (NYS PSC, 2010). According to the Senior Engineer, Program Manager, MPP Quality Assurance, Taitem Engineering:

> We were hired to be a third party objective opinion on how things are going and to provide a third perspective from NYSERDA and the program implementer. We basically see our role in getting involved in all aspects of the program, mainly on the technical aspects of the program. That has largely been our focus, that energy savings are delivered, (pers. comm., April 27, 2010).

The second intervention b, impact, process, and market evaluations, involves evaluation and research. NYSERDA has an evaluation team made up of NYSERDA staff and external contractors (NYSERDA, 2004b). NYSERDA's evaluation activities include day-to-day work on the New York Energy $mart Program portfolio and the individual programs that comprise it such as annual reports that detail status and evaluation of the programs' budget and spending, energy savings and other program benefits, program theories and logics, program processes, and markets analyses (NYSERDA, 2004b). NYSERDA submits quarterly and annual evaluation and status reports to the NYS PSC throughout the year. NYSERDA had also developed a comprehensive program logic model in February 2007[56] and proposed an evaluation approach in 2008, which incorporates evaluation, measurement and verification, and research. The evaluation approach includes impact, process, and market evaluations.

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[55] As program implementer TRC also has the function of quality control contractor.
[56] Program Logic Model Report for MPP prepared by GDS Associates.

NYSERDA's primary evaluation goal was to verify anticipated program savings and assess free ridership[57] and spill-over[58] with secondary goals involving the investigation of program participant awareness, satisfaction, barriers, and decision making (NYS PSC, 2008c).

Impact evaluation includes: 1) measurement and verification involving program cycle site visits, on-site surveys, and DOE-2 modelling (energy modelling) for non-participating, partial participating (i.e., buildings that have used program partners but have not participated in the MPP), and participating new multifamily buildings; pre and post-participation energy use and savings assessment with a full year of billing data for existing multifamily buildings; and 2) net-to-gross evaluation that examines spill-over and free ridership through an enhanced self-report survey process with the stakeholders (e.g., building owners, architects/engineers, vendors, technical assistance providers) (NYS PSC, 2008c).

Process evaluations involve interviews with NYSERDA staff, program implementation staff, participating and non-participating building owners, energy service providers and energy consulting firms for the purposes of highlighting potential issues and to investigate opportunities for improving program effectiveness (NYS PSC, 2008c). Two process evaluations, conducted by Wirtshafter Associates and Research Into Action in June 2007 and April 2008, identified some of the issues referenced in this paper and included interviews with NYSERDA program staff, partners and building owners.

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[57] Participants in a program who receive an incentive or other assistance, but would have acted even without the program (Blumstein, 2009).

[58] Occurs when the effects of an energy efficiency program affects other behaviour (Blumstein, 2009). For example a program non-participant who acts on energy efficiency measures because of an energy efficiency program, but not receiving the benefits offered by the program or a program participant stimulated to pursue additional measures without program benefits (Blumstein, 2009).

Market evaluation involves developing a program theory and logic model that will define expected program outcomes and indicators to guide future evaluations (NYS PSC, 2008c). Further work is also required to understand the market environment in which the program is operating by conducting a baseline study of new construction and a baseline and measure saturation study for existing buildings (NYS PSC, 2008c). For new construction the study would involve onsite data collection with a sample on non-participating buildings combined with participant impact evaluations to characterize current multifamily construction practices, estimate building efficiency levels, and identify key market actors, in addition to survey work to establish a baseline of market actor capacity and work (NYS PSC, 2008c). For existing buildings the study would involve site visits to characterize buildings in the multifamily sector, survey work to define key market actors with significant influence and involvement in the market, and establishing a baseline of market actor capacity and work (NYS PSC, 2008c).

Documents collected for this research included NYSERDA's NYE$ MPP logic model, two process evaluations for the MPP, quarterly and annual evaluation and status reports, and an examination report on the preliminary results of the MPP for the existing buildings component. The program logic model and executive summaries of the process evaluations can be found on the NYSERDA website (NYSERDA, 2004b). Highlights of the second quarter evaluation and status report for June 2010 indicates slow progress due to time devoted to program design and lengthy timelines[59] for individual projects. A total of approximately $100 million US was spent from July 1, 2006 to June 30, 2010 on multifamily building performance with 863,707 million British thermal units (Btu) of gas savings, 75.7 Gigawatt hour (GWh) of electrical savings, 108,693

[59] MPP allows for up to 34 months for completion on existing buildings component (Falk and Robbins, 2010). Ideally 24 months for completion on new buildings component (Pipeline Manager New Construction MPP, personal communication, April 8, 2010).

units receiving energy efficiency services, and $22.4 million US of tenant energy savings (NYS PSC, 2009e). Refer to the following Table for details.

Table 5.5 *NYE$ Multifamily Performance Program Achievements*
*Source: adapted from NYS PSC (2009e)*

| | Fuel Savings (Million Btu) | | Electricity Savings (GWh) | | [2]No. units receiving energy efficiency services | | [3]Tenant energy savings/year (US$Million) |
|---|---|---|---|---|---|---|---|
| MPP Building Component | [1]Jul '06 to Jun' 10 | % of Goal Achieved | [1]Jul '06 to Jun' 10 | % of Goal Achieved | Jul '06 to Jun' 10 | % of Goal Achieved | Jul '06 to Jun' 10 |
| Existing | 834,830 | 15% | 73.5 | 23% | 105,527 | 74% | 21.8 |
| New | 28,877 | 4% | 2.2 | 9% | 3,166 | 26% | 0.6 |
| Totals | 863,707 | | 75.7 | | 108,693 | | 22.4 |

[1]Total funding includes system benefit charges (SBC) and Energy Efficiency Portfolio Standard (EEPS) for programs from July 1, 2006 to June 30, 2011. Values include legacy program (Assisted Multifamily Program) results and are not adjusted for free ridership or spill-over.

[2]Includes savings from partially completed units with installed measures. 84,123 of 105,527 existing units are low-income existing and 2,942 of 3,166 are low-income new.

[3]Approximately US$17MM energy savings from existing and new low-income multifamily units and US$5MM on existing and new market rate multifamily units.

Ten interviews with program participants and examination results from NYSERDA's existing buildings component of the MPP conducted by Falk and Robbins (2010) highlight the importance of understanding non-energy benefits, influences on energy use behaviour (refer to Figure 2.4), re-bound effects,[60] product performance, and reasons for over-estimated energy savings. Some of the highlights have been summarized in Table 5.6.

[60] Rebound' or 'takeback' effect is an increase in demand for energy services because improving energy efficiency lowers the cost of energy making it more affordable for more energy services (Herring, 2006; International Energy Agency [IEA], 2005; Khazzoom, 1980).

Table 5.6 *Influencing Factors, Non-energy Benefits, Product Performance, Over-estimation Findings*

| Example or Comments | Subjects requiring understanding | Reference |
|---|---|---|
| The people from before (the upgrades) were really the lowest people that you could rent to, is what I inherited. There were a lot of people on public assistance and desperate means and did not have much to plug in anyways. Now that I am getting a little better clientele, well most people have a computer, desktop, multiple TVs, iPods, all these gadgets. | Non-energy benefit: better tenants for building owner; influencing factors: contextual factors and personal capability; potential indirect rebound effect[61] | (Building owner, personal communication, May 3, 2010) |
| In retrospect, I would advise anybody to at least involve their customer (e.g., whether it is an apartment building, student housing, retirement community) in the end-using device and think about how it affects the people. Is it going to feel stuffier, is it going to feel more comfortable? You are going to want to be able to communicate that. Are the thermostats good or not so good? If you involve people ahead of time, in proper measure, it saves you a lot of damage control down the road. | Influencing factors: contextual factors; non-energy benefit: comfort; product performance | (Building owner, personal communication, May 24, 2010) |
| Plug load creep (people are buying more stuff and plugging stuff in). Hard to convince people that all those devices people buy are impacting their electricity use. | Influencing factors: contextual factors, attitudinal factors, personal capability; potential indirect rebound effect | (NYSERDA Program Manager MBP, personal communication, March 1, 2010) |
| - Compact fluorescent lighting installed as an energy reduction measure failed because residents ultimately discarded them.<br>- Installation of outdoor security lighting increased energy load.<br>- Security concern – installation of 2,000 security cameras increased energy load.<br>- Added laundering facilities increased energy load. | Influencing factors: contextual factors, social norms and expectations (e.g., security, product acceptance, amenity); product performance | (Falk and Robbins, 2010) |
| - Installation of energy efficient chiller – increased use of chiller. | Non-energy benefit: comfort; Influencing factors: contextual factors; potential direct rebound effect[62] | (Falk and Robbins, 2010) |
| - Pre and post evaluation overestimated electric energy savings more pronounced in mid and high-rise buildings. | Overestimated electric energy savings | (Falk and Robbins, 2010) |

[61] Indirect rebound effect occurs when the consumer has a little more money to spend on all goods and services because of a reduction in the cost of energy services (Herring, 2006).
[62] Direct rebound effect occurs when there is increased use of energy services because of a reduction in price due to greater efficiency (Herring, 2006).

Overall, the NYSERDA examination by Falk and Robbins (2010) indicated an average energy savings per project of 19.7%, which achieved the 20% lower energy use building performance target. Their findings showed that 59% of the projects in their database achieved the 20% performance target but those projects that missed the performance target missed the target by a significant margin (Falk and Robbins, 2010). Based on the interviews and the NYSERDA examination, a broader scope for evaluation and research is warranted for understanding and identifying non-energy benefits and their value to market actors, understanding the influences on energy use behaviour and choice, understanding product performance and use, and understanding the reasons for over-estimated energy savings.

The key features of these interventions, as summarized in Table 5.7, are the importance of having reliable energy reduction measures for long term energy savings, evaluation and research to improve the program and verify energy savings, understanding the market, establishing a baseline, having a program administration with good governance (accountable), understanding behaviour and choice, and identifying non-energy benefits.

Table 5.7 *MPP Key Features of Monitoring and Compliance Interventions*

| NYE$ Multifamily Performance Program (MPP) Key Features | Program Category: Monitoring and Compliance |
|---|---|
| (F) Having reliable energy reduction measures for long-term energy savings | a b |
| (J) Understanding the market | b |
| (K) Understanding behaviour and choice | b |
| (L) Identifying non-energy benefits | b |
| (M) Evaluation and research to improve program and verify energy savings | b |
| (N) Program administration: good governance | b |
| (P) Establishing a baseline | b |

### 5.3.5 Behaviour

The NYE$ MPP does not have any interventions under this category. It is assumed that interventions under the other program categories affect energy use behaviour and ultimately the outcomes.

## 5.4 NYE$ MPP Key Features and Theory Differentiation

Key features for the NYE$ MPP from all of the different interventions described above are summarized in Table 5.8. To facilitate comparison between the cases, a common summary table of key features is used in both cases. As a result, there are categories and features listed in the table for which the NYE$ MPP has no interventions. Specifically, these are the “Behaviour” category and Feature (B) – Having a point person.

Table 5.8 *Key Features of NYE$ Multifamily Performance Program*

| NYE$ Multifamily Performance Program (MPP) Key Features | Program Categories and Interventions | | | | |
|---|---|---|---|---|---|
| | IKC | COM | BC | MC | B |
| (A) Working with industry to advance energy reduction | b e | b d | a b | | |
| (B) Having a point person | | | | | |
| (C) Demonstrating and proving energy reduction to market | e h | d | c | | |
| (D) Using experienced energy service providers | | a | a b | | |
| (E) Having ESP training outside of program | | | b | | |
| (F) Having reliable energy reduction measures for long-term energy savings | | | a b c d | a b | |
| (G) Having effective communication/education strategies | a c d | | | | |
| (H) Targeting the audience | i | | | | |
| (I) Having proper building owner training/education for long-term energy savings | a f | e | | | |
| (J) Understanding the market | | | | b | |
| (K) Understanding behaviour and choice | | | | b | |
| (L) Identifying non-energy benefits | h | | | b | |
| (M) Evaluation and research to improve program and verify energy savings | | | | b | |
| (N) Program administration: trusted/independent/mandated/good governance/relationship builder | Refer to Section 5.2 Program Administration Context (A) addresses relationship building, b | | | | |
| (O) Improving program clarity and ease of use | g | | | | |
| (P) Establishing a baseline | | | | b | |
| (Q) Whole building approach | | | a | | |
| (R) Addressing energy efficiency and conservation measures before alternatives | | | a | | |
| (S) Having diverse financing tools | | c d | | | |

Notes. IKC-Information, Knowledge and Communication; COM-Capital Costs, Operation and Maintenance; BC-Building Convention; MC-Monitoring and Compliance; B-Behaviour

Overall, the NYE$ MPP addresses most of the guiding principles of novel programming, which were presented in Chapter Two, by targeting upstream and downstream market actors; employing diverse interventions in almost all program categories; having collaborative work teams with program administration, implementers, quality assurance contractor, and evaluators; having a mandated, credible, accountable, flexible program administration; and developing a comprehensive evaluation approach that includes evaluation and research for program improvement and verification of energy savings.

NYSERDA has developed a comprehensive program logic model for its MPP with a program approach aimed at increasing the demand for energy reduction measures and facilitating development of the infrastructure to address the demand, with anticipation of eventual changes to building codes. The MPP includes many interventions for upstream and downstream actors including activities in recruitment and training; facilitation and market infrastructure development; technical and financial assistance; promotion and education; and quality assurance.

The theoretical deficiencies in the NYE$ MPP in terms of novel program principles include some aspects of real-time monitoring and evaluation feedback loops, qualitative assessment to address non-quantifiable/non-energy benefits (e.g., tenant comfort, increased value of the building due to energy performance improvements) that are important to market actors, and undertakings to understand the influences of energy use behaviour and choice. NYSERDA's evaluation approach appears to have real-time monitoring and evaluation feedback loops in its use of a web portal, meetings, and conferences for its partners and its administration and associates. Yet there is also evidence in their process evaluation reports (e.g., issues regarding training of partners, building owner portal and forum) and corroboration of similar findings during data

collection for this research, to suggest that the feedback to provide actionable information for program adjustment is not integrated in a real-time way, in that the contract evaluators conduct and report on evaluations done according to set schedules rather than having ongoing feedback. In addition, it was not apparent from the data collected that an interdisciplinary approach to developing performance metrics, evaluation and research was used.

Even with the diverse program interventions developed by NYSERDA, results from a NYSERDA examination of completed projects on the existing buildings component of the MPP and interviews with program participants confirm the need to go beyond technological/economic fixes. There needs to be a better understanding of influences on energy use behaviour and choice and qualitative assessment of the non-quantifiable/non-energy benefits to upstream and downstream actors. NYSERDA's examination showed just how important it is to understand and determine the influences of energy use behaviour and choice as just implementing the measures alone can fall short of anticipated energy savings.

## 5.5 Summary

NYSERDA has a comprehensive market transformation program with interventions targeting upstream and downstream actors. The highlights for the program are:

- Facilitiating the demand for energy reduction measures by providing information and training and financial assistance and incentives for building owners;
- Proving that energy reduction measures result in real energy savings;
- Facilitating the development of a market infrastructure of qualified building specialists or design teams for energy reducing goods and services by providing incentives and training;

- Working with private financial lenders to improve availability of capital for energy reduction projects;
- Promoting the ENERGY STAR label and requiring a whole building approach to new construction and retrofits of multifamily buildings;
- Having extensive quality control/assurance and evaluation and research strategies that include impact, process, and market evaluations.

## Chapter Six: Comparative Analysis

This chapter is a comparative analysis of the precedent programs describing the similarities and differences between the program approaches and key features. The discussion describes the differences in program approach, features that are unique to each program, and common or similar features. The chapter concludes with a discussion on what the programs have not addressed.

Overall, the programs are differentiated by the administration's intended emphasis on transforming the market and increasing the uptake of energy reduction measures. TAF is looking to work with industry to identify and find the solutions to the issues (risks and barriers), concentrating efforts on outreach and educating downstream actors on energy reduction measures, proving energy reduction projects save energy, and proving by example to private financial lenders that these projects can be successfully financed with innovative models. NYSERDA, on the other hand, is facilitating the demand of energy reduction measures with information and training, financial assistance and incentives and facilitating the development of a market infrastructure of building specialists or design teams for energy reducing goods and services by providing incentives and training. The goal being spill-over and eventual changes to the building codes and construction practices. NYSERDA's NYE$ MPP is more comprehensive in that it addresses many of the guiding principles of novel programming in its approach, and has more diverse interventions in the different program categories when compared to TAF's TWP (highlighted in each program model illustrated in Figures 4.1 and 5.1).

Despite these differences, the TAF TowerWise and the NYE$ Multifamily Performance programs share a number of features, as well as having features that are unique to each. The key features from both programs are summarized in

Table 6.1 and the following discussion will begin with the features unique to each of the programs followed by the similar features.

Table 6.1 *Precedent Programs Key Features Comparison*

| Key Features | TAF TWP | NYE$ MPP |
|---|---|---|
| (A) Working with industry to advance energy reduction | ✓ | ✓ |
| (B) Having a point person | ✓ | |
| (C) Demonstrating and proving energy reduction to market | ✓ | ✓ |
| (D) Using experienced energy service providers | ✓ | ✓ |
| (E) Having energy service provider training outside of program | | ✓ |
| (F) Having reliable energy reduction measures for long-term energy savings | ✓ | ✓ |
| (G) Having effective communication/education strategies | ✓ | ✓ |
| (H) Targeting the audience | ✓ | ✓ |
| (I) Having proper building owner training/education for long-term energy savings | ✓ | ✓ |
| (J) Understanding the market | | ✓ |
| (K) Understanding behaviour and choice | | ✓ |
| (L) Identifying non-energy benefits | | ✓ |
| (M) Evaluation and research to improve program and verify energy savings | | ✓ |
| (N) Program administration: trusted/independent/mandated/good governance/relationship builder | ✓ | ✓ |
| (O) Improving program clarity and ease of use | ✓ | ✓ |
| (P) Establishing a baseline | ✓ | ✓ |
| (Q) Whole building approach | ✓ | ✓ |
| (R) Addressing energy efficiency and conservation measures before alternatives | ✓ | ✓ |
| (S) Having diverse financing tools | ✓ | ✓ |

Notes. ✓ - Features of TAF TWP; ✓ - Features of NYE$ MPP

## 6.1 Features Unique to Each Program

Feature B is unique to the TAF TowerWise program. TAF has a point person, the TowerWise Conservation Incentives Advisor, who has effectively increased traffic to the TowerWise website and increased interest and participation in many programs offered to the residential high-rise sector in Toronto. Instead of relying just on users to find the programs through online websites and traditional print, radio, and television marketing and advertising strategies, having someone who assists building owners by making themselves available and actively seeking building owners out at apartment association or property management meetings has been effective for the TowerWise program.

Features E, J, K, L, and M are unique to the NYSERDA NYE$ MPP and have come either from interviews with program participants or NYSERDA's program evaluation efforts. These features include the importance of having training for energy service providers outside of the program, understanding the market, understanding behaviour and choice, identifying non-energy benefits, and evaluation and research to improve the program and verify anticipated energy savings. Respondents from the NYE$ MPP indicated that the partner network expanded too quickly with inexperienced partners. The result was extra time and cost for partners to get up to speed on conducting proper energy reduction projects and also for the program administration and associates responsible to address quality work and real energy savings. The lesson learned (Feature E), included looking to expand the energy services field through the state community college network outside of the MPP and looking towards more specific hands-on program training.

Features J through M, generally emphasize the need for broader evaluation strategies and research into understanding behavioural-socio-techno-economic interactions of the market and how they ultimately affect energy use. It

is these features that support the guiding principles of novel programming such as an expanded approach to intervening in the market for energy reducing goods and services, beyond the economic technology fix, and incorporating interdisciplinary program teams to help in program design, evaluation and research (e.g., qualitative and quantitative assessment of energy and non-energy benefits, understanding influences on energy use behaviour and choice). In addition, monitoring and evaluation feedback are intrinsic to these features and critical in addressing program improvement and determining the impacts of interventions.

## 6.2 Common Program Features

The features that are similar, but vary in the types of program interventions are A, C, D, F, G, H, I, N, O, P, Q, R, and S. Rather than re-iterating information contained within the chapters on the precedent programs, a high level discussion of these features and the differences between the programs will follow.

(A) Both TAF and NYSERDA interviewees spoke about needing collaborative efforts with industry to help solve the issues and both programs have been successful through collaboration and partnerships with industry in their own approach. The primary difference is that TAF has formalized a broad industry stakeholder group (TEEAC) made up of representatives from the development, building construction and property management sectors, the energy efficiency and utility sector, organized labour, industry associations, tenant associations, and government representatives. TAF created industry partnerships and a decision making network to help identify issues and solutions, to help with program development, and facilitate educational seminars. NYSERDA, on the other hand, has had programs for energy building performance since the late 1990s. It has a more mature market for energy

related services[63] and similarly collaborates with others in industry but focuses most of its program efforts with a network of energy service providers (partners) to advance energy reduction.

Feature C, demonstrating and proving energy reduction to the market, is one of the most significant features from both precedent programs as the majority of respondents in both programs identified it. Both programs incorporate online testimonials and techno-economic detailed case study documents as a means to demonstrate and prove to end users that energy reduction measures work. It is apparent from the interviews how important it is to demonstrate and prove what energy reduction measures are effective in terms of energy and non-energy benefits. However, where both programs are weak is in the delivery of the message in that they assume all building owners are driven by energy benefit facts and figures. To prove energy reduction measures are beneficial to building owners, both programs are also working to prove financing models for energy reduction projects with the intent of improving confidence in private lending. TAF is leading by example and providing innovative financing loan options, while NYSERDA is working with the financial lenders on buy-down loan options.

(D) Using experienced energy service providers is common to both programs. Both TAF and NYSERDA collaborate or work with veteran energy efficiency professionals to gain experience with energy reduction projects and obtain input in setting appropriate program performance targets. However, NYSERDA is also assisting in building the capacity of energy service providers (a partner network) by incentivizing and providing proper training, so that there will be competent energy service providers capable of providing the necessary energy related services for the market.

[63] 2 respondents.

(F) Having reliable energy reduction measures for long-term energy savings is important in both programs. Each program looks to setting achievable cost-effective performance targets, incorporating a more comprehensive whole building analysis and approach (addresses education, health, safety, energy and water use), using proven and tested products and services, and instituting some kind of quality control. The difference is that the NYE$ MPP has an extensive evaluation approach, quality control and assurance, and promotes the ENERGY STAR label.

(G) Both programs have comprehensive websites with information, resources, tools, and services, but the communication/education strategies are different because of differences in the focus areas and target users of the programs. NYSERDA has outreach and education for end users, but has also created very specific communication strategies such as the website partner portal and comprehensive residential information system (CRIS) to accommodate program administration, program implementers, quality assurance contractors, and partners. These strategies have been effective for the program team and partners in learning about new ideas and voicing issues associated with energy reduction measures, projects, program process and/or requirements. In addition, through one of NYSERDA's process evaluations, they recognized the need for a building owners portal. TAF on the other hand, has a less interactive website (e.g., website is limited to comments for seminar or event attendees) and one-way communication/education strategies focused primary on outreach and educating the end users on how to go about implementing their own energy reduction retrofit projects.

(H) TAF's audience for the TowerWise program are more to address developers and end users in market rate rental and condominium buildings in Toronto because a separate initiative (Tower Renewal) addresses the public or

affordable housing high-rise sector in Toronto. NYSERDA's efforts and resources are aimed state-wide at new construction and existing multifamily (5+ units) buildings for market-rate and low to medium income multifamily housing. Interviews from both programs indicated challenges with condominiums/co-operatives because of issues such as lengthy board approval processes, lack of access to tenant suites and bylaws in condominiums.

(I) Poor building operation and maintenance practices erode energy savings and are an issue that both programs are looking to address through building owner training. The difference in approach is that TAF refers building owners to the training courses available by a third party, while NYSERDA takes a more proactive role by offering financial incentives and working with industry to provide training courses for building owners across the state.

(N) From the data collected, the TAF and NYSERDA program administration is mandated, trusted/credible, legitimate, accountable, adaptable, and has shown successful collaboration with industry. Both TAF and NYSERDA operate under very specific energy policies and mandates from the City of Toronto and State of New York, respectively. Interviews indicate that both organizations are trusted or credible. The administration for the programs in Toronto and New York are legitimate as both TAF and NYSERDA are enacted entities and established to address very specific mandates. TAF was established by the province enacting the TAF Act in 1992 at the request of the City of Toronto and NYSERDA was created in 1975 under the State Public Authorities Law. The administration for the precedent programs are accountable to a board comprising of government and citizen members for TAF and government, business/industry, and citizen members for NYSERDA. Both precedent program administrators are flexible and responsive in their ability to react to changing issues (e.g., TAF re-allocation budget for an incentives advisor position, NYSERDA's PSC required

modifications to the MPP). Both program administrators have shown success in working with industry players to resolve issues (e.g., TAF worked with a major developer to create the Green Condo Loan and NYSERDA holds open forums for partners to voice concerns over program process and/or energy reduction measures).

TAF is limited to working in the Greater Toronto Area with its program, works hard at maintaining an independent unbiased image in order to build multiple partnerships to solve the issues, and has a lot less funding ($8 million for loans or $27/unit[64]) and only a handful of staff to pursue certain program initiatives or interventions when compared to NYSERDA. NYSERDA's MPP is state wide, includes a collaborative program team (NYSERDA program administration with contracted program implementer/quality control, quality assurance, and evaluators) and network of energy service providers, and is better funded (~$100 million or $72/unit spent on the NYE$ MPP from July 1, 2006 through June 30, 2011).

(O) Having confusing and difficult program requirements can prevent developers and end users from participating in a program and the precedent programs are addressing this issue quite differently as a result of their different operating climates. In Toronto, there happens to be multiple energy efficiency and alternative energy programs currently available to the residential high-rise sector run by different program administrators. The solution to reduce confusion and improve program ease of use was to create an Independent Conservation Incentives Advisor, sponsored by TAF and other industry stakeholders, whose role is to help building owners maximize their benefits and navigate through the

[64] Dollars per unit uses the capital available divided by the number of high-rise dwellings (in 5 or more stories or 50+ unit structure) in Toronto or New York State according to Canadian or U.S. census data. Toronto number of dwellings adjusted for percentage of modern slab high-rises (~63%).

different programs available. In New York State, NYSERDA has been the primary administrator for energy efficiency programs and in the past NYSERDA had multiple programs to address multifamily building performance. However, they have found consolidating all of the legacy programs into the NYE$ MPP effective in reducing confusion and improving program ease of use.

(P) The need to establish a baseline of energy use for residential high-rises is clear in both programs. In reference to the TAF TowerWise program, one of the energy service providers interviewed lamented the lack of a benchmarking tool to catalogue and understand energy use in high-rises and suggested that TAF establish a baseline of energy profiles. NYSERDA has specified its intention, as outlined in its program administration proposal September 22, 2008, to conduct baseline studies for their MPP new construction and existing buildings components (NYS PSC, 2008c).

(Q, R) Both programs promote a comprehensive or whole building approach and address energy efficiency and conservation ahead of alternative measures. A whole building approach is a way to get deeper energy savings, address interactive effects, prevent missed opportunities, aid in removing responsibility divisions of the professions, and address measures not related to energy use such as education, water conservation and health and safety measures. Both TAF and NYSERDA worked with energy efficiency professionals in setting appropriate performance targets, although the specific targets and requirements differ by program. TAF is targeting a 25% energy reduction when compared to the national building code (Canadian Model National Energy Code for Buildings) for new construction and a 15% energy reduction when compared to prior building performance for existing buildings. NYSERDA, on the other hand, is targeting 20% better energy performance than a building modelled after ASHRAE 90.1-2004 for new construction and a 20% source energy reduction for

existing buildings. As for the types of measures, both programs focus much of their measures on HVAC upgrades and lighting retrofits. Unlike NYSERDA, TAF does not require a list of measures that must be evaluated, and although TAF promotes energy efficiency and conservation measures before alternative measures, it does not make it a program requirement.

(S) In terms of financing options both programs are offering different types of financial assistance and incentives. The benefit to having diverse financing tools is that every building owner has a different financial situation and will require different solutions for financing. TAF is offering two different types of loans, one to address the developer/condominium owners split incentive and one staged loan for retrofits. NYSERDA's MPP (prior to modifications) provided a 4% 10 year buy-down loan and/or capital incentives or scheduled grants worth approximately 25% of total project capital which were straight forward for building owners to calculate and aided their projects to completion. Interviews with program participants in the NYE$ MPP indicated that the scheduled grants offered were successful in aiding building owners to get their projects completed and with energy reduction measures that may not have been considered otherwise. Furthermore, the NYE$ Loan Fund was a successful public/private collaboration that demonstrated to private financial institutions the value in lending for energy reduction projects, making them comfortable enough to provide loans to many large building owners outside of the MPP.

### 6.3 Summary

Overall, the two programs share many common features, although they vary in the details. The NYE$ MPP is a much more comprehensive and well developed market transformation program with more interventions for upstream and downstream actors and evaluation strategies when compared to the TAF TWP. What is clearly missing from both programs is evaluation and research into

what influences energy use behaviour and choice, and interventions that look to address behaviour rather than assuming that interventions reliant on techno-economic fixes in all the other categories and modules will affect behaviour and result in reduced energy use.

# Chapter Seven: Designing an Energy Reduction Program for Alberta

This chapter details the Alberta context and needs analysis, and puts forward a set of recommendations for an Alberta energy reduction program design that builds on the learning from the precedent case studies.

## 7.1 Alberta Context and Needs Analysis

An energy reduction program for Alberta residential high-rises is influenced by the context in which it will operate. There is no one program that is suitable in all instances; that can respond equally effectively to different economic, social, political, and environmental circumstances. Information used to understand and describe the Alberta context includes: publicly available documents on energy policies, regulatory frameworks at different levels of government, and institutional frameworks; surveys of Albertans regarding energy and the environment; and interview responses containing significant themes and issues.

Understanding the position and strategies that different levels of government have on climate change reflects what the government's commitment could be to making policy changes and potentially addressing energy reduction initiatives in the built environment.

In 2008, the government of Alberta issued a Provincial Energy Strategy and Climate Change Strategy. In part, the Provincial Energy Strategy asserts to promote energy efficiency and conservation at all levels and hopes to achieve wise energy use by increasing knowledge and awareness of energy issues and seeking to change energy consumption behaviour (Government of Alberta, 2010a). The Alberta's Climate Change Strategy sets provincial greenhouse gas reduction targets at 20 megatonnes by 2010, 50 megatonnes by 2020, and 200

megatonnes by 2050 (Government of Alberta, 2010b). The target for 2050 is equivalent to 50% below business as usual or 14% below 2005 levels. The strategy outlined by the provincial government will focus attention on conserving and using energy efficiently, implementing carbon capture and storage, and greening energy production (Government of Alberta, 2010b). A number of actions on conservation and energy efficiency are expected to result in a reduction of 24 megatonnes out of the 200 megatonnes target for 2050, with the remaining reductions expected from carbon capture and storage estimated at 139 megatonnes and greening energy production estimated at 37 megatonnes (Government of Alberta, 2010b). The goal of the province, as outlined in the 2008 Climate Change Strategy, is to reduce greenhouse gas emissions by transforming how energy is used, applying energy efficient solutions, and conserving energy (Government of Alberta, 2010b). The actions for conservation and energy efficiency include:

- developing an energy efficiency act;[65]
- establishing an incentive program for energy efficient appliances and home improvements;
- having energy efficiency standards in the building codes;
- providing support to municipalities and other climate change partners regarding emission reduction strategies;
- implementing greenhouse gas reduction strategies in the agricultural and forestry sectors;
- developing reporting protocols for facilities that emit over 50,000 tonnes of greenhouse gas emissions;
- continuing efforts on the carbon offset market;
- introducing energy efficiency standards for government buildings, products, and fleet;

[65] Note that third party sources indicate a change from developing an act to an action plan.

- establishing a team to raise energy efficiency and conservation awareness province-wide (Government of Alberta, 2010b).

With regards to the second action listed above, which specifically addresses energy efficiency programming, the Alberta government has committed to investing $36 million over three years on energy efficiency rebates for homeowners that are administered by Climate Change Central, a public/private not-for-profit aimed at empowering Albertans to take action on climate change and established by the Alberta government in 1999 (Climate Change Central, 2009a; Government of Alberta, 2010b).

The Cities of Edmonton and Calgary have set more aggressive municipal level greenhouse gas emission targets when compared to the province and will require substantial action plans to reduce energy use from all sectors. In October 2009, The City of Calgary signed the Climate Change Accord that commits to corporate greenhouse gas emission reduction targets of 20% by 2020 to a minimum 80% by 2050 below 2005 levels (City of Calgary, 2009). The Calgary Climate Change Accord also commits the City to approving official policies and plans to reduce greenhouse gas emissions for the community that parallel the corporate targets; establishing a 2005 baseline of all community GHG sources; creating a plan to reduce emissions and promote lower-carbon living; and establishing a mechanism to report community progress (City of Calgary, 2009). For Calgary, the baseline greenhouse gas emissions in 2005 were approximately 16,800 kilotonnes/year (kt/yr) (City of Calgary, 2006), with residential buildings accounting for approximately 25% of the total or 4,200 kt/yr (City of Calgary, 2010a). With an 80% reduction from 2005 levels there would need to be an approximately 3,400 kt/yr reduction in buildings plus any incremental greenhouse gas emissions associated with the City's population growth. The 3,400 kt/yr reduction would be equivalent to making approximately 260,000 typical Alberta residences (13 tonnes CO2/yr) carbon neutral.

In 2005 a community visioning process engaging over 18,000 Calgarians, called imagineCALGARY took place to create a 100 year vision for Calgary (City of Calgary, 2010b). In September 2009, an integrated Municipal Development Plan and Calgary Transportation Plan developed through a process called Plan It Calgary, created to align with the vision and goals of imagineCALGARY, was approved by council (City of Calgary, 2010b). The goal of Plan It Calgary was to set a long-term direction for smart growth in Calgary over the next 60 years (City of Calgary, 2010b). As part of the Plan It Calgary research, the City of Calgary in July 2008, commissioned an energy mapping study (discussed in Chapter One section 1.1.1). The study intended to provide direction about the potential to reduce greenhouse gas emissions and encourage alternative energy systems through the design of new and existing buildings (residential low, medium, and high-rise; commercial office and retail; industrial; institutional) and encourage more compact, mixed-use and high density communities (Canadian Urban Institute, 2008). The Canadian Urban Institute findings, as discussed in Chapter One, show that there are economic savings to be realized through implementing energy reduction measures and recommended encouraging higher energy performance building standards and advancing the development of incentives for green building in all building types (Canadian Urban Institute, 2008).

The City of Edmonton has set its greenhouse gas reduction targets at 6% by 2010 and 20% by 2020 below 1990 levels. Edmonton's baseline greenhouse gas emissions within city boundaries were approximately 13,200 kt/yr in 1990 and 18,300 kt/yr in 2008 (City of Edmonton, 2009; City of Edmonton, 2010a) with residential buildings accounting for approximately 17% of the emissions (City of Edmonton, 2010b). Unfortunately, Edmonton's emissions continue to rise making it more challenging for the City to meet its targets.

To achieve their targets, the City of Edmonton in 2002 officially launched with City Council approval a community-wide greenhouse gas emission reduction plan referred to as the $CO_2$RE Strategy (City of Edmonton, 2010c). A team of people representing the residential, business, industrial and institutional sectors helped to develop the strategy (City of Edmonton, 2010c). The $CO_2$RE Strategy includes:

- building on residential programs and launching commercial/institutional programs;
- using a combination of education, incentives and regulation;
- collective effort by City departments, other orders of government, businesses, industry, and citizens;
- City leadership in its policies, planning, programs, advocacy, and its own operations (City of Edmonton, 2010d).

The $CO_2$RE website has a lot of information on energy efficiency for the residential sector and already provides information on all the different types of energy efficiency and alternative energy programs available to the single-family homeowner and information tips on saving energy for renters and condominium owners. The City's $CO_2$RE program has been recognized in Copenhagen's Climate Change Summit with a Climate Leadership in Canada award for its community-based initiative to reduce local greenhouse gas emissions (CTV Edmonton, 2009). The $CO_2$RE program will very likely be instrumental in the development of a more focused energy reduction program for residential high-rises. The City of Edmonton, similar to many municipalities in Alberta, are partnering with Climate Change Central to administer its rebate programs.

In sum, the Cities of Calgary and Edmonton have municipal strategic plans, policies, and targets to address climate change, yet no comprehensive programs to specifically address energy reduction in the residential high-rise sector even though the need for energy reduction in all areas is required to

reduce their greenhouse gas emissions. There is no doubt that single family homes dominate the residential sector and are a priority, but given increasing infrastructure costs and the need to look at more compact urban land use, it would be proactive to address energy use in the residential high-rise sector sooner rather than later as the demand for these types of buildings grows and becomes more of an issue over time.

As for non-governmental entities, there are a number of institutional and industry stakeholders working towards improving energy efficiency and conservation in the built environment. Two that could be potentially instrumental in the development and implementation of an Alberta energy reduction program for residential high-rises are the Alberta Energy Efficiency Alliance and Climate Change Central. The Alberta Energy Efficiency Alliance (AEEA) is made up of a number of stakeholders from government, industry, associations, non-profits and institutions (AEEA, 2010). Their mission is to maximize energy efficiency by being open to all organizations, having open discussions, having collaborative problem solving, co-ordinating member action, and having common member messaging (AEEA, 2010). AEEA has already organized a stakeholder network with many important industry players that would need to be involved in the development and implementation of an Alberta energy reduction program. Climate Change Central is a not-for-profit public-private partnership[66] established by the government of Alberta in 1999 (Government of Alberta, 2010b). Climate Change Central works with industry and municipalities (including the City of Edmonton, but not Calgary) on consumer rebate programs, demonstration projects and educational outreach, and collective efforts in developing a provincial carbon market (Climate Change Central, 2009b).

[66] Climate Change Central is a non-profit that works with all levels of government and some corporate entities such as ENMAX, Encana, and Cenovus Energy wanting to motivate and provide incentives for their employees to save energy and water.

As indicated earlier, part of the Alberta Provincial Energy Strategy is to promote energy efficiency and conservation at all levels and achieve wise energy use by increasing knowledge and awareness of energy issues and seeking to change energy consumption behaviour (Government of Alberta, 2010a). However, the success of a program and the uptake of energy reduction initiatives by Albertans will first depend on understanding energy use behaviour and the perceptions of how important it is to Albertans to reduce energy use in the residential high-rise sector. Very little has been published about energy use behaviour in Alberta, apart from two dated surveys, one conducted for Edmonton only, and one for both Calgary and Edmonton.

Jackson (1980) conducted a study to understand patterns of energy consumption, perceptions of energy resources, and the adoption of conservation practices. His study involved approximately an equal sample of respondents from Edmonton and Calgary in the fall of 1977. His findings showed that other problems such as inflation, unemployment and pollution took precedence over energy resource problems;[67] Albertans had initiated efforts to conserve energy but the efforts involved little personal sacrifice or change in habitual behaviour; there was lack of concern about energy and indications of misperception and denial of the seriousness of energy scarcity amongst segments of the public; and there were limited conservation practices perceived and adopted (p. 126-127). Specific to apartment dwellers, Jackson found that they expressed concern about energy problems less frequently and were less aware of conservation practices than homeowners (p. 122, 124). However, socio-economic conditions and public awareness of environmental issues, as well as the range, availability and cost of energy efficiency technologies, has changed significantly in the last 30 years, so some of Jackson's findings may be out of date.

[67] While energy prices increased rapidly during the crisis, the 1970s was also a period of high inflation and unemployment.

A more recent study was conducted by Ciona in 2000. In her Master Degree Project to develop a voluntary residential energy conservation program for an Edmonton utility company, Ciona surveyed 600 randomly selected Edmonton residents to confirm barriers to energy conservation, and provide responses and perceptions on climate change, energy conservation and a model energy conservation program (p. 63). The survey findings showed that:

- climate change was not listed as an important issue for Alberta;
- the environment ranked low (sixth) out of ten important issues identified in Alberta;
- the impact of energy conservation on climate change is perceived to be negligible and therefore not worth the effort;
- only one quarter of respondents were very familiar with ways to conserve energy;
- key factors that influence energy conservation (in descending order of ranking) were reducing negative impact on the environment, dollar savings, and knowledge that others are conserving energy;
- those that rent an apartment or own a condo unit are less likely to participate in a conservation program (p. 64-66, 68).

The findings from these two studies raise some very specific issues related to the lack of awareness among the public of what energy saving measures are available to them, the low importance placed on reducing energy use, and what factors may or may not be motivating consumers to reduce energy use. More recent research into understanding energy use behaviour is required to inform the design of an energy reduction program. In particular, we would want to know: Have the perceptions and values changed with increasing media coverage of environmental issues and climate change? What prevents energy reducing initiatives from being widely adopted by Albertans living in high-rise buildings? These are questions that need to be answered and why research on

what influences energy use behaviour of those living in the residential high-rise sector has to be integral in the design of an energy reduction program. It would be presumptuous to assume that we can change behaviour without first understanding what perpetuates it.

To obtain further insight into the local economic, social, political, and cultural context in Alberta, interviews were conducted with potential program administrators and those already working in the energy efficiency and building industry. Eight personal semi-structured interviews and two written responses to the interview questions were coded to determine significant themes and issues. Interviews included respondents from: The City of Calgary, The City of Edmonton, ENMAX, ATCO, EPCOR, Climate Change Central, EnerVision, Alberta Energy Efficiency Alliance, Canada Mortgage Housing Corporation (CMHC), and Natural Resources Canada (NRCan). Respondents from these interviews from here on will be referred to as Alberta context respondents.

A combination of the responses from Alberta context respondents indicated the reasons for the lack of attention to the residential high-rise sector is because of the sector's smaller market share and the fact that the buildings are more difficult to address because of size, uniqueness, complexity, ownership structures, and the need for professional services.[68] Even though single family homes make up the majority of the market share and are easier to address, respondents agreed that there is a need to address multi-unit residential buildings[69] although there will be challenges associated with funding,[70] political will and leadership.[71]

[68] 8 respondents.
[69] 7 respondents.
[70] 6 respondents.
[71] 3 respondents.

Significant themes identified from Alberta context respondents shaped the recommendations for the energy reduction program design. They include:

(1) Program development should include partnerships between government and industry.[68] Those involved need to co-operate and find consensus on how to address energy reduction strategies in the high-rise sector.[68] Co-operation and consensus are needed as there is currently animosity between regulators and builders that would need to be overcome.[71]

(2) A provincial or municipal administered program is more likely than a federal one.[72]

(3) Nobody in industry favours a regulatory approach. The current social climate is one that is preferentially driven by market forces rather than regulation.[71]

(4) Demonstrate to stakeholders that energy reduction initiatives are worthwhile[68] (e.g., need information on benefits such as actual savings or performance attributes). There is currently a lack of good information to tell the consumer what energy reduction measures are most effective.[73] A program needs to provide information on energy reduction initiatives (i.e., feedback to the market[71]) and show success.[72]

(5) There is always a need for good research[71] (i.e., to make sure the building energy performance standards are set appropriately).

(6) There are only enough technical experts as there is current demand[70] (i.e., not many), few people can do energy modelling, and modelling proficiency varies.[72]

(7) Concentrate training on contractors as they seem to be the weak link.[72]

(8) Need innovative financing for energy reduction measures.[71] Private funding is better as public funded programs are costly to administer.[73]

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[72] 1 respondent.
[73] 2 respondents.

(9) Consumer behaviour can account for a lot of energy savings and there should be some mechanism to address this.[71]

(10) There is no good baseline of energy use profiles for high-rises across Canada.[73]

Overall, the context and needs analysis has highlighted the current and future need to working with industry and community, ensuring success and demonstrating that energy reduction measures are beneficial, looking at the issues and benefits from the perspective of all market actors, and obtaining a better understanding of energy use behaviour.

## 7.2 Recommendations for an Energy Reduction Program Design: Relevant Case Learning for Alberta

This section puts forward recommendations and key considerations for the development of an Alberta energy reduction program for high-rise residential buildings. The recommendations draw on key features from the precedent programs, modifying, adapting and improving on them as needed to address the specific Alberta context and needs. The discussion will begin with detailed recommendations for the Alberta energy reduction program administration then follow with the program approach and program interventions.

### 7.2.1 Program Administration

Establishing the proper program administration will be one of the most critical endeavours in the development of a program to address existing and new residential high-rise buildings in Alberta's two largest cities. An important guiding principle in program design is to have a program administration that is mandated with specific energy policies, trusted by sector-specific stakeholders, and operates with good governance.

#### 7.2.1.1 Specific Energy Policies and Mandate

As discussed in section 7.1, it is clear from government documents that the province and both Edmonton and Calgary have specific goals to reduce energy use in the built environment and targets to reduce greenhouse gas emissions. The question becomes, what level of administration is most suitable in the context of Alberta, provincial or municipal? As almost all residential high-rise buildings in Alberta are located in the cities of Edmonton and Calgary (over 95% of residential high-rise dwellings spread equally amongst the two cities according to 2006 census data), the municipalities are taking the lead by adopting more aggressive greenhouse gas emission reduction targets than the province. These municipalities are looking to its own residential energy reduction initiatives as seen by Plan It Calgary's energy mapping research and Edmonton's community-based $CO_2$RE strategic plans and programs. Even though the plans and policies are set at the municipal level, the City of Edmonton is using Climate Change Central to administer its residential single-family homeowner rebate programs. Having a central administrator who is partnered with the provincial government can provide consistency of services across the province, yet is able to work with municipalities and industry to address local goals and objectives, may be the best course of action. A federally administered program would not be appropriate (Theme 2 from section 7.1). A Senior Officer with Buildings Division/Technical and Support Services with Natural Resources Canada indicated that:

> Outside of the three big cities (Toronto, Montreal, Vancouver), high-rise multi-unit residential buildings have not been seen as the predominant building type. I think that is changing, it is no longer just the three big cities as sort of the medium sized cities get on it as well. So, in a way, it is not a national phenomena, which tends to take the federal government out of the picture and introduce the provincial governments and perhaps the municipal governments as the interested governmental parties, (pers. comm., June 9, 2010).

#### 7.2.1.2 Program Administration and Relationship Building

As shown by the precedent programs and the key features from Chapter Six, it is also important to have a program implemented by a program administrator that end users as well as all the other necessary stakeholders in the residential high-rise sector can trust. For developers and end users, the costs of implementing energy reduction measures in residential high-rises can involve large upfront capital costs and ensuring you are getting trusted information and services becomes paramount especially when spending upwards of a quarter of a million dollars or more on a retrofit. With this kind of large capital investment, it is important to have an organization or entity that has public trust in order to influence people to move forward on projects and make the program work (Lutzenhiser, 1993; McKenzie-Mohr and Smith; 1999; Stern et al., 1985).

As shown by the precedent programs, a program administration that has credibility or trust by other stakeholders will help to identify as well as resolve road blocks to energy reduction initiatives. As indicated earlier, one of the significant themes obtained from Alberta context respondents is the fact that there is an adversarial relationship between government regulators and the builders/developers (Theme 1). An adversarial relationship could pose a problem, for example in setting energy performance related building codes/standards for the residential high-rise sector. Therefore a program administrator that is trusted, impartial, and who is endorsed by both parties can help to bridge the relationship and move forward on initiatives.

To achieve the proposed municipal targets and increase the chances of a successful program, a novel approach to programming will require a program administration that has support and collaboration amongst upstream and downstream actors (Hammarlund, 1993; York, Kushler, and Witte, 2008) and re-thinking the relationships in the market (Blumstein et al., 2000). In Alberta, there

are already many organizations working together on energy efficiency (e.g., AEEA) and based on interviews or written responses from representatives with NRCan, Climate Change Central, Cities of Calgary and Edmonton, EnerVision, Alberta Energy Efficiency Alliance, ENMAX, and ATCO there is general consensus that all the stakeholders in the high-rise residential sector need to be involved in program development.

#### 7.2.1.3 Good Governance

Both precedent programs have a program administration that is legitimate, accountable and adaptable. Good governance is expected for the program administration of an Alberta energy reduction program. Legitimacy for the program administration can either come from obtaining consensus amongst relevant stakeholders or by legislation. The former is the most likely course of action because as stated before, Alberta context respondents indicate the need to have government and industry co-operation and involvement in program development (Theme 1). The recommendation is to develop a program administration based on consensus amongst the stakeholders. As for accountability and adaptability, these criteria are also very important as shown from the precedent programs and should be considered as the program becomes operational.

### 7.2.2 Program Approach and Recommendations for Intervention

The program approach for an Alberta energy reduction program has been derived using ideas from novel programming and key features from the precedent programs, that have been modified, applied or adapted for the Alberta context. The program approach is:

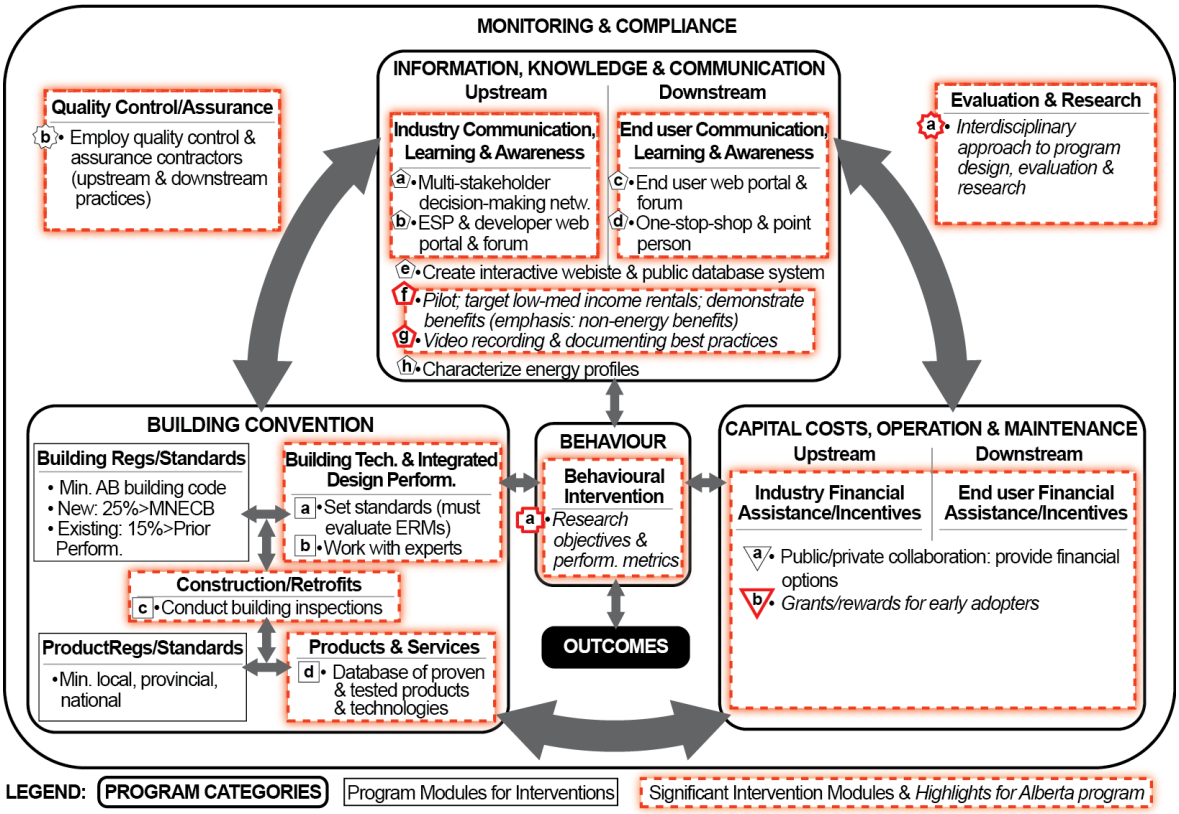
> A collaborative multi-stakeholder pilot program that aims to begin to transform the market by demonstrating and proving the benefits of energy reduction projects with a focus on having developers and end users

educating and advocating the non-energy benefits to program non-participants – leading to increased demand and eventual improvement of energy performance building codes, standards, and practices.

The pilot program will include new and existing residential high-rises and focus on: 1) piloting and demonstrating energy reduction benefits (emphasis on developer and end user non-energy benefits); 2) data collection for training, benchmarking, and future change to codes and standards; 3) having a one-stop-shop for easy access and to reduce confusion for market actors; 4) having an interdisciplinary team to develop qualitative and quantitative performance metrics and conduct evaluation and research (with real-time monitoring and feedback when feasible and cost-effective).

In the subsections to follow, recommendations for intervention are proposed for an Alberta energy reduction program and will be described according to the relational model program categories for the final energy reduction program design shown in Figure 7.1.

*Figure 7.1.* An Energy Reduction Program for Alberta Residential High-rise Buildings




Notes. 1997 Model National Energy Code for Buildings (MNECB); Regs - Regulations; AB - Alberta; Min. - Minimum; Perform. - Performance; Tech. - Technology; ESP - Energy Service Provider; med - medium; netw. - network; ERMs - energy reduction measures.

### 7.2.2.1 Information, Knowledge and Communication

Interventions that target upstream and downstream actors under the program category of information, knowledge and communication will be very important given the weak market for and lack of understanding and knowledge of energy reducing goods and services in Alberta, and the underdeveloped skilled labour force to support, install, operate and maintain the energy saving products. Eight interventions listed alphabetically have been recommended under this program category. The first recommended intervention ⓐ is creating a multi-stakeholder decision-making network committed to meeting regularly. The multi-stakeholder decision-making network will address program development; find

solutions to issues (e.g., collaborating with financial lenders to improve access to financing for energy reduction projects); work at making future changes to building codes and standards; and educate industry (e.g., developers) and end-users. This intervention follows from the key features of working with industry to advance energy reduction initiatives (A) and having effective communication/education strategies (G). The TAF approach to creating industry partnerships and a decision making network (described in section 6.2) is a suitable approach for Alberta, as industry involvement and partnerships in program development is corroborated by Alberta context respondents (Theme 1).

In addition, Alberta context respondents indicated an aversion to regulations without proof and Alberta having a social climate that does not support further regulation and would rather see the initiatives driven by the market (Theme 3 and 4). In other words, imposing regulation will not be accepted by industry. Therefore, having a collaborative multi-stakeholder decision-making network that can work with developers and end users to show that energy reduction measures are beneficial, could eventually lead to increasing demand, more accessible financing, and improved energy performance codes, standards, and practices. As indicated by the Program Manager Sustainable Housing with EnerVision:

> It's better if the builders understand what they are building, how they are building, and how it benefits the consumers. And the consumers understand what they are buying, how they are buying, and how it benefits them [...] builders don't like having code enforced on them, so government can provide the funding for the builders to learn and get knowledge and provide capacity to the builders for building energy efficiency. The building industry prefers if the government does not mandate it, (pers. comm., June 18, 2010).

The ultimate goal is to get stakeholders in the residential high-rise sector collaborating at the start of the program for future change in construction practices and energy performance codes and standards for the industry, as

regulatory instruments such as codes and standards are potentially more cost-effective in reducing greenhouse gas emissions (Ürge-Vorsatz et al., 2007b). As corroborated by VP Distributed Generation with ENMAX, "[T]he best thing that we can possibly do is to enhance the building code. Policy is always the cheapest way to implement energy efficiency" (pers. comm., June 11, 2010). Notably, having stringent energy performance building codes and standards for residential high-rise buildings and appliance standards is a way to address the split incentive market failure in the renter/landlord and developer/occupant-owned residential high-rise market (IEA, 2007).

Changing construction practices and setting appropriate energy performance codes and standards will be difficult to achieve without key industry players, who are likely not to accept a change without their involvement. Industry players such as developer/builder associations, who have a substantial interest in and are affected by issues related to energy performance in buildings, need to be consulted.

As for the approach of working with industry as NYSERDA has, through creation of a partner network of energy service providers, the approach is not likely to be effective for Alberta. Alberta's funding for energy efficiency and conservation is limited and the industry for energy efficiency and conservation initiatives are not as far along as in New York State. For instance, Alberta has allocated $36 million over three years (retroactive to January 1, 2009) primarily targeting single-family homeowners, while New York State has a well developed multifamily energy reduction program that has evolved from legacy programs[74] (NYS PSC, 2009e). Moreover, there is not yet a well established industry dealing with energy efficient high-rise buildings to work with in Alberta, because of the

[74] SBC I, II, and III funding: from July 1, 1998 through June 30, 2011 (transition from legacy programs to MPP, which started in May 2007).

very small and underdeveloped market for high-rise retrofits. One of the challenges for this program will be to develop the service provider sector.

Interventions ⓑ, ⓒ, and ⓔ include having web portals and forums for energy service providers, developers and end-users, and a comprehensive interactive website and public database system. These interventions are recommended on the basis of having effective communication/education strategies (G) to address a lack of knowledge and understanding of energy reduction measures by industry and end users. Much of the expertise, information and knowledge on energy reduction measures are with individual energy service providers, so having these interventions provides a way to disseminate information and knowledge on energy reduction measures to a wider audience.

Based on the comparison from section 6.2, the ideas from both precedent program strategies should be adopted for the Alberta energy reduction program. Having a way for those involved in an Alberta program, to communicate not only with program administration but amongst each other would provide an opportunity to learn from one another and address issues on project status, process, product performance, technologies, services, tenant concerns, etc. The recommendation for the Alberta energy reduction program is to have increased transparency and accessibility to information and knowledge gathered on energy reduction projects. Having an easy to navigate interactive website, using social media, and having a public database system are advantageous in disseminating and presenting information, educating, and communicating issues, ideas, and experiences. The idea would be to provide the platform for key market actors to be able to communicate amongst each other and to also have a proper forum for advocacy of energy reduction measures and educating program non-participants on the measures. The recommended education strategy would involve

disseminating information and knowledge gathered on energy reduction projects through a public database system shared with industry[75] (e.g., ESPs, CMHC, developers/builders) and educational institutions (e.g., universities, technical colleges), who could then provide the necessary courses and training.

Intervention  is to have a "one-stop-shop" and point person as the first line of contact for the program. The key features from the precedent programs is to have a point person (B); improve program clarity and make obtaining information and services easier for the developers and end users by having the "one-stop-shop" (O); and have effective communication/education strategies (G). The TAF TowerWise program supported an independent incentives advisor to inform and help building owners maximize their benefits with the different programs offered, while NYSERDA's NYE$ MPP consolidated many of its legacy programs into one. Based on their experiences with these interventions, it would be good for an Alberta energy reduction program to both minimize the number of different programs offered to participants and to have a point person who can explain the details of the program and assist in maximizing end user benefits through other program offerings (e.g., federal NRCan programs).

Intervention  is an Alberta highlight intervention that involves piloting, targeting the appropriate audience and demonstrating and proving the benefits of reducing energy use. Piloting and demonstration would be the most prudent strategy for Albertan's to gain experience and knowledge of energy reduction measures and feel confident enough to increase resources for initiatives and change policies, codes and standards. Piloting a market transformation program offers the opportunity to learn, improve, and minimize risks and problems if they

[75] A good example of a comprehensive public database is one that the Energy Resources Conservation Board (regulator of Alberta's energy resources) maintains for the oil and gas industry. Oil and gas production data and well drilling and completions data is available to the public and to industry.

occur before attempting a full-scale program (Blumstein et al., 2000). Piloting, especially for a new program funded with public money minimizes the risk and improves the chance of success. In section 7.1, Alberta context respondents indicated that it is important to demonstrate that energy reduction measures are worthwhile and show success (Theme 4). In addition, respondents also indicated it will be a challenge to obtain program funding and qualified experts in energy efficiency (Theme 6) and therefore justifiable to conduct a pilot, given minimal resources.

The key features from the precedent programs for this intervention are targeting the appropriate audience (H), demonstrating and proving energy reduction to the market (C) and identifying non-energy benefits (L).

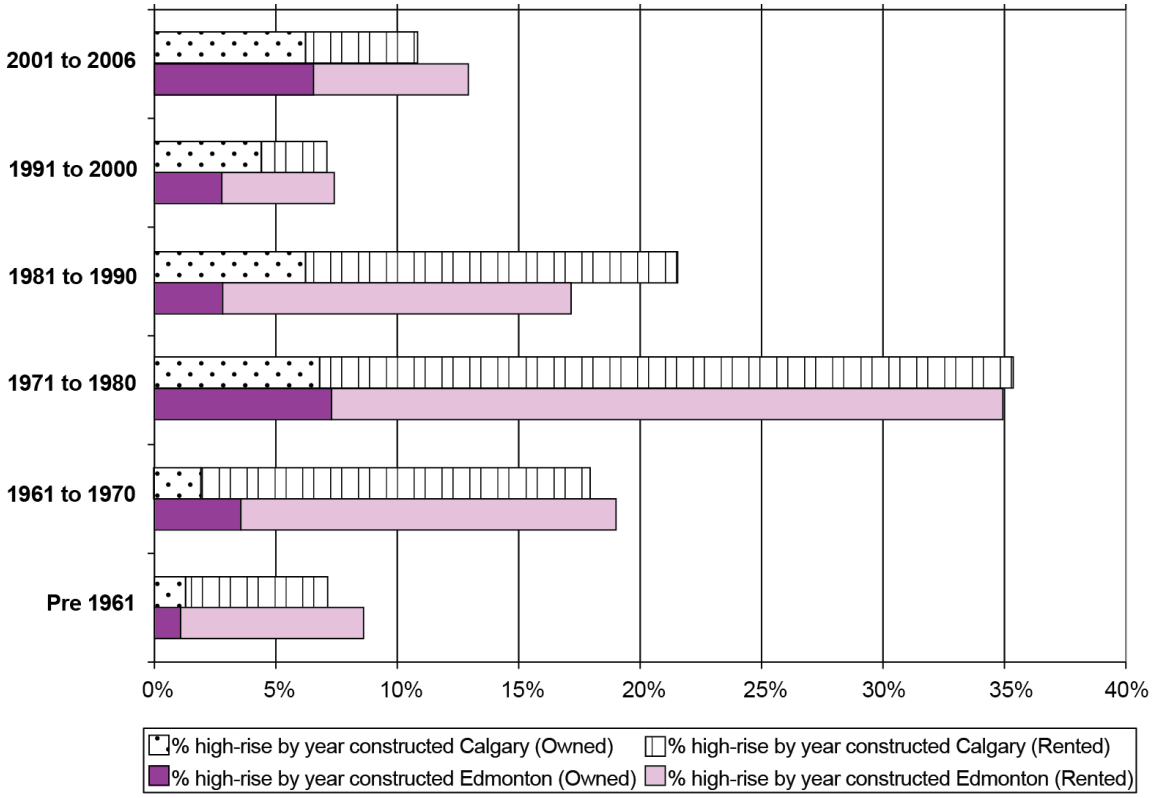
In the precedent programs, efforts were targeted at particular types of owners and their buildings. TAF's efforts are focused on market rate rentals and condominiums because more affordable housing is addressed by a different City of Toronto initiative, while NYSERDA's MPP is an all encompassing program focused more on low to medium income multifamily buildings while still addressing market rate buildings. Similar to the NYE$ MPP, the target for the pilot should start with the people in the buildings that need it the most (i.e., the rental building stock that house individuals with low to medium income), but not to the exclusion of market rate buildings as this sector continues to grow.[76]

According to 2006 Census data, approximately 74% of the residential high-rise dwellings in Edmonton and Calgary combined are rentals with approximately 60% of them constructed between 1960 and 1990 as shown in Figure 7.2. The recommendation for the Alberta pilot is to focus on retrofit

[76] According to trends in the Calgary housing market, in 2006 72% of 946 rental units where lost due to conversion to condominiums (City of Calgary, 2010c).

projects within this construction age range, but to also include new construction and less aged retrofit high-rise projects. As discussed in section 1.1.3, renters typically pay 30% or more of their income on housing. Focus on improving the building and reducing energy use in older rental high-rise buildings with low to medium income tenants will provide tenants with increased comfort (e.g., less draft from an improved building envelope) and for tenants paying the utility bills, potentially more disposable income from energy savings for other uses. An additional advantage of focusing on this segment of the high-rise market is that rental buildings tend to avoid the slower and more challenging condominium decision-making processes.

*Figure 7.2.* Percentage of Alberta Residential High-rises by Construction Age and Occupancy Type



Notwithstanding the above, including new high-rise construction projects in the pilot is equally important in demonstrating the benefits of energy reduction to the market and for eventual change of building standards, codes and practices. The market for new high-rise condominiums is increasing and if they are not addressed through the program now, they will require expensive retrofitting in the future. As for the type of building owners, a diversity of ownership structures should be included to represent the market. As for condominiums/co-operatives, respondents from both precedent programs indicated challenges with this particular ownership structure. Despite the challenges, these types of ownership structures are growing in the market and should not be excluded from the pilot. The recommendation is to perhaps require that program applicants issue memorandum of understandings with all owners in the building prior to participation in an energy reduction project. This course of action is to prevent delays in projects due to a lack of owner consensus, and allow for access to tenant suites. The idea is to have the condominium/co-operative corporations resolve any owner issues prior to the pilot as opposed to during the pilot.

Demonstrating and proving energy reduction to the market is one of the most significant features identified throughout the research (Feature C in the precedent case studies, and Theme 4 from Alberta respondents). Demonstrating and proving the benefits of energy reduction measures (i.e., taking action on measures and achieving results) is needed to increase awareness and understanding of such measures, thereby leading to increased energy reduction initiatives and reduce perceptions of risk by developers, end-users and financial lenders. What is clear from both the Toronto and New York program is the importance of understanding and showing what works and what does not through their case studies or project reviews in order to address the lack in understanding energy reduction measures and perceived risk of energy reduction projects by

developers, end users and financial lenders. Alberta context respondents similarly voice that you have to demonstrate to stakeholders that it is worthwhile because regulations will not change without proof in the market. Alberta context respondents state:

> It's better if the builders understand what they are building, how they are building, and how it benefits the consumers. And the consumers understand what they are buying, how they are buying, and how it benefits them [...], (Program Manager Sustainable Housing EnerVision, pers. comm., June 18, 2010).

> You do it [build energy efficient buildings] now because you can make it work economically or because you are ethically inclined to do it. But there is none of this 'well he said it was great but she said it terrible' – well that is irrelevant. [...] We are now dealing with half a billion dollar projects with massive energy requirements in a world of diminishing resources. Let's be a little objective here people, let's think about things instead of just feeling things, (Energy and Environment Coordinator City of Calgary, pers. comm., May 21, 2010).

> The way policy gets driven here is people have already got to be demanding it, doing it, the building industry has got to largely be there and then the policy will be one step behind that, (VP of Distributed Generation ENMAX, pers. comm., June 11, 2010).

Yet there appears to be some deficiencies in the way the precedent programs demonstrate and prove energy reduction to the market and consequently opportunities for improvement. The improvements would include accessibility to information, the type of information conveyed, and the way in which the information is communicated.

During the data collection phase, one of the objectives was to find the case studies and data on completed projects. Both programs had posted a few case studies either on their websites or they were available on the energy service provider's websites. Requests were made to obtain more information from energy service providers, but additional case studies either had not yet been

drafted or the information could not be released without approval from the energy service providers and the building owners. In many instances, recent case studies or information on project reviews were not as easily accessible as one would expect. Making it difficult for end users to obtain information by forcing them to navigate through different sources and approvals will slow the uptake of energy reduction measures. As a result, a recommendation for an Alberta pilot program would be to ensure easier access to information on projects by increasing transparency for non-participants and making information disclosure a requirement for those participating in the program. Non-participants should not have to endure great difficulty in gaining access to information, especially information gathered from a publicly funded program. Hence the recommended public database system discussed in section 7.2.2.1.

The case studies or testimonials that were collected from the precedent programs typically outline short descriptions of the buildings; the building's use and history; reason for upgrades; types of energy performance improvements; source of funding; capital spent; projected savings and greenhouse gas emission reductions. All this of information is very useful, but heavy on the technical and economic details with a gloss over other non-energy benefits such as comfort, quality of life, health, and safety. In many instances, it appears that the information in these case studies is not only written by people with technical and economic backgrounds, but also meant for an audience with a similar background. The information needs to be more appealing to the developers and end users who are not purely driven by interest in the technology and cost. Reading and hearing about "what", "why", and "how" developers or end users do a project does not always boil down to technology and cost savings. Yet we continue to try to sell energy reduction measures on technology and cost savings, rather than looking, for instance, at how energy reduction measures can improve the way you live. For example, in purchasing a refrigerator not everyone

will purchase it just because it is energy efficient, but rather because it is the right size to fit into your kitchen space or because it has the capacity to keep your favourite bottles of wine. Stern (2008) has indicated that cost minimization is only one of many motives that affect consumer choices and energy use and many other factors or reasons need to be considered. Investments in energy efficiency are far below levels justified by the cost savings they create. Energy cost savings are necessary, but not sufficient to achieve the expected levels of investments in energy reduction measures.

Interviews with some of the NYE$ MPP building owners revealed some of these other factors or reasons not directly related to energy savings (non-energy benefits as discussed in sections 2.6, 5.3.1 and 5.3.4). Non-energy benefits have largely been ignored because they cannot always be monetized (Brown, 2001; Knight et al., 2006). However, in a small survey of homeowners pursuing whole-house retrofits, Knight et al. (2006) found that reducing energy bills was far from the only reason for doing the retrofits. They found people motivated by home comfort, equipment upkeep (e.g., replacing poorly-functioning equipment), and just doing the right thing. The non-energy benefits described by the NYE$ MPP interview respondents (refer to section 5.3.1) are easy to relate to and as a condominium owner myself, more interesting and compelling than just talking about how much energy savings there will be and when the investment will payback. The information needs to have more emphasis on non-energy benefits that can influence a developer's or end user's decision to proceed on energy reduction projects. As was indicated by respondents with the NYE$ MPP, there are non-energy benefits that can also motivate action on projects. One particular interview respondent indicated how installing energy reduction measures has made his building more attractive to prospective renters, thereby increasing rental demand and tenant retention. This particular example illustrates the kind of information on non-energy benefits (e.g., the landlord is benefiting in

some other way than through direct energy savings) that may be useful in resolving the renter/landlord split incentive.

More importantly, given the relatively low energy prices in Alberta (as compared to Toronto or New York State),[77] convincing end users to pursue energy reduction projects on the basis of energy savings alone will likely not be as effective as taking the effort to also discover and demonstrate the non-energy benefits.

How the information is communicated is very important. From personal experience serving on the board of directors of a condominium, having information from the experts is essential, but having references and discussions with other condominium boards going through the same process is even better. It is not enough to hear the message or get a synopsis case study write-up from the energy service providers who are trying to sell their services. The message will be more effective coming from a credible program administrator (McKenzie-Mohr, 1999), but there are also other market actors such as realtors, other building owners, or tenants that may be able to reach a larger audience and convey information not known to either an energy service provider or program administrator (e.g., realtor tells you that your building could be worth more with the retrofit, building owner tells you that he has better tenant retention). For the communication to be more effective, there needs to be captivating information delivered in the right way, by the right people, and to the right audience

[77] In comparing the energy prices, the annual average price of natural gas in Alberta is lower (2007: $8.38/mcf; 2008: $11.23/mcf; 2009: $5.08/mcf) when compared to both Toronto (2007: $14.25/mcf; 2008: $15.87/mcf; 2009: $9.46/mcf) and New York State (2007: $17.01/mcf; 2008: $18.86/mcf; 2009: $15.70/mcf) (Alberta Utilities Commission, 2010; Energy Shop.com, n.d.; Ontario Energy Board, 2010; NYSERDA, 2010) . According to Hydro Quebec (2011), the average price in Canadian dollars of electricity for a 750 kwh/month bill in Alberta was not significantly different (2007: ¢12.10/kwh; 2008: ¢13.97/kwh; 2009: ¢11.76/kwh) than Toronto (2007: ¢11.77/kwh; 2008: ¢11.50/kwh; 2009: ¢11.89/kwh), but substantially lower than New York (2007: ¢23.84/kwh; 2008: ¢21.70/kwh; 2009: ¢25.89/kwh).

(McKenzie-Mohr and Smith, 1999). The recommendation for an Alberta program is to not only have the energy service providers communicate the energy benefits to developers and end users, but to require those who are participating in the program and affected by the changes (particularly the developers and end-users) to play a leading role in advocating and educating the non-energy benefits of energy reduction measures in their buildings. Advocacy and education should be done through personal contact, with frank discussions and open forums that reach non-participants (e.g., meetings with community associations, condominium associations, builders associations; website video or written testimonials; other social networking strategies). Similar to TAF's efforts in holding industry seminars, program administration should facilitate and assist in making the advocacy and education easy for program participants and non-participants.

The purpose of this intervention is to pilot, target the audience, and successfully demonstrate and prove the benefits of energy reduction measures, so that there is spill-over (getting those not part of the pilot interested in doing energy reduction measures without the program) into the market and increasing demand. Ultimately the pilot program should provide the proof to make changes in building energy performance codes, standards, and practices.

Intervention  is another Alberta highlight intervention. It involves video recording and documenting projects to capture information on energy reduction projects and using the information to educate and train upstream and downstream actors. The recommendation for this intervention is the result of what was learned from the precedent programs, which include having reliable energy reduction measures for long-term energy savings (F), energy service provider training outside of the program (E) and proper building owner training/education for long-term energy savings (I). Having reliable energy

reduction measures and having proper building owner training is a lesson to be taken from both programs. More importantly, lessons from NYSERDA's MPP include having building inspections and being in the building to address quality work for real energy savings and providing the means to train energy service providers and building owners.

The idea for this intervention is to have the program administration and/or industry designate take part in video recording and documenting construction, operation, and maintenance practices done by the experts selected to execute the program projects. The purpose would be for third party quality control and assurance and for future use in training/educational materials for energy service providers or design teams, contractors/trades, and building owners/superintendents. From one of NYSERDA's lessons with the MPP, it would be better to have the energy service providers trained outside of the program to prevent escalating administration, time and costs to program projects. Expertise in the area of energy reduction is essential for successful execution of a project and as such highlights the importance of having experts involved in executing the program projects and contributing to proper skills training for a future workforce. According to the Energy and Environment Coordinator at the City of Calgary (Theme 7):

> In terms of formalized training it is generally aimed at the contractor. The reason it is aimed at the contractor is because in some ways they seem to be the weak link [...]. Regardless of how good your intentions are, if you don't have the know-how and expertise and care and diligence in construction, it just doesn't work (pers. comm., May 21, 2010).

Intervention ⓗ addresses establishing a baseline or characterizing energy profiles for residential high-rises. Both precedent programs and Alberta context respondents identified the need for understanding energy profiles and benchmarking multifamily buildings (sections 6.2 and 7.1, Theme 10). The

Alberta energy reduction program projects could be used in establishing and adding to ongoing national work such as the:

1. CMHC (2005) energy and water consumption load profiles in MURBs;
2. CMHC (2001c) analysis of the annual energy and water consumption of apartment buildings in the CMHC HiSTAR database;
3. Demand Side Management Working Group Sub-Committee on Building and Housing Energy Labelling report on Building energy benchmarking: recommendation and work outline for a system for Canada (Tanguay, 2010).

#### 7.2.2.2 Capital Costs, Operation and Maintenance

Intervention  involves providing financing options for developers and end users from collaborative efforts between program administration and financial lenders (intervention  ), while highlight intervention  involves providing grants as rewards to program participants. These interventions have been recommended as a result of precedent program features, working with industry to advance energy reduction (A), demonstrating and proving energy reduction to the market (C), and having diverse financing tools (S).

According to a Clean Energy Solution (2010) paper on financing options, completing deep retrofits (capturing 20-30% efficiency) requires capital investments that may be beyond the means of most property owners. As a result some kind of financing option for ERMs that provides reasonable interest rates and longer loan terms is an important tool in assisting property owners with high upfront costs and creating positive cash flow for program participants (Clean Energy Solutions, 2010; Fuller, Portis, and Kammen, 2009; Milken Institute, 2010). Much of the current innovative financing models that emerged in 2009 out of the US are for single-family residents and include energy efficiency mortgages, unsecured home improvement loans, property tax based financing (PACE), and

on bill payment through utilities (Milken Institute, 2010). Clean Energy Solutions (2010) identifies other financing options for municipalities such as revolving loans, emerging bond options that present capital investment opportunities for municipal sponsored loan funds, loan loss reserve and interest buy down loan programs. There are many financing models currently available, but not a lot of literature has been found regarding the comparison of all of these financing models as many are still being piloted (Milken Institute, 2010). Moreover, multifamily housing has different challenges and will require tailored financial product features (Milken Institute, 2010).

Energy reduction measures cannot be funded with public money in the long-term (i.e., much of the capital for energy reduction programs is for the measures, so private funding for the capital is essential) and as shown by both precedent programs it will be important to work with financiers on loan options and/or establish innovative loan products to address the different ownership structures in the high-rise sector. Alberta context respondents corroborate this need (Theme 8). An important lesson from the NYE$ MPP, as indicated in section 6.2, is the success the program achieved in getting building owners interested in the program and getting their projects completed with the assistance of scheduled incentives, and getting financial lenders comfortable with providing loans outside of the MPP. Furthermore, both precedent programs allowed building owners to take advantage of different forms of financing depending on their circumstances, which is important for a program. The reason providing different forms of financing is important is because, according to an evaluation of the effectiveness of incentives for residential energy conservation conducted by Stern et al. (1985), different types of households have different preferences for the types of incentives and the best approach is to have a choice of different types of incentives to attract people who would otherwise have rejected the incentives if only one type were offered. Diversity in financing options will

increase the likelihood of program participation and having an innovative loan option such as TAF's Green Condo Loan will address the developer/occupant-owned split incentive for new residential high-rise developments.

For an Alberta energy reduction pilot program, a combination of scheduled grants/rewards and financing options is recommended. Initially, financing options would need to be developed and decided upon through collaboration amongst program administration and financial lenders, so as to provide the necessary upfront capital for the pilot projects. Scheduled grants would be used to reward developers and end users (early adopters) and assist them to complete their projects successfully. Developers and end users will be required to educate and advocate the non-energy and energy benefits of their own energy reduction projects. This course of action requires a firm, active, and public commitment by developers and/or end users to advocate and educate the benefits of energy reduction measures. Details for the financial options and grants/rewards include:

- Providing multiple financing options – tailored for the developer and/or end user and determined through public-private collaboration, including program administration, the provincial and municipal governments, and financial lenders (members of multi-stakeholder decision-making network).
- Requiring some developer and end user capital in the energy reduction projects.
- Providing scheduled grants/rewards to assist developers and end users in completing projects (schedule similar to NYSERDA's scheduling: audit or design, mid construction, completion, post construction evaluation with utility data, and education and advocacy as an additional requirement in receiving the grant). The amount of the grants for the measures can be 25% of the total capital, similar to the NYE$ MPP or a percentage decided upon by the multi-stakeholder decision-making network.

- Providing higher grants to low-income and affordable housing similar to NYSERDA.
- Providing innovative financing strategies such as those used in the precedent programs or pool the risk over several projects by setting an investment return for the pooled projects and offering an additional reward upon post construction evaluation if energy savings exceed predicted savings.

#### 7.2.2.3 Building Convention

Four interventions are proposed for the building convention program category as shown in Figure 7.1. Intervention [a] and [b] involves setting appropriate standards for the program to achieve reliable energy reduction measures for long-term energy savings (F) by working with qualified experts in the area of energy reduction (A, D). The interventions also involve adopting a whole building approach (Q), and addressing energy efficiency and conservation before alternative measures (R).

An Alberta energy reduction program design, similar to the precedent programs, will require input from the experts and industry to set minimum building energy performance standards for the new and existing high-rises participating in the pilot program. Local industry experts in energy reduction should be used in the pilot to implement the projects to minimize risk and increase the chances of success (Theme 4).

As for the minimum performance targets, the recommendation would be to adopt TAF TowerWise's minimum performance targets (refer to section 6.2), which have already been established by experience, unless otherwise agreed upon by Alberta energy reduction experts and industry. Interview respondents

from the TowerWise Program[78] and City of Calgary[79] indicate that the TowerWise program targets are reasonable and achievable. In fact, these standards are also in line with the minimum performance standards for the Canada Green Building Council (2010) LEED® Canada for New Construction and Major Renovations 2009 Rating System released on June 21, 2010, which require demonstration of a 23% energy cost improvement over MNECB 1997 for new buildings and a 19% energy cost improvement for major renovations compared with the reference building performance rating.

As also indicated from the precedent programs, a whole building approach is a way to get deeper energy savings, address interactive effects, prevent missed opportunities, and address measures not related to energy use such as water conservation and health and safety measures. The recommended approach would be tailored for Alberta with a list of “must be evaluated” measures targeting energy efficiency and conservation measures ahead of alternative measures, similar to the NYE$ MPP. The “must be evaluated” list of measures for the pilot would: (i) be decided on by the multi-stakeholder decision-making network and an interdisciplinary program administration team to ensure that certain non-energy and energy related measures are assessed; (ii) provide a starting point for the audit and analysis; and (iii) provide consistency in project evaluation.

Intervention C is conducting building inspections, adapted from a NYE$ MPP feature, which addresses quality control/assurance and having reliable energy reduction measures for long-term energy savings (F). For the Alberta program this intervention also involves capturing best practices of the experts hired to implement the projects for future education and training purposes (E).

[78] 4 respondents.
[79] 1 respondent.

The lesson of training the energy service providers (ESPs) from the NYE$ MPP showed how using inexperienced ESPs can really slow the progress of a program (refer to section 5.3.3 and 6.1). As such, the recommendation for the pilot is to use the most experienced ESPs to not only minimize risk and increase chances of a successful project as indicated before, but as an opportunity to video record and document best construction, installation, operating, and maintenance practices.

The last intervention [d] under this program category is creating a database of proven and tested products and services. The features underlying this intervention are demonstrating and proving energy reduction to the market (C) and having reliable energy reduction measures for long-term energy savings (F). Interviews from respondents in both precedent programs raised the issue of performance of products. In the Alberta pilot program, demonstrating energy reduction projects offers the opportunity to determine and document in-building performance of products and services like how easy the products are to install for trades, how well things perform under varying conditions, how easy the products/technologies/devices are to maintain and operate. According to Vine (1992), programs can be designed to assist and facilitate the study of persistence by improving program tracking databases to collect information on key items of interest. Reliable or persistent energy savings will come from good service and properly performing and easy to operate and maintain products and technologies.

#### 7.2.2.4 Monitoring and Compliance and Behaviour

Highlight interventions [a], having interdisciplinary approach to program design, evaluation and research, and [a], developing research objectives and performance metrics, under the program categories Monitoring and Compliance

and Behaviour will be discussed together. Intervention a involves having interdisciplinary teams to: develop performance metrics (energy and non-energy); conduct evaluation and research using qualitative/quantitative assessments with real-time monitoring and feedback. Intervention a involves understanding energy use behaviour and setting behaviour specific performance metrics. The features underlying these interventions include having reliable ERMs for long-term savings (F), understanding the market (J), understanding behaviour and choice (K), identifying non-energy benefits (L), and evaluation and research to improve the program and verify energy savings (M). The lessons have been taken almost entirely from novel programming theory and/or the NYE$ MPP.

As indicated in Chapter Two on theory, transforming the market for energy reduction measures requires a broader understanding of the market and therefore the need to employ interdisciplinary teams in fields such as engineering, economics, psychology, sociology, and anthropology. From the data collected and reviewed on the precedent programs, an interdisciplinary approach to setting the performance metrics for evaluation and research objectives prior to and after evaluation appears to be absent. Although NYSERDA identified research opportunities, it is uncertain whether an interdisciplinary team would be deployed. The recommendation for Alberta is to adopt an interdisciplinary approach to program design, evaluation and research, which expands the traditional focus on economics, engineering and building science, to those fields that look to identify non-energy benefits and understand the factors (attitudinal factors, contextual factors, etc. shown in Figure 2.4) that influence energy use behaviour and choice. Having an interdisciplinary team at the beginning should contribute to a more comprehensive and well-rounded program with broader evaluation and research strategies.

Evaluation protocols for programs are often used to improve the performance of programs and offer accountability or proof of cost-effectiveness (Lutzenhiser et al., 2009; Vine, 2008). However, novel programming requires rethinking evaluation and having evaluation go beyond traditional quantification of energy savings (Blumstein et al., 2000). Market transformation strategies are long-term and it is not useful to evaluate them in a similar manner as traditional energy efficiency programs (Nadel and Latham, 1998). In many cases, it is difficult if not impossible to determine if an outcome is the result of one intervention or many acting all at once. Yet we continue to look to quantify and put value on things that are difficult to quantify without understanding what people want and why they want or do not want it. NYSERDA had proposed a comprehensive evaluation approach for the NYE$ MPP by having detailed performance metrics and program impact, process, and marketing evaluations. However, the data collected did not indicate that there were performance metrics or evaluations focused on identifying the non-energy benefits for end users or the influencing factors that affect behaviour and choice outside the realm of technology and economics. Yet, on the basis of personal interviews and NYSERDA's examination of seventeen completed projects under the existing buildings component of the MPP, non-energy benefits and influencing factors exist, can be significant, and should not be discounted. Alberta respondents also highlighted the importance of having a way to address consumer behaviour (Theme 9). Therefore an Alberta pilot program needs to set performance metrics and evaluation protocols that go beyond just quantifying energy savings and look to performance metrics that can qualitatively assess the non-energy benefits and influencing factors on energy use behaviour and choice (e.g., assessing the type of individuals living in the high-rise building and understanding the factors influencing their energy use behaviour). Perhaps in conjunction to a typical energy audit that identifies ERMs, the program could have an addition to the

audit, which determines the type of occupants and their energy use needs and habits (i.e., a behavioural intervention).

Real-time monitoring and evaluation feedback loops are characteristic of novel programming theory, however practically real-time monitoring and evaluation feedback loops may not be possible as indicated in section 2.9. However, it is recommended that real-time monitoring and evaluation feedback be incorporated into the Alberta design when the information to be gathered is important for program improvement and when it is feasible and cost-effective. For example, it is important, feasible and cost-effective to set-up website forums that provide immediate feedback from program participants on what is working and what is not with staff dedicated to addressing the issues (a lesson taken from the NYE$ MPP). It is likely not feasible and cost-effective for program administrators to document and evaluate ongoing changes in a building's energy use, but more feasible to facilitate and empower end users in performing the task. The idea is to assist and shift the responsibility of monitoring and evaluation to the market actors.

Based on the literature, learning from the NYE$ MPP, and Alberta context respondents (Theme 5), research is an important aspect in program design. Research objectives, set at the beginning of the program and as part of the program after evaluation results transpire, are needed to understand what energy performance can be achieved, understand the market, and understand the influences on energy use behaviour and choice. According to Blumstein et al. (2000), an agenda for research helps to develop new knowledge about institutional arrangements, regulatory dynamics, organizational networks, firm practices, consumer-vendor interactions, all those factors that influence market actor behaviour. Again, results from NYSERDA's preliminary examination of seventeen completed projects under the existing buildings component of the

MPP and interviews with MPP building owners for this paper, highlighted potential research opportunities to identify non-energy benefits and understand the influences on energy use behaviour and choice. For the Alberta pilot program, research is needed because very little recent research is available on the energy use behaviour of Albertans as indicated in section 7.1. As stated by one Alberta context respondent:

> I think we need a clarity to our legislation of what good energy standards are for those kind of buildings [residential high-rises]. And quite frankly I think we need a whole lot more study on this stuff [...]. Quite literally, human activity is housed in buildings in this climate. You can't do anything without being in a building, so everything we do is related back to the building. So 100% of our energy regime is affected by our building standards. You put it in that sense it becomes pretty imperative that we actually start studying this stuff, (Energy and Environment Coordinator City of Calgary, pers. comm., May 21, 2010).

The proposed program has to have an expanded evaluation and research agenda with real-time monitoring and feedback loops to understand how and what can be done to get long-term energy savings and why in some cases we cannot get persistent energy savings. It would be a mistake to assume that installing the technology alone would get the types of long-term energy savings needed to achieve the greenhouse gas emission reduction targets set by Alberta's municipalities.

The last intervention ⓑ is employing quality control/assurance personnel, a feature from the NYE$ MPP to address quality work on projects and ultimately to achieve reliable long-term energy savings (Feature F). An additional recommendation for this intervention is to have those conducting the quality control/assurance or a designated third party entity to video record and document the construction, installation, and operation and maintenance best practices for future industry and end user training materials. This additional recommendation

is based on features (E) – having ESP training outside of the program and (I) – having proper building owner training/education for long-term energy savings.

## 7.3 An Energy Reduction Program for Alberta Residential High-rises

The recommended Alberta energy reduction program primarily focuses on demonstrating and proving the benefits of energy reduction measures with particular emphasis on advocacy and education of non-energy benefits by the developers and end users participating in the program. Proper information and communication of the benefits is needed to increase demand and convince those in industry for an eventual improvement in building codes, standards, and practices. Table 7.1 and Figure 7.1 summarize and show the final program interventions recommended for the Alberta energy reduction program. The highlights of the program are:

- Multi-stakeholder decision-making network for program development, to identify solutions to identified risks and barriers that impede the adoption of ERMs, educate industry and end users, and to work towards improving energy performance building codes, standards, and practices.
- Pilot projects and demonstrate and prove benefits of energy reduction projects with emphasis on advocacy and education of non-energy benefits by developers and end users.
- Have web portals, forums, an interactive website, and public database for participants and non-participants to learn from one another.
- Video record and document best practices for education and training of a future energy reduction workforce.
- Staged incentives for early adopters to complete energy reduction projects and advocate and educate non-participants.
- Have public/private collaboration in developing and providing diverse financing options for the residential high-rise sector.

- Work with experts to set the building performance standards, conduct the pilot projects with a whole building approach and “Must Be Evaluated” ERMs, and establish a database of proven and tested products and services.
- Interdisciplinary approach to program design, evaluation and research (energy and non-energy performance metrics, quantitative/qualitative assessment, behavioural interventions).

Table 7.1 *Alberta Energy Reduction Program Proposed Interventions*

| Key Features | Programs | | | AB Interventions | | | | |
|---|---|---|---|---|---|---|---|---|
| | TAF TWP | NYE$ MPP | AB ERP | IKC | COM | BC | MC | B |
| **(A)** Working with industry to advance energy reduction | ✓ | ✓ | ✓ | a | a | a b | | |
| **(B)** Having a point person | ✓ | | ✓ | d | | | | |
| **(C)** Demonstrating and proving energy reduction to market | ✓ | ✓ | ✓,✓ | f | a b | d | | |
| **(D)** Using experienced energy service providers [ESPs] | ✓ | ✓ | ✓ | | | a b | | |
| **(E)** Having ESP training outside of program | | ✓ | ✓ | g | | c | b | |
| **(F)** Having reliable ERMs for long-term energy savings | ✓ | ✓ | ✓,✓ | g | | a b c d | a b | a |
| **(G)** Having effective communication/education strategies | ✓ | ✓ | ✓,✓ | a b c d e | | | | |
| **(H)** Targeting the audience | ✓ | ✓ | ✓ | f | | | | |
| **(I)** Having proper building owner training/education for long-term energy savings | ✓ | ✓ | ✓,✓ | g | | | b | |
| **(J)** Understanding the market | | ✓ | ✓ | | | | a | a |
| **(K)** Understanding behaviour and choice | | ✓ | ✓ | | | | a | a |
| **(L)** Identifying non-energy benefits | | ✓ | ✓ | f | | | a | a |
| **(M)** Evaluation and research to improve program and verify energy savings | | ✓ | ✓ | | | | a | a |
| **(N)** Program administration: trusted/ independent/mandated/good governance/ relationship builder | ✓ | ✓ | ✓,✓ | | | | | |
| **(O)** Improving program clarity and ease of use | ✓ | ✓ | ✓,✓ | d | | | | |
| **(P)** Establishing a baseline | ✓ | ✓ | ✓,✓ | h | | | | |
| **(Q)** Whole building approach | ✓ | ✓ | ✓ | | | a b | | |
| **(R)** Addressing EECMs before alternatives | ✓ | ✓ | ✓,✓ | | | a b | | |
| **(S)** Having diverse financing tools | ✓ | ✓ | ✓,✓ | | a | | | |

Notes. ✓ - Features for TAF TWP; ✓ - Features for NYE$ MPP; AB ERP-Alberta Energy Reduction Program; IKC-Information, Knowledge and Communication; COM-Capital Costs, Operation and Maintenance; BC-Building Convention; MC-Monitoring and Compliance; B-Behaviour

# Chapter Eight: Conclusions

This chapter will cover general recommendations for the Alberta Energy Reduction Program for residential high-rises, reflections on theory and methodology, and future research opportunities.

## 8.1 General Recommendations

Reducing energy use through traditional programming has not been enough to close the "gap" and realize the levels of energy reduction that are possible and cost-effective (Nadel, 1992). Program designers in leading U.S. states such as California, Massachusetts, Oregon and New York recognize this fact and are looking to market transformation strategies (Molina et al., 2010). Theory-based market transformation is a novel approach to programming detailed by Blumstein et al. (2000) and cited in the paper by Lutzenhiser et al. (2009). The study of two precedent programs employing market transformation strategies have highlighted key features and provided insightful lessons, that together with the theoretical learning and relational model, were used to craft a design for market-transforming energy reduction initiatives in Alberta's residential high-rise sector.

Based on theory and practical learning from the precedent programs, the general recommendation for the design of an energy reduction program for Alberta residential high-rises is to have:

> A collaborative multi-stakeholder pilot program that aims to begin to transform the market by demonstrating and proving the benefits of energy reduction projects with a focus on having developers and end-users educating and advocating the non-energy benefits to program non-participants – leading to increased demand and eventual improvement of energy performance building codes, standards, and practices.

With regards to program administration, the recommendation is to have a program administrator selected or created on the basis of stakeholder consensus. The program administrator also has to have the mandate for energy reduction in the high-rise building sector, be credible and operate under good governance.

The following are key interventions recommended within each of the program categories.

i) Information, Knowledge and Communication Interventions

1. Establishing a multi-stakeholder decision-making network to collaborate on program development, provide input for the solutions to identified risks and barriers (e.g., public/private collaboration in developing diverse financing options), educate industry and end users, and work at improving energy performance building codes, standards, and practices. Working towards establishing stringent energy performance building codes and product standards is a way to address the split incentive market failure in the renter/landlord and developer/occupant-owned residential high-rise market.
2. Pilot projects with older rental and market rate high-rises. Emphasis on older rental high-rises and target lower to medium income tenants, who would benefit the most from energy reduction measures (i.e., more disposable income from energy savings for other uses).
3. Demonstration and proof of the benefits of energy reduction projects with emphasis on advocacy and education of non-energy benefits by developers and end users. This intervention addresses one of the most significant market failures, that is, the lack of understanding and knowledge and perceived risk of energy reduction measures by market actors. Provision of information on non-energy benefits could also help overcome split incentive market failures.

4. Have web portals, forums, interactive website, and public database for participants and non-participants to learn from one another and to develop the market for energy reducing goods and services.
5. Video recording and documenting projects to capture best practices on energy reduction measures and using the information to educate and train upstream and downstream actors. Lack of resources and insufficient training are market failures. Therefore, proper training of industry professions is needed to meet the demand.

ii) Capital Costs, Operation and Maintenance Interventions

1. Providing financial grants/rewards to developers and end users (early adopters) for completing energy reduction projects and advocating and educating the benefits (energy and non-energy) of the projects to program non-participants. This intervention addresses lack of access to upfront capital, but also rewards the early adopters for completing energy reduction projects and advocating and educating the benefits of energy reduction measures.
2. Providing diverse financing options for the residential high-rise sector. This intervention addresses the lack of access to upfront capital for the different ownership structures in the residential high-rise sector, but is also to provide proof to financial lenders that energy reduction projects are financially viable and can be underwritten.

iii) Building Convention Interventions

1. Selecting energy reduction experts to help set program minimum building performance standards and execute the projects using whole building analysis. Have “Must Be Evaluated” ERMs and establish a database of proven and tested products and services. It is important to show success in the pilot projects by addressing long-term energy savings with

appropriate energy reduction measures. Experts are needed to conduct the projects to address any performance issues with the measures.

iv) Monitoring and Compliance and Behaviour Interventions

1. Employing a quality control/assurance entity and capturing best practices for future training and education of an energy reduction workforce. Lack of resources and insufficient training are a major constraint. This intervention addresses quality work and training for future industry professions.
2. Broadening evaluation and research objectives to include an interdisciplinary approach to defining performance metrics and conducting evaluation and research with quantitative and qualitative assessment. Behavioural constraints can affect energy reduction measures and consequently behavioural interventions are required, and evaluation and research needs to be expanded beyond conventional quantification of energy savings.
3. Incorporating real-time monitoring and evaluation feedback loops in the program design when the information to be gathered is highly desirable, provided it can be done cost-effectively. Work to expand the responsibilities of monitoring and feedback to the market actors. Monitoring and evaluation feedback is needed to improve the program and address persistent energy savings.

The Alberta residential high-rise building sector needs to have an energy reduction program with a market transformation approach to programming to realize untapped cost-effective energy savings. Energy savings and other non-energy benefits will be important for everyone living in high-rise buildings, but especially for those who can least afford rising costs.

## 8.2 Reflections on Theory

The following discussion includes reflections on the relational model and its usefulness, precedent program theory differentiation, and deficiencies in the theory itself. A theory-based market transformation approach to program design is a novel approach to programming because the approach calls for adaptivity to the market that is dictated by the social, political, economic, environmental climate in which the program needs to operate, leading to no one program being the same. However, deciding on which policy instruments or program interventions to adopt is challenging, especially when many exist. The developed relational model was useful in identifying and illustrating the precedent program approaches and the interventions used to address the issues impeding the adoption of energy reduction measures.

The NYE$ MPP in large part (refer to section 5.4) and the TAF TWP partially (refer to section 4.4) meet the ideals of the market transformation approach. Both programs have shown to have mandated, credible, accountable, and adaptive program administrators. The NYE$ MPP is a much more comprehensive program in comparison to the TAF TWP by: 1) having diversity in its interventions by targeting upstream and downstream market actors (e.g., energy service providers, developers, building owners), and 2) incorporating integrated work teams for evaluation and research related to program impact, process and market effects.

In regards to theory deficiency, both programs are deficient in that they: 1) rely heavily on interventions related to techno-economic fixes (i.e., techno-economic fixes or information, awareness, and education on techno-economic fixes are assumed to change energy use behaviour), 2) do not incorporate an interdisciplinary approach to program design, evaluation and research (i.e., including quantitative and qualitative assessment of non-energy benefits to

market actors and understanding the influences on energy use behaviour and choice), and 3) do not incorporate real-time monitoring and evaluation feedback loops in all program categories. However, practical execution can be fraught with entrenched traditional programming ideas (i.e., PTEM), lack of leadership and resources, and specific regulatory or oversight requirements that do not allow for deviations. Although the precedent programs under perform in some areas, the idea behind these types of programs is that they are never static and consequently failures are a part of the process in order for them to adapt to the changes. The objective is to try to minimize the impact of the failures and to quickly make the necessary changes. The only real failure would be to adopt a program that never changes, remains static, and hopes to change the market based on assumptions rather than real understanding and knowledge of the market.

Returning to the discussion in section 2.9 (What Theory Does Not Reveal About Market Transformation), all but two of the questions have been addressed by the precedent program case studies. The precedent program research and the relational model helped to:

1) Determine who should do the intervening and the interventions used to address the issues as discussed in detail in sections 4.3 and 5.3;
2) Show that the scale of pilot programs are limited by available resources (e.g., TAF TWP only has access to $8 million of a city endowment for its financing initiatives and NYSERDA may have expanded the program too quickly with inexperienced energy service providers);
3) Substantiate that reducing or eliminating risks and barriers and introducing labelling strategies can begin to transform the market for energy reducing goods and services (e.g., TAF success in working to change Toronto property standards for motion sensor lighting and NYE$ MPP ENERGY STAR label for new multifamily buildings);

4) Reveal that the effectiveness of a program needs to be determined with a wide range of evaluation techniques – not limited to traditional impact evaluation and cost-effectiveness tests (e.g., NYE$ MPP examination of existing building retrofits showing that behavioural effects can significantly affect energy savings).

One unanswered question or theory deficiency, as shown from practical application of both programs, lies with real-time monitoring and evaluation feedback loops. Is it even possible to address real-time monitoring and evaluation feedback loops in all areas of programming (e.g., monitoring and evaluating persistence in energy savings, effects of outreach and education interventions, program process issues, market uptake of energy reduction measures, product performance, factors influencing energy use behaviour)? As indicated earlier, market transformation strategies by their nature take time and in many cases can be difficult to evaluate and should not be evaluated with traditional techniques. Consequently, real-time monitoring and evaluation are likely to be cost prohibitive and unrealistic given the uncertainty of programs and their funding sources. The recommendation made for the Alberta energy reduction program (yet to be proven) is to have the program administration prioritize based on feasibility and cost and widen the responsibility of monitoring and evaluation from program administration to the market actors. The idea is to have a program administrator assist market actors and provide them the necessary tools to take on the responsibility. After all, is it not the best interest of those involved in the market for energy reducing goods and services to know their own client base and if they are having an impact with their goods and services? Or for building owners to know that their tenants' behaviours and how the building is being maintained and operated is affecting energy use and operating costs?

The second unanswered question is scalability of a large scale market transformation program and in particular the applicability of the TAF TowerWise program or NYE$ MPP model to Alberta, which has a much smaller residential high-rise building sector.

In sum, the proposed design for an energy reduction program for Alberta has been customized for the Alberta context, and is based on precedent program learning, and novel programming guiding principles. The true test of the program design and approach will only come from practical implementation.

## 8.3 Reflections on Methodology

The overall methodology has been effective in helping to answer the research question – “How to design an energy reduction program for new and existing Alberta residential high-rise buildings?” Case study analysis on precedent programs provided key insights that improved overall understanding of the programs and how they proposed to transform the market for energy reduction measures. Likewise, the semi-structured interviews with Alberta context respondents helped to tailor the proposed interventions for the final program design. The overall case-based design study methodology resulted in the final approach and program interventions most suitable for the Alberta energy reduction program.

Unfortunately, what did not work as planned was getting the number of interviewees anticipated for the precedent programs, more unrestricted access to information on completed projects, and access to interview tenants in some of the participating buildings. Originally a total of approximately 50 interviewees (including regulatory/oversight representatives, program administrators and associates, energy service providers, developers and building owners) per program were anticipated. The total interview count ended up at 23 for the NYE$

MPP and 7 for the TAF TWP, because of fewer completed projects than anticipated and/or difficulty in obtaining contact information and individuals with program experience. At the time of data collection, the TAF TowerWise program had fewer projects completed and fewer individuals with program experience than anticipated. The NYE$ MPP also had fewer projects than expected with post evaluation results. However, of the completed projects, access to the information (i.e., case studies) on them was restricted, requiring approvals from multiple parties for information disclosure. As for tenant interviews, the TAF TowerWise program had only a few new construction projects with executed Green Condo Loans and consequently it was decided that speaking with new tenants would not have provided any additional information that the program administration or developer could provide. In speaking with building owners from the NYE$ MPP, those that were asked about tenant involvement indicated that the tenants were not involved in the dealings of the program and consequently tenant interviews were not pursued.

Given the opportunity to revise the methodology the changes would include expanding the interview respondents to include NYE$ MPP financial lenders and contract evaluators involved with financing program projects and program evaluation, respectively. Financial lenders would likely have been able to provide further insight into possible financing options and some of the reasons for the lack of access to capital for energy reduction projects, while contract evaluators may have been able to provide details on program evaluation techniques.

## 8.4 Future Research

A theory-based market transformation approach involves an iterative process of learning and adapting to new knowledge; well targeted strategic market interventions that are based on formal and experiential knowledge; pilot

testing; real-time monitoring and evaluation with feedback loops; and research to develop new knowledge about the market and the various arrangements that govern behaviour of actors in the markets (Blumstein et al., 2000; Lutzenhiser et al., 2009). The approach for the Alberta energy reduction program is demonstrating and proving successful energy reduction projects and the benefits (with emphasis on non-energy) through advocacy and education by developers and end-users to increase demand and eventually have the proof to improved residential high-rise building energy performance codes, standards, and practices. Research in a theory-based market transformation approach is integral to the program design, so future research will arise from implementing the recommended Alberta energy reduction program.

Knowledge on the effectiveness of the different financing options, factors that influence energy use behaviour and choice, and scalability of the Toronto and New York program models needs to be acquired through further research. As mentioned in section 7.2.2.2 financing models are predominantly for single family housing and many models are still being piloted. More research is needed to determine the effectiveness of these various models and their applicability to multifamily housing. Very little is also known about understanding energy use behaviour and choice of Albertans that live in residential high-rise buildings. Setting research objectives and performance metrics regarding energy use behaviour will be an integral part of the Alberta Energy Reduction program, however conducting preliminary research on energy use behaviour and choice of Albertans that live in residential high-rise buildings would be beneficial prior to program development and implementation. Lastly, as discussed in sections 2.9 and 8.2, further research is needed to determine the scalability of market transformation programs and whether the Toronto and New York program models can work effectively with a reduced residential high-rise building stock similar to that of Alberta.

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# Appendix I: Semi-structured Interview Questions

**TowerWise Program: Government Regulators/Program Oversight Representatives (Respondents 1a)**

Interview Questions

Roles and Responsibilities

1 a Explain what role and responsibilities you have, with regards to the TAF TowerWise Program? Role of City of Toronto?

b How long have you worked with TAF staff on the TowerWise Program?

Program Performance Standards; Program Administrative Structure; Program Strengths

2 a What TowerWise Program performance measures, if any, are used? If there are performance measures, are they being met? If yes, how are they determined? Who was involved in deciding what they are? How is program performance reported?

b In your experience, how has the TAF TowerWise program worked in meeting Toronto's climate change objectives?

c TowerWise is a public-private partnership. What made you choose this model? Were other administrative structures considered?

d Is the TAF Act 2005 still applicable? What has been the impact of the Act on the TowerWise Program?

e In your experience, what are the key strengths and advantages of the program?

Program Challenges/Barriers; Information, Knowledge, and Communication amongst Stakeholders

3 a What types of issues, with regards to the TowerWise Program, often need to be addressed?

b How are the issues addressed between the City staff and TAF TowerWise staff? Who specifically is involved?

c In your experience, what are the biggest challenges/barriers for energy efficiency and alternative energy uptake in existing and new residential high-rises? Top five?

d How do you think the challenges/barriers could be addressed through the program?

Program Funding

4 a I believe a $23MM City endowment is used to fund TAF. How are Toronto Atmospheric funds allocated to the TowerWise Program? Funds allocated on what basis? Other sources of funding? Who is involved?

b What are the restrictions, if any, associated with the Toronto Atmospheric funds that are allocated to the TowerWise Program?

c Is secure funding an issue? If not, what makes a program less stable or secure?

d Have other funding strategies been considered? Ratepayer fees on utility bills or taxes?

e What funding sources are most desirable and why?

5 Are there any other issues, that I have not raised, that you think are important to consider in the design of an effective energy efficiency and alternative energy program for multifamily high-rises? Are there any documents that may be useful in my research that you can provide or refer me to?

**TowerWise Program: Program Administration (Respondents 1b)**

Interview Questions

Roles and Responsibilities

1 Could you describe your involvement in the program and how long you have been in your current role?

Program Regulations and Standards

2 a I'm aware that you have performance targets for new and existing high-rises. 25% less energy than the Model National Energy Code for Buildings (MNECB) for new and 15% less energy than MNECB or building benchmark for existing high-rises (5 or more storeys), is this correct? Are there any others?

b How did you/TAF decide on the standards for the performance targets?

c Who is involved?

Building Technology, Products and Services

3 a How do you ensure that there are qualified service contractors that can meet the objectives of the TowerWise Program performance standards?

b What is your relationship with the service contractors?

c How do participants (developers, building owners/managers, condo boards/co-operatives, unit owners, renters) obtain qualified service contractors?

4 a What are the standards for equipment, appliances, and lighting? Differences for new construction versus retrofitting existing high-rises (5 or more stories)?

b How do you/TAF decide what standards to promote?

5 a What technology, products, and services do participants (developers, building owners/managers, condo boards/co-operatives, unit owners, renters) need or use to effectively participate in the program?

b Are the technology, products, and services recommended through the program? If not, why not?

Program Funding, Financial Assistance & Incentives

6 a I am aware that you have financial assistance for new and existing buildings, a green loan for new and existing buildings outlined in website documents. Are there any others? Any documents outlining the incentives that you could provide to me?

b Are there other performance measures associated with qualifying for the financial assistance? If yes, what are they? If no, why not? How are they determined? Who is involved in deciding on the performance measures for the program?

c How do you choose what kind of financial assistance and/or incentive would be appropriate to meet your program objectives?

d How do you assist the client to maximize on his/her financial benefits?

e How are Toronto Atmospheric funds allocated to the TowerWise Program? Funds allocated on what basis? Other sources of funding? Who is involved? Is funding adequate to run the program? If yes, how do you decide how much is adequate? If no, what needs to be done to provide adequate program funding?

7 Audits (Energy Reduction Plans) are required to receive the loan or incentives, how are projects handled when the participant does not meet the predicted energy savings?

8 What affect does the program have in encouraging building owners with rental properties to spend capital for energy efficiency and/or alternative energy measures/initiatives?

Information, Knowledge, and Communication amongst Stakeholders

9 I noticed you have an extensive website with information on 1) the importance of energy efficiency and alternative energy measures/initiatives, 2) the program, 3) the available services and tools, are there any other communication strategies through the program? If yes, what are they? How do you determined the effectiveness of these strategies? Who is the target audience for the program?

10 What feedback mechanisms are being used to learn from successful projects? Failed projects? Follow-up, monitoring and evaluation of the program?

Program Strengths and Challenges/Barriers

11 a In your experience, what are the biggest challenges in the program? Top five?

b How are you trying to address them?

12 In your experience, what are the key strengths and advantages of the program?

13 a Are there any other issues, that I have not raised, that you think are important to consider in the design of an effective energy efficiency and alternative energy program for multifamily high-rises?

b Could you provide me with any program manuals or brochures that you think might be useful for my research?

c Would it be possible to look at some completed projects or case studies in detail as I would like to contact the participants for those completed projects for additional insight on the program?

d Are the service contractors and developers listed on your website program participants? I may be contacting some of them for further insight.

**TowerWise Program: Program Associates (Respondents 1b)**

Interview Questions

Roles and Responsibilities

1 The incentives advisor's role sounds quite extensive including "providing information on how an energy retrofit can reduce operating costs and add value to a building; independent advice on how to plan and sequence an energy efficiency retrofit; comprehensive information on all the incentive and rebate programs available; and assisting in applying for and securing any incentives for which a retrofit project is eligible" (Canadian Apartment Magazine, 2009). What duties don't you perform? What is your role versus the energy services provider? Is there only one application to obtain all incentives?

Program Strengths and Challenges/Barriers

2 In your experience, what are the key strengths and advantages of the TowerWise program?

3 What affect does the program have in encouraging building owners with rental properties to spend capital for energy efficiency and/or alternative energy measures/initiatives?

4 The TowerWise Program appears to be a public-private market transformation program. Do the affiliated rebate or resource acquisition programs complement or detract from the overall objective of market transformation? How do you measure success on a market transformation program?

5 a In your experience with the program, what are the biggest challenges/barriers for energy efficiency and alternative energy uptake in existing and new residential high-rises? Top five?

b How are you trying to address them?

Building Technology, Products, and Services

6 Whole building analysis with energy modelling is promoted in the program. What measures/initiatives provide the largest energy savings impacts? How are measures/initiatives determined and prioritized if the client doesn't want to implement all measures? Difference in new construction versus retrofitting existing high-rises?

7 In your experience, are there enough qualified energy services providers to meet the demand? If yes, how was the supply of qualified energy services providers created? If not, how could you address this issue?

Information, Knowledge, and Communication amongst Stakeholders

8 a TowerWise has an extensive website with information on 1) the importance of energy efficiency and alternative energy measures/initiatives, 2) the program, 3) the available services and tools. Who is the target audience for the program?

b What is the most common kind of information or service requested by inquiring program participants?

9 a Are there any other issues, that I have not raised, that you think are important to consider in the design of an effective energy efficiency and alternative energy program for multifamily high-rises?

b Are there other documents that you think might be useful for my research?

c Are there any case studies that you could share with me?

**TowerWise Program: Energy Service Providers (Respondents 1c)**

Interview Questions

Roles and Responsibilities; Motivation

1 a How did you come to be involved with TAF staff in the TowerWise Program? Part of the TEEAC?

b What does your firm do? Are you a energy service company that offers performance contracts (tie company's compensation to the energy savings generated by the project)?

c Do you work on both new construction and retrofitting high-rises (5 or more storeys) or just one?

d How long have you worked in the TowerWise Program?

e What is your primary motivation for participation in the program?

Program Strengths and Challenges/Barriers

2 In your experience, what are the key strengths and advantages of the TowerWise program?

3 a In your experience, what are the biggest challenges/barriers for energy efficiency and alternative energy uptake in existing and new residential high-rises? Top five?

b How do you think the challenges/barriers could be addressed?

Program Regulations and Standards; Building Technology, Products, and Services

4 In your experience, are the performance standards reasonable? Why or why not?

5 What technology, products, and services do you provide to clients (developers, building owners/managers, condo boards/co-operatives, unit owners, renters) that are most useful in qualifying for the program and its affiliated programs? Difference for retrofitting existing high-rises versus new construction of high-rises?

6 a Whole building analysis with energy modelling is promoted in the program. What measures/initiatives provide the largest energy savings impacts? How are measures/initiatives determined and prioritized if the client does not want to implement all measures? Difference in new construction versus retrofitting existing high-rises?

b What problems, if any, have you encountered in specifying energy efficient or alternative energy technology, products and services? Is it different for new construction versus retrofitting existing high-rises? If so, how?

7 a How do you assist the client to maximize on his/her financial benefits? Your role versus the incentives advisor?

b What are some of the key issues in qualifying for energy efficiency and alternative energy programs? Recommendations for improvement?

8 Energy service companies (ESCOs) develop & implement turnkey energy efficiency projects. They offer performance contracts that tie the compensation of the ESCO to the energy savings generated by the project. [Move to next question if not ESCO].

Would you say that there is an advantage to being an ESCO as compared to other energy service providers/management firms?

Information, Knowledge, and Communication amongst Stakeholders

9 The TowerWise website has a lot of information about 1) the importance of energy efficiency and alternative energy measures/initiatives, 2) the program, 3) the available services and tools. How have these strategies worked for you?

10 In terms of deciding on energy efficiency measures/initiatives, your role compared with the client, what is your role? What is the process? How are decisions made?

11 What feedback mechanisms are being used to learn from successful projects? Failed projects? Do clients ever request follow-up monitoring on their projects?

12 a Are there any other issues or experiences, that I have not raised, that you want to share with me regarding the TowerWise Program?

b Would you be able to provide a summary of a few of your projects or case studies?

**TowerWise Program: Developers (Respondents 1d)**

Interview Questions

Roles and Responsibilities; Motivation

1 a How did you come to be involved with TAF staff in the TowerWise Program? Part of the TEEAC?
b Are you aware of any other energy efficiency and alternative energy programs? If yes, what others? How did you hear about the others? Which ones are you participating in and why?
c Why this program? What is your primary motivation for participation in the program?

Program Strengths and Challenges/Barriers

2 What have been the strengths or advantages in working with the program? Would you have addressed energy efficiency and/or alternative energy measures/initiatives without this program and/or its affiliates?

3 a In your experience, what are the biggest challenges/barriers for energy efficiency and alternative energy uptake in existing and new residential high-rises? Top five?
b How do you think the challenges/barriers could be addressed?

Program Regulations and Standards; Building Technology, Products, and Services

4 In your experience, are the performance standards reasonable? Why or why not?

5 a In your experience, what are the technology, products, and services that provide the greatest value to your projects? Are there enough? Are there other technology, products, and services that are not available that you think would be valuable and useful?
b What problems, if any, have you encountered in acquiring energy efficient or alternative energy technology, products and services for new high-rise construction projects?

6 a Whole building analysis using energy modelling is recommended by the program, are you implementing all the recommended measures/initiatives? If not, how do you prioritize or choose the measures/initiatives to implement?
b What occurs when you are not able to meet the time limitations to complete your project?

7 Has the program introduced you to other energy efficiency and alternative energy programs? If yes, how are you assisted to maximize the financial benefits from other programs?

8 What are some of the key issues in qualifying for energy efficiency and alternative energy programs? Recommendations for improvement?

Information, Knowledge, and Communication amongst Stakeholders

9 The TowerWise website has a lot of information about 1) the importance of energy efficiency and alternative energy measures/initiatives, 2) the program, 3) the available services and tools. How have these strategies worked for you?

10 a In terms of deciding on energy efficiency measures/initiatives, your role compared with the service contractor, what is your role? What is the process? How are decisions made?
b What influences the final choice in energy efficiency and/or alternative energy measures/initiatives for a project?

11 What feedback mechanisms are being used to learn from successful projects? Failed projects? Follow-up and monitoring on your project?

12 a Are there any other issues or experiences, that I have not raised, that you want to share with me regarding the TowerWise Program?
b Would you be able to share some of your projects/case studies with me?

**TowerWise Program: Building Owners/Managers, Condo boards, Co-operatives (Respondents 1e)**

Interview Questions

Roles and Responsibilities; Motivation

1 a How did you come to be involved with TAF staff in the TowerWise Program? Part of the TEEAC?

b Why this program? What is your primary motivation for participation in the program?

Program Strengths and Challenges/Barriers

2 What have been the strengths or advantages in working with the program? Would you have addressed energy efficiency and/or alternative energy measures/initiatives without the program?

3 a In your experience, what are the biggest challenges/barriers for energy efficiency and alternative energy uptake in existing and new residential high-rises? Top five?

b How do you think the challenges/barriers could be addressed?

Building Technology, Products, and Services

4 a What EEAE technology, products, and services that are provided to you, are most valuable and useful to you? Are there enough? Are there other technology, products, and services that are not available that you think would be valuable and useful?

b What problems, if any, have you encountered in acquiring energy efficient or alternative energy technology, products and services? Is it different for new construction versus retrofitting existing high-rises? If so, how?

5 a Was whole building analysis with energy modelling done for your building? If yes, what measures/initiatives provide the largest energy savings impacts for retrofitting high-rises? If no, how are measures/initiatives determined?

b Are you implementing all the recommended measures/initiatives? If not, how do you prioritize or choose the measures/initiatives to implement?

c What occurs when you are not able to meet the time limitations to complete your project?

6 Has the program introduced you to other energy efficiency and alternative energy programs? If yes, how are you assisted to maximize the financial benefits from other programs?

7 What are some of the key issues in qualifying for energy efficiency and alternative energy programs? Recommendations for improvement?

Information, Knowledge, and Communication amongst Stakeholders

8 a If condo or cooperative high-rise. Otherwise goto 8b

What was involved in raising the capital amongst all owners for energy efficiency or alternative energy measures/initiatives? Have you considered partnering with other buildings? Why or why not?

b If rental or affordable housing high-rise.

What role in the program, if any, do renters have? Have you considered partnering with other buildings? Why or why not?

9 The TowerWise website has a lot of information about 1) the importance of energy efficiency and alternative energy measures/initiatives, 2) the program, 3) the available services and tools. How have these strategies worked for you?

10 a In terms of deciding on energy efficiency measures/initiatives, your role compared with the service contractor, what is your role? What is the process? How are decisions made?

b What led to your final choice in energy efficiency and/or alternative energy measures/initiatives for your project?

11 What feedback mechanisms are being used to learn from successful projects? Failed projects? Follow-up and monitoring on your project?

12 a Are there any other issues or experiences, that I have not raised, that you want to share with me regarding the TowerWise Program?

b Would you be able to provide a summary of a few of your completed projects and post a notice in a couple of your high-rise projects, that participated in the program, in order for me to obtain phone interviews from the occupants?

**New York Energy $mart Mutlifamily Performance Program: Government Regulators/ Program Oversight Representatives (Respondents 2a)**

Interview Questions

Roles and Responsibilities

1 a Explain what role and responsibilities you have with the department of public service (DPS) and specifically with regards to the NYSERDA Multifamily Performance Program (MPP)? Role of Public Service Commission?

b How long have you worked with NYSERDA staff on the Multifamily Performance Program?

Program Performance Standards; Program Administrative Structure; Program Strengths

2 a What MPP performance measures, if any, are used? How are they determined? Who is involved in deciding what they are? How is program performance reported?

b In your experience, how has the existing program administrative structure with NYSERDA worked in achieving local and state energy reduction objectives?

c From my understanding the PSC orders for Energy Efficiency Portfolio Standard and the orders approving multifamily energy efficiency programs with modifications establishes a hybrid program administrative structure with a mix between utility versus NYSERDA versus independent programs. How do you expect NYSERDA MPP to work with the other programs?

d According to the multifamily energy efficiency programs with modifications order, what is the reason for having NYSERDA handle multifamily buildings with 50+ units and utilities addressing multifamily buildings with 5 to 50 units?

e In your experience, what are the key strengths and advantages of the program?

Program Challenges/Barriers; Information, Knowledge, and Communication amongst Stakeholders

3 a What types of issues, with regards to the MPP, often need to be addressed?

b How are the issues addressed between the DPS staff and NYSERDA MPP staff? Who specifically is involved?

c In your experience, what are the biggest challenges/barriers for energy efficiency and alternative energy uptake in existing and new residential high-rises in the program? Top five?

d How do you think the challenges/barriers could be addressed through energy efficiency programs?

Program Funding

4 a As outlined in the order approving the multifamily energy efficiency programs, how are the system benefit funds allocated to the NYSERDA MPP? Allocation on what basis? Who is involved in decision making?

b How are funds allocated across the state or respective counties? Eg. How much does New York City get? Who is involved in decision making?

c Is the funding for the Energy Efficiency Portfolio Standard (EEPS) adequate to meet program objectives? If yes, how do you decide how much funding is adequate?

d Is secure funding an issue? If not, what makes a program less stable or secure?

e Are there alternative sources that you have considered? If yes, what are they? If no, do you expect SBC funding to be longterm?

f What funding sources are most desirable and why?

5 Are there any other issues, that I have not raised, that you think are important to consider in the design of an effective energy efficiency and alternative energy program for multifamily high-rises? Are there any documents that may be useful in my research that you can provide or refer me to?

**New York Energy $mart Mutlifamily Performance Program: Program Administration (Respondents 2b)**

Interview Questions

Roles and Responsibilities

1 Could you describe your involvement in the program and how long you have been in your current role?

Program Strengths

2 In your experience, what are the key strengths and advantages of the program? Would you say that the program focuses on market transformation, resource acquisition, or both?

Program Regulations and Standards

3 a I'm aware that you have performance targets for new and existing high-rises. 20% less energy than ASHRAE 90.1-2004 for new and 20% less energy than peer buildings using your benchmarking tool for existing high-rises (5 or more storeys). Are there any others?

b How did you decide on the standards for the performance targets?

c Who is involved?

d Have any performance targets been affected by the Public Service Commission (PSC) Order Approving Multifamily Energy Efficiency Programs with Modifications July 27, 2009? If yes, how have they been affected?

4 a Can you comment on if you have been satisfied with the implementation of the standards by the service contractors?

b I noticed that there is a very extensive partnership agreement that contains terms and conditions for partners, submission requirements, and much more. Why did the partnership agreement come about? How did you create the network?

c How effective is the partnership in meeting program objectives and dealing with problems?

5 a What are the standards for equipment, appliances, and lighting? Differences for new construction versus retrofitting existing high-rises?

b How do you decide what standards to promote?

Building Technology, Products & Services

6 a What technology, products, and services do participants (developers, building owners/managers, condo boards/co-operatives, unit owners, renters) need or use to effectively participate in the program?

b Are the technology, products, and services recommended through the program? If not, why not?

c What affect, if any has the July 2009 PSC Order had?

Program Funding, Financial Assistance and Incentives

7 a I am aware that you have performance incentives for new and existing buildings, a loan fund for new and existing buildings, and incentives for advanced measures outlined in website documents. Are there any others? Any documents outlining the incentives that you could provide me?

b I am aware of the PSC order approving multifamily energy efficiency programs with modifications July 27, 2009, but want to clarify - has the order modified or changed these incentives? If yes, what are the changes?

c How do you choose what kind of financial assistance and/or incentive would be appropriate to meet your program objectives?

d How are system benefit charges/Energy Efficiency Portfolio Standard funds allocated for New York City high-rise projects? Funds allocated on what basis? Other sources of funding? Who is involved?

e Is the funding for the Energy Efficiency Portfolio Standard (EEPS) adequate to meet program objectives? If yes, how do you decide how much funding is adequate?

f If no, what needs to be done to provide adequate program funding?

8 Audits (Energy Reduction Plans) are required to receive the loan or incentives, how are projects handled when the participant does not meet the predicted energy savings?

9 What affect does the program have in encouraging building owners with rental properties to spend capital for energy efficiency and/or alternative energy measures/initiatives?

Information, Knowledge, and Communication amongst Stakeholders

10 What communication strategy is used to raise awareness about 1) the importance of energy efficiency and alternative energy measures/initiatives, 2) the program, 3) the available services and tools? How do you determined the effectiveness of the strategy? Who is the target audience for the program?

11 What feedback mechanisms are being used to learn from successful projects? Failed projects? Follow-up, monitoring and evaluation of the program?

Program Challenges/Barriers

12 a In your experience, what are the biggest challenges/barriers for energy efficiency and alternative energy uptake in existing and new residential high-rises? Top five?

b How are you trying to address them through the program?

13 a Are there any other issues, that I have not raised, that you think are important to consider in the design of an effective energy efficiency and alternative energy program for multifamily high-rises?

b Could you provide me with any program manuals or brochures that you think might be useful for my research?

c Would it be possible to obtain some completed projects or case studies as I would like to contact the participants for those completed projects for additional insight on the program?

d Are the service contractors listed on your website program participants? I may be contacting some of them for further insight?

**New York Energy $mart Mutlifamily Performance Program: Program Associates (Respondents 2b)**

Interview Questions

Roles and Responsibilities, Motives for Participation

1 a Explain what role and responsibilities you have with regards to the NYSERDA MPP (New Construction or Existing Buildings Component?
b How did (TRC or Taitem Engineering) come to be involved with the NYSERDA MPP? Is your relationship contractual?

Program Strengths

2 From your experience, what have been the strengths or advantages of the program?

Program Regulations and Standards

3 a In your experience, are the performance standards reasonable? Why or why not? Could they be higher?
b What are the parts of the application process for the New Construction or Existing Buildings Component? Who was involved in developing the application process?

Building Technology, Products, Services

4 a The program promotes whole building analysis with energy modelling, what measures/initiatives provide the largest energy savings impacts? How are measures/initiatives determined and prioritized if the client can't implement all measures? Difference in new construction versus retrofitting existing high-rises?
b What affect, if any has the July 2009 PSC Order had?
c What problems, if any, have the partners encountered in specifying energy efficient or alternative energy technology, products and services? Is it different for new construction versus retrofitting existing high-rises? If so, how?
d How do you assist the client to maximize on his/her financial benefits?

5 What are the key issues in qualifying for the program from the beginning to the end of a project? Recommendations for improvement?

6 Energy service companies (ESCOs) develop & implement turnkey energy efficiency projects. They offer performance contracts that tie the compensation of the ESCO to the energy savings generated by the project. [Move to next question if not ESCO].

Would you say that there is an advantage to being an ESCO as compared to other service contractors?

Information, Knowledge, and Communication amongst Stakeholders

7 a What communication strategy is used to raise awareness about 1) the importance of energy efficiency and alternative energy measures/initiatives, 2) the program, 3) the available services and tools? How do you determined the effectiveness of the strategy? Who is involved in the development of the strategy?
b In terms of deciding on energy efficiency measures/initiatives, your role compared with the client, what is your role? What is the process? How are decisions made?

8 What feedback mechanisms are being used to learn from the stakeholders? Successful projects? Failed projects?

Program Challenges/Barriers

9 a In your experience with the program, what are the biggest challenges/barriers in energy efficiency and alternative energy uptake in existing and new residential high-rises? Top five?
b How do you think the challenges/barriers could be addressed?

10 a Are there any other issues or experiences, that I have not raised, that you want to share with me regarding the NYSERDA Multifamily Performance Program?
b Would you be able to provide a summary of a few of your projects or case studies?

**New York Energy $mart Mutlifamily Performance Program: Partners - Energy Service Providers (Respondents 2c)**

Interview Questions

Roles and Responsibilities, Motives for Participation

1 a Are you still a NYSERDA partner? What does your firm do? Are you a energy service company that offers performance contracts (tie company's compensation to the energy savings generated by the project)?
b Do you work on both new construction and retrofitting high-rises (5 or more storeys) or just one?
c NYSERDA partners are required to sign an agreement and meet certain terms and conditions, can you comment of the process? How long have you been a partner?
d What is your primary motivation for participation in the program?

Program Strengths

2 What have been the strengths or advantages in working with the program?

Program Regulations and Standards

3 a In your experience, are the performance standards reasonable? Why or why not? Could they be higher?
b Does the program provide you with any education and tools to assist in achieving the goals of the program? If yes, what kinds of education and tools do they provide you? If no, where do you get the education and tools?

Building Technology, Products, Services

4 a What technology, products, and services do you provide to clients (developers, building owners/managers, condo boards/co-operatives, unit owners, renters) that are needed and used to effectively participate in the program? Difference for new versus existing high-rises?
b Are the technology, products, and services recommended through the program? If not, do you think they should be?

5 a The program promotes whole building analysis with energy modelling, what measures/initiatives provide the largest energy savings impacts? How are measures/initiatives determined and prioritized if the client can't implement all measures? Difference in new construction versus retrofitting existing high-rises?
b What affect, if any has the July 2009 PSC Order had?
c What problems, if any, have you encountered in specifying energy efficient or alternative energy technology, products and services? Is it different for new construction versus retrofitting existing high-rises? If so, how?

6 a How do you assist the client to maximize on his/her financial benefits?
b What are the key issues in qualifying for the program from the beginning to the end of a project? Recommendations for improvement?

7 Energy service companies (ESCOs) develop & implement turnkey energy efficiency projects. They offer performance contracts that tie the compensation of the ESCO to the energy savings generated by the project. [Move to next question if not ESCO].

Would you say that there is an advantage to being an ESCO as compared to other service contractors?

Program Financial Assistance and Incentives

8 Are the amounts for financial assistance and incentives large enough? If no, what amounts would be more adequate? What are the economic thresholds? Can you make a business case for energy efficiency and alternative energy measures without financial assistance and incentives? If yes, would you bother pursuing the incentives from the MPP for the client?

Information, Knowledge, and Communication amongst Stakeholders

9 What communication strategy is used to raise awareness about 1) the importance of energy efficiency and alternative energy measures/initiatives, 2) the program, 3) the available services and tools? How has the strategy worked for you?

10 In terms of deciding on energy efficiency measures/initiatives, your role compared with the client, what is your role? What is the process? How are decisions made?

11 What feedback mechanisms are being used to learn from the stakeholders? Successful projects? Failed projects?

Program Challenges/Barriers

12 a In your experience with the program, what are the biggest challenges/barriers in energy efficiency and alternative energy uptake in existing and new residential high-rises? Top five?
b How do you think the challenges/barriers could be addressed?

13 a Are there any other issues or experiences, that I have not raised, that you want to share with me regarding the NYSERDA Multifamily Performance Program?
b Would you be able to provide a summary of a few of your projects or case studies?

**New York Energy $mart Mutlifamily Performance Program: Developers (Respondents 2d)**

Interview Questions

Motives for Program Participation

1 a How did you learn about the program?
b Are you aware of any other programs? If yes, what others? How did you hear about the others? Which ones are you participating in and why?
c Why this program? What is your primary motivation for participation in the program?

Program Strengths

2 What have been the strengths or advantages in working with the program? Would you have addressed energy efficiency and/or alternative energy measures/initiatives without the program?

Program Regulations and Standards

3 In your experience, are the performance standards reasonable? Why or why not?

4 Does the program provide you with any education and tools to assist in achieving the goals of the program? If yes, what kinds of education and tools do they provide you? If no, where do you get the education and tools?

Building Technology, Products, & Services

5 a In your experience, what are the technology, products, and services that provide the greatest value to your projects? Are there enough? Are there other technology, products, and services that are not available that you think would be valuable and useful?
b Are the technology, products, and services recommended through the program? If not, do you think they should be?
c What problems, if any, have you encountered in acquiring energy efficient or alternative energy technology, products and services for new high-rise construction projects?

6 a The program promotes whole building analysis with energy modelling, what measures/initiatives provide the largest energy savings impacts for new construction of high-rises?
b Are you implementing all the recommended measures/initiatives? If not, how do you prioritize or choose the
c What occurs when you are not able to meet the time limitations to complete your project?

Information, Knowledge, and Communication amongst Stakeholders

7 a Has the program introduced you to other energy efficiency and alternative energy programs? If yes, how are you assisted to maximize the financial benefits from other programs?
b What were the key issues in qualifying for the program from the beginning to the end of a project? Recommendations for improvement?

8 What communication strategy is used to raise awareness about 1) the importance of energy efficiency and alternative energy measures/initiatives, 2) the program, 3) the available services and tools? How has the strategy worked for you?

9 a In terms of deciding on energy efficiency measures/initiatives, your role compared with the partner (service contractor), what is your role? What is the process? How are decisions made?
b What led to your final choice in energy efficiency and/or alternative energy measures/initiatives for your project?

10 What feedback mechanisms are being used to learn from successful projects? Failed projects? Follow-up and monitoring on your project? Would case studies be useful in making decisions regarding energy efficiency investments?

Program Challenges/Barriers

11 a In your experience, what are the biggest challenges with either qualifying for the program or getting energy efficiency measures implemented in multifamily high-rise residences?
b How do you think the challenges/barriers could be addressed?

12 a Are there any other issues or experiences, that I have not raised, that you want to share with me regarding the NYSERDA Multifamily Performance Program?
b Would you be able to provide a summary of a few of your projects/case studies done through the MPP?

**New York Energy $mart Mutlifamily Performance Program: Building Owners/Managers, Condo boards, Co-operatives (Respondents 2e)**

Interview Questions

Motives for Program Participation

1 a How long have you been the building owner\building manager\condominium board member\co-operative member of one or more high-rises (5 or more storeys)?
b How did you learn about the program?
c Are you aware of any other programs? If yes, what others? How did you hear about the others? Which ones are you participating in and why?
d Why this program? What is your primary motivation for participation in the program?

Program Strengths

2 What have been the strengths or advantages in working with the program? Would you have addressed energy efficiency and/or alternative energy measures/initiatives without the program?

Building Technology, Products, & Services

3 a What technology, products, and services that are provided to you, are most valuable and useful to you? Are there enough? Are there other technology, products, and services that are not available that you think would be valuable and useful?
b Are the technology, products, and services recommended through the program? If not, do you think they should be?
c What problems, if any, have you encountered in acquiring energy efficient or alternative energy technology, products and services? Is it different for new construction versus retrofitting existing high-rises? If so, how?

4 a The program promotes whole building analysis with energy modelling, what measures/initiatives provide the largest energy savings impacts for retrofitting existing high-rises?
b Are you implementing all the recommended measures/initiatives? If not, how do you prioritize or choose the measures/initiatives to implement?
c What occurs when you are not able to meet the time limitations to complete your project?

5 a Has the program introduced you to other energy efficiency and alternative energy programs? If yes, how are you assisted to maximize the financial benefits from other programs?
b What were the key issues in qualifying for the program from the beginning to the end of a project? Recommendations for improvement?

Information, Knowledge, and Communication amongst Stakeholders

6 a If condo or cooperative high-rise.

What was involved in raising the capital amongst all owners for energy efficiency or alternative energy measures/initiatives? Have you considered partnering with other buildings? Why or why not?
b If rental or affordable housing high-rise.

What role in the program, if any, do renters have? Have you considered partnering with other buildings? Why or why not?

7 What communication strategy is used to raise awareness about 1) the importance of energy efficiency and alternative energy measures/initiatives, 2) the program, 3) the available services and tools? How has the strategy worked for you?

8 a In terms of deciding on energy efficiency measures/initiatives, your role compared with the service contractor, what is your role? What is the process? How are decisions made?
b What led to your final choice in energy efficiency and/or alternative energy measures/initiatives for your project?

9 What feedback mechanisms are being used to learn from successful projects? Failed projects? Follow-up and monitoring on your project? Would case studies be useful in making decisions regarding energy efficiency investments?

Program Challenges/Barriers

10 a In your experience, what are the biggest challenges with either qualifying for the program or getting energy efficiency measures implemented in multifamily high-rise residences?
b How do you think the challenges/barriers could be addressed?

11 a Are there any other issues or experiences, that I have not raised, that you want to share with me regarding the NYSERDA Multifamily Performance Program?
b Would you be able to provide a summary of a few of your completed projects and post a notice in a couple of your high-rise projects, that participated in the program, in order for me to obtain phone interviews from the occupants?

**Alberta Context - Potential Program Administrators: Government, Utilities, Non-profits (Respondents 3a)**

Interview Question

Company's Role in Energy Efficiency in the Residential Sector

1 What is the role of (Climate Change Central, CO2RE, City of Calgary, etc.) in promoting energy efficiency/conservation in the residential sector?

Experience with Residential Energy Efficiency Programs

2 Given your experience with energy efficiency and alternative energy programs in residential buildings and given the different climatic conditions within Canada.

Why hasn't there been a program established specifically for high-rise (5 or more stories) multi-unit residential buildings in Alberta cities? Do you think there is a need? If no, why not?

3 a What would be the possible funding sources for energy efficiency and alternative energy programs for residential high-rises in Alberta cities (Calgary and Edmonton)?

b Who would need to be involved in program development?

c What existing partnerships could benefit a new program?

d What new partnerships would be needed to set-up a program?

Challenges with Energy Efficiency Programs

4 In your opinion, what challenges would need to be addressed in order to introduce an energy efficiency and alternative energy program for residential high-rises in Alberta Cities (Calgary and Edmonton)?

Standards for Energy Efficiency Programs

5 Other energy efficiency programs are setting performance targets for new residential high-rises (5 or more storeys) at 25% better than the Model National Energy Code for Buildings (MNECB) or 20% better than ASHRAE 90.1-2004. For existing buildings 15% or 20% better than prior building performance.

How reasonable would it be to adopt these standards in Alberta cities (Calgary and Edmonton)? What would be required?

6 Other energy efficiency programs are using Energy Star standards for appliance, equipment, and lighting.

How reasonable would it be to adopt these standards in Alberta cities (Calgary and Edmonton)? Is there an issue with supply? If yes, how do you think we could address the supply issue?

7 Who would need to be involved in setting the standards? Building performance versus appliance, equipment, and lighting standards?

Energy Efficiency Workforce

8 Can you comment on whether you think that the city or province has a sufficient number of qualified energy efficiency experts/energy services providers to participate in an energy efficiency and alternative energy program for residential high-rises? If not, what would need to be done?

9 Are there any other issues or experiences, that I have not raised, that you think could be important in designing an energy efficiency and alternative energy program for new and existing residential high-rises?

## Appendix II: Precedent Program Issues (Risks and Barriers), Interventions, Outputs, and Outcomes

### Toronto Atmospheric Fund TowerWise Program

**INFORMATION, KNOWLEDGE, & COMMUNICATION**

| Program Module | | Intervention | Issues Addressed | Outputs | Expected Outcomes | Results Y/N |
|---|---|---|---|---|---|---|
| Industry & End user Communication, Learning & Awareness | a | Create website: information, resources, tools, & services (independent & trusted resource) | Lack of understanding energy reduction measures; poor operation/maintenance -inefficient energy use | No. hits on website, time on website, No. of attendees to seminars or events | Increased knowledge of ERMs; improved operation & maintenance practices by building owners | N<br>No information |
| Industry Communication, Learning & Awareness | b | Work & consult w/ industry & create TEEAC to address issues & advance energy efficiency | Stakeholder needs; regulatory barriers, developers don't want to pay for EE (split-incentive), lack of financing options; no guarantee of savings | TEEAC 40+ stakeholder group meet quarterly; other industry meetings/ partnerships; no. of seminars | Create conservation incentives advisor position; Toronto property standards changed: motion sensor lighting; private executed Green Condo & STEP loans, insurance product; | Y/N<br>TAF still working on insurance product; lending industry still not mature |
| End user Communication, Learning & Awareness | c | Industry lead seminars or events | Lack of understanding energy reduction measures (ERMs) | ⇑ in attendees; Feedback from seminars or events | Increased knowledge of ERMs | N<br>No information |
| | d | Demonstrate & prove ERMs work with case studies and proper information | Lack of understanding ERMs; perceived risk & no guarantee of savings | No. Case Studies: 5 BBP/TowerWise, 2 BBP, 5 Enbridge, 1 TowerWise video | Building owner confidence & ⇑ implementation of ERMs | N<br>No information |
| | e | Have a one-window service: assistance from an independent conservation incentives advisor | Low participation in Toronto programs; arduous unclear program rules; building owner inertia | ⇑ no. hits & time on website; ⇑ advisor calls | ⇑ no. applications | Y |
| | f | Introduce training for condo directors | Condo owners w/ low interest or capability to pursue ERMs | No. training courses taken by condo directors | Knowledgeable condo champions implementing ERMs | N<br>No information |

Notes. TowerWise Energy Education Action Committee (TEEAC); Energy Efficiency (EE); Energy Reduction Measures (ERMs); Better Buildings Partnership (BBP); Model National Energy Code for Buildings (MNECB).

## CAPITAL COSTS, OPERATION & MAINTENANCE

| Program Module | Intervention | Issues Addressed | Outputs | Expected Outcomes | Results Y/N |
|---|---|---|---|---|---|
| Industry & End user Financial Assistance/ Incentives | a Administer Green Condo loans (proving the financial model to unlock private funding) | No developer expense; no access to capital & immature financial lenders; Uncertain long term energy savings | Five Green Condo loans valued at $3.2MM transacted between 2004 to 2009 | No defaulted loans & loans paid back by energy savings; ⇑ uptake of loans by private sector | N<br>No information |
| End user Financial Assistance/ Incentives | b Administer STEP loan (proving the financial models to unlock private funding) | No access to capital & lack of maturity in financial lending; Uncertain long-term energy savings | No STEP loans transacted; loan under development | No defaulted loans & loans paid back by energy savings; ⇑ uptake of loans by private sector | N<br>No information |

## BUILDING CONVENTION

| | | | | | |
|---|---|---|---|---|---|
| Building Technology & Integrated Design Performance | a Set appropriate standards (consult experts to assist, promote comprehensive retrofits) | Uncertain long-term energy savings; encouraging deep v.s. shallow savings; responsibility division | Developed required program standards: 25%>MNECB new; 15%>Prior performance retrofits | Complete new buildings at 25%>MNECB & retrofits at 15%>Prior performance | N<br>No information |
| Products & Services | b Draw attention to proven & tested product & technologies | Unreliable/poor energy performing products & technologies | Increase number of products/technologies installed | Reliable performing products/technologies; long-term savings | N<br>No information |

## MONITORING & COMPLIANCE

| | | | | | |
|---|---|---|---|---|---|
| Evaluation | a Conduct annual meetings & prepare reports | Accountability & program effectiveness | Annual reports, board minutes, financial statements/budgets | Meeting TAF board of director expectations | Y/N<br>Need tool for benchmarking |
| Quality Control/ Assurance | b Obtain independent verification NRCan and City of Toronto experts | Quality of work; Uncertain long-term energy savings | No. of verified energy models | Meeting or exceeding projected energy savings | N<br>No information |
| ⇓ | c Future deployment of independent auditor to work w/ incentives advisor | Quality of work; Uncertain long-term energy savings | No. of verified retrofit energy audits | Meeting or exceeding projected energy savings | N<br>On TAF wish list |

## New York Energy $mart[SM] Multifamily Performance Program

### INFORMATION, KNOWLEDGE, & COMMUNICATION

| Program Module | | Intervention | Issues Addressed | Outputs | Expected Outcomes | Results Y/N |
|---|---|---|---|---|---|---|
| Industry & End-user Communication, Learning & Awareness | a | Create interactive website: information, resources, tools, & services | Lack of understanding ERMs & program; poor building operation & maintenance; lack of knowledgeable ESPs | No. hits on website, No. 3rd party training courses taken; No. inquires & program participants | Increased knowledge of ERMs & program process; improved industry practices by building owners & ESPs | N<br>No information |
| Industry Communication, Learning & Awareness | b | NYSERDA & partner marketing (more focus on partner marketing) | Low program participation & uptake of ERMs | 1st 10 months 383 approved applications; 75% of new projects from partner efforts | More buildings in the program completing projects & implementing ERMs | N<br>Program disruption 2009 |
| | c | Conduct partner meetings & conferences | Resolve partner issues w/ program process or ERMs; need for program evaluation & feedback | Partner webinars, monthly teleconferences (technical tips), & annual meetings | Partners satisfied w/ communication efforts (issues resolved); program process improvements | Y<br>Process evaluation results |
| | d | Create a partner portal & CRIS | Know when to act (i.e., approvals; incentive payout; inspections); project record keeping | CRIS database & web portal access to partners, NYSERDA, program implementer | Real-time tracking of projects & their status | Y/N<br>need for building owner portal/forum |
| | e | Work with financial lenders | Lack of maturity in financial lending & no access to capital | No. financial lenders working with NYSERDA on energy reduction projects | No. transacted loans with financial lenders on energy reduction projects; private lending w/o program | Y/N |
| End-user Communication, Learning & Awareness | f | Offer building owner training (3rd party) | Poor operation & maintenance | No. of building owners trained | Improved building owner operation & maintenance & long-term energy savings | N |

Notes. Energy Efficiency (EE); Energy service providers (ESPs); Energy conservation measures (ERMs); Comprehensive Residential Information System (CRIS).

| Program Module | Intervention | Issues Addressed | Outputs | Expected Outcomes | Results Y/N |
|---|---|---|---|---|---|
| **INFORMATION, KNOWLEDGE, & COMMUNICATION** | | | | | |
| | g Create one-stop-shop for information & services | Too many different programs confusing & too much work for partners & building owners | Combine legacy programs; link to other state programs increased demand | Many partners indicate MPP is easier to work with; no shifting around (process eval. report) | Y |
| End-user Communication, Learning & Awareness | h Demonstrate & prove ERMs work with case studies and project reviews | Lack of understanding ERMs & the benefits; perceived risk; what works & what doesn't? | No. Case Studies: one online; others on partner websites | Proceeding w/ ERMs w/ or w/o program; building owners realize energy & non-energy benefits | Y/N (few cases due to slow project execution & required approvals) |
| | i Target efforts: low-med. Income & older buildings | Differences in ownership structure (condos are challenge to market for ERMs); older high energy consuming buildings | In 2008, 66% applications affordable; new builds 80+% affordable housing | Achieved July 1, 2006 through June 30, 2010 ~$17MM low-income tenant energy savings per year | Y |
| **CAPITAL COSTS, OPERATION & MAINTENANCE** | | | | | |
| Industry Financial Assistance/ Incentives | a Offer partner training & certification incentives (75% re-imbursement) | Quality energy services | No. of incentives paid out, no. of training courses, no. of certifications | Expanded available no. of partners from 5 to 45 | Y |
| | b Offer 25% co-operative advertising costs (new & existing building components of program) | Low participation in program | Amount of money spent on co-operative advertising costs | Building owners motivated to retain partners to participate in program & do more ERMs | N No information |

Notes. Energy efficiency (EE); with (w/); without (w/o); System Benefit Charge (SBC); SBC III is a funding plan period by New York State (NYS) Public Service Commission (PSC).

| Program Module | Intervention | Issues Addressed | Outputs | Expected Outcomes | Results Y/N |
|---|---|---|---|---|---|
| **CAPITAL COSTS, OPERATION & MAINTENANCE** | | | | | |
| End-user Financial Assistance/ Incentives | c Offer staged incentives (new & existing building components of program) | No access to capital; high upfront cost for ERMs; incent building owners to move ahead w/ ERMs | Incentives avg. ~25% of total project costs; ~105,000 existing & ~3200 new units receiving EE services | Building owners motivated to complete project & do more ERMs; incentives low for small buildings | Y |
| | d Offer NYE$ Loan Fund: Buy-down loans for new & existing buildings | Lack of maturity in financial lending & no access to capital | No. buy down loans for program participants (new & existing) | Building owners motivated to do more ERMs; ⇑ uptake of loans by private sector | Y/N Small building loans not attractive |
| | e Offer building owner training incentives | Poor building operations & maintenance; Uncertain long-term energy savings | Training offered in certain locations in the state; No. building owners trained | Improved building owner operation & maintenance & long-term energy savings | N No information |
| **BUILDING CONVENTION** | | | | | |
| Building Technology & Integrated Design Performance | a Set appropriate standards (whole building approach)-work w/ EPA & use previous program experience | Uncertain long-term energy savings; encouraging deep v.s. shallow savings; responsibility division | No. energy reduction plans; no. new & existing buildings constructed or retrofitted to standards | NYS has most Energy Star high-rises (new builds); avg. ~20% energy savings per project (existing builds) | Y |
| | b Create partner network | Inadequate number of knowledgeable building specialists in market to meet increasing demand | No. partners recruited & approved for NYE$ MPP; expanded from 5 to 45. | Infrastructure of knowledgeable building specialists to provide necessary services for building owners | Y/N Qualifications lower than expected - ⇑ QC/QA (arduous program-slow projects & ⇑ costs) |

Notes. US Environmental Protection Agency (EPA); Quality Control/Quality Assurance (QC/QA).

| Program Module | Intervention | Issues Addressed | Outputs | Expected Outcomes | Results Y/N |
|---|---|---|---|---|---|
| **BUILDING CONVENTION** | | | | | |
| Products & Services | c Promote Energy Star | Unreliable & poor energy performing products/technologies | Increase number of Energy Star products/technologies installed | Reliable performing products/technologies; long-term energy savings | N (some products not performing well) |
| Construction/ Retrofits | d Conduct building inspections | Poor construction practices & improper installation | No. of building inspections | Quality work in buildings–real energy savings & program compliance | Y/N (completed projects evaluations underway) |
| **MONITORING & COMPLIANCE** | | | | | |
| Quality Control/ Assurance (QC/QA) | a Employing quality control & assurance contractors for new construction & retrofit projects | Ensure partners meeting program criteria & whole quality control process is working effectively | No. approved energy reduction plans; QA evaluations of QC policies & procedures | Quality work by partners/contractors; compliance; obtain real long-term energy savings; program changes | N No information |
| Evaluation & Research | b Conduct impact, process, and market evaluations | Program cost-effectiveness; verify anticipated energy savings; what works & what doesn't & why; program improvements; understanding market environment | Program logic model; Program evaluation & status reports (quarterly & annual); 2 process evaluations (Jun 2007/Apr 2008); NYSERDA internal examination report | Verified average ~20% savings on existing buildings; identified re-bound, behaviour effects, unanticipated loads, over-estimation of energy savings, poor product performance; ~$22MM energy savings/yr (~864,000 MMBtu, 76 GWh) | Y/N NYSERDA revising operating plans because of PSC order; baseline studies for new & existing buildings components |

Notes: 'rebound' or 'takeback' effect is an increase in demand for energy services because improving energy efficiency lowers the cost of energy making it more affordable for more energy services (Herring, 2006; International Energy Agency [IEA], 2005; Khazzoom, 1980).

## Appendix III: NYE$ MPP Incentives

| NEW CONSTRUCTION | Affordable Housing | Market-Rate Housing |
|---|---|---|
| **Payment #1** | | |
| ASHRAE Approach | $20,000 | $15,000 |
| HERS Approach | $10,000 | $7,500 |
| *Payable upon receipt of the signed contract between the Developer and the Partner, approval of a draft proposed Energy Reduction Plan, and evidence that the Developer has paid at least 75% of the design team's fees. | | |
| **Payment #2** | $1.50/ghsf** | $1.00/ghsf** |
| *Payable upon approval of the final proposed Energy Reduction Plan that indicates achievement of a performance target of at least 20% by the proposed design. | | |
| **Payment #3** For final Performance Targets within the following ranges:<br>20-22%: $0.50/ghsf** minus 10% retainage<br>23-25%: $0.75/ghsf** minus 10% retainage<br>26% or higher: $1.00/ghsf** minus 10% retainage | | |
| *Payable upon approval of the final Energy Reduction Plan confirming a performance target of at least 20%. | | |
| **Payment #4** 10% retainage held from Payment #3 | | |
| *Payable upon receipt of the fuel release forms as detailed in the Participation Agreement. | | |

Notes. *Incentives are payable to the owner upon NYSERDA approval of the request made by the Partner.
**ghsf = gross heated square footage of residential space based on the Energy Reduction Plan or as revised in the final proposed Energy Reduction Plan.

Source: adapted from NYSERDA (2009g).

| EXISTING BUILDINGS | Affordable Housing | Market-Rate Housing |
|---|---|---|
| **Payment #1** | | |
| Base Incentive (for projects up to 30 units) | $5,000/project | $2,500/project |
| Base Incentive (for projects from 31 units to 100 units) | $10,000/project | $5,000/project |
| Incremental Incentive | $20/unit over 100 units | $10/unit over 100 units |
| *Incentive payable upon receipt of signed contract between the Participant and Partner, and approval of a draft proposed Energy Reduction Plan, which must include documentation that the building has been benchmarked using the NYSERDA Benchmarking Tool. | | |
| **Payment #2** | $800/unit | $300/unit |
| *Incentive payable at 50% construction completion, based upon a successful interim inspection. | | |
| **Payment #3** | $400/unit | $300/unit |
| *Incentive payable at completion of construction, based upon a successful post-construction inspection and performance test(s) as applicable. | | |

**Payment #4**

| Initial Benchmark Score | Performance Target | Per Unit | Per Unit |
|---|---|---|---|
| 0-25 | 20% | $400 | $200 |
| 26-50 | 20% | $375 | $175 |
| 51-75 | 20% | $350 | $150 |
| 76-100 | 20% | $325 | $125 |
| For every 1% above the Performance Target | | $40 | $20 |

All benchmarking scores will be calculated using the NYSERDA Benchmarking Tool. Incentive payable only if the project achieves the Performance Target as specified above for the building's initial benchmark score. Proof of energy savings will be determined by analyzing actual post-construction consumption data for the project using the Benchmarking Tool. Such determination must be made no sooner than one year, nor later than 18 months, following completion of the Energy Reduction Plan.

Note. *Incentives are payable to the owner upon NYSERDA approval of the request made by the Partner.
Source: adapted from NYSERDA (2009h).

| ADVANCED MEASURE INCENTIVES | Affordable Housing | Market-Rate Housing |
|---|---|---|
| **ADVANCED METERING EQUIPMENT** | | |
| Residential Education and Regulatory Assistance | $3,500/project | $2,000/project |
| Advanced Submeter Installation | $200/unit | $150/unit |
| Advanced Master Meter Installation | $2,000/meter | $1,500/meter |
| Resident Education and Regulatory Assistance incentive is payable upon receipt of NY Public Service Commission (PSC) approval letter for submeter installation and invoice for regulatory assistance and training services, including breakdown of number of training sessions and attendance. If training sessions are conducted by in-house staff, submit labour and materials cost along with training session details (# of sessions and attendance). Incentive will not exceed 100% of cost for services. Advanced Submeter and Master Meter incentives are payable upon receipt of metering contractor invoice for advanced meter installation. Advanced metering system must be functional and may be subject to inspection. See Submetering Guidelines for specifications of a qualified advanced submetering system. Incentives will not exceed 50% of the total metering installation cost. | | |
| **COMBINED HEAT AND POWER (CHP) SYSTEMS** | | |
| CHP System Installation | $1,000/kW | $750/kW |
| CHP System incentive is payable per the terms and conditions of NYSERDA's CHP Systems Manual. | | |
| **BUILDING OPERATOR TRAINING AND CERTIFICATION** | | |
| Building Operator Training & Certification | $1,500/attendee | $1,000/attendee |
| Training & Certification incentive is payable upon receipt of training completion certificate for each attendee, including training dates, location, and instructor name. Incentive will not exceed 75% of the costs for Affordable Housing projects and 50% of the costs for Market Rate projects. | | |
| **PHOTOVOLTAIC (PV) SYSTEMS** | | |
| PV System up to 40kW | $3.00/Watt | |
| Building Integrated PV System up to 40kW | $3.50/Watt | |
| PV System between 41 – 80kW | $2.00/Watt over 41 kW | |
| Building Integrated PV System between 41 – 80kW | $2.50/Watt over 25 kW | |
| PV System incentives will be payable per the terms and conditions of NYSERDA's New York Energy $mart Photovoltaic (PV) Incentive Program (80 kW and smaller) and are subject to change. | | |
| **OWNER'S MANUAL** | | |
| Owner's Manual | $500/manual | |
| Owner's Manual and Building Operator Training | $1,000/manual | $750/manual |
| Owner's Manual incentive is payable upon receipt of a CD containing, in electronic form, the complete contents of the Owner's Manual. See Section 3 for a listing of items required to be in an Owner's Manual. | | |

Source: adapted from NYSERDA (2009c).