A Toolkit for Affordability Driven Home Energy Efficiency Retrofits Through Local Improvement Charge Programs

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Literature Review

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A Review of LIC and PACE Programs in Canada

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Table of Contents

Executive Summary

Municipalities are becoming leaders in developing ambitious climate mitigation plans in response to rising concerns over climate change and its adverse impacts on the environment and people across Canada. As buildings are one of the most significant sources of greenhouse gas (GHG) emissions and a primary climate change driver, municipalities have been prompted to develop policies and programs to help people make retrofit upgrades, improve building conditions, and reduce greenhouse gas emissions.

Energy efficiency programs and financial incentives can be effective mechanisms for municipalities to promote building retrofits and reduce GHG emissions within their jurisdiction. Local Improvement Charges (LICs) and Property Assessed Clean Energy (PACE) are temporary low-interest loans offered by municipalities or non-profit organizations to provide financing for property owners to conduct retrofit projects. These loans are added to a property tax bill and repaid by homeowners through their property tax bill. Their status as a special charge on the tax role means LICs and PACE assessments remain with the property when sold rather than with the former owner. In Canada, six provinces and one territory in Canada (Alberta, British Columbia, Nova Scotia, Ontario, Prince Edward Island (PEI), Saskatchewan, and the Yukon) have implemented LIC and PACE financing for building retrofits and/or renewable energy installation.

However, implementing energy efficiency programs and delivering financial incentives face potential challenges and barriers. These challenges and barriers can affect program success and effectiveness. Participant challenges, program financing, stakeholder diversity, marketing and customer outreach, trained contractor shortage, and lack of strong leadership have been identified in the literature as potential challenges affecting programs and limiting participation. In contrast, greater financial support, social and demographic variables (i.e., increased income and education), simplified administrative process through assistance from other organizations (e.g., community groups), and effective marketing strategies have been recognized as potential factors apt to motivate public participation.

Considering the lessons learned from the literature review, this report makes recommendations on the following four areas:

Table 1 - Key Recommendations

Main Areas	Key recommendations
Program design	1. Considering major stakeholders' perspectives to minimize associated risks and difficulties between stakeholders. 2. Considering households' socio-demographic conditions, such as income, age, education, and language, in designing different components of a program. 3. Improving household motivator variables and reducing barriers to participation. 4. Collaborating with local housing rehabilitation organizations to address minor homes' safety issues. 5. Including a wide range of energy efficiency measures and renewable technologies in programs. 6. Evaluating programs' positive and negative short term and long term impacts on participants.
Policies and regulations	1. Changing policies that can implement barriers to participation, like property owner contribution and mortgage lender approval. 2. Improving awareness of energy conservation, ways to lower utility costs, and a basic understanding of renewable energy technologies among households, particularly low-income households. 3. Considering the impacts of social and health factors on program participation and developing programs that address environmental, social, and health concerns. 4. Developing appropriate incentive levels for residential building owners. 5. Promoting policies and regulations that encourage property owners, building managers, and residents of multi-unit residential buildings.
Administrative process	1. Streamlining administrative processes and requirements. 2. Considering non-energy or co-benefits of programs rather than energy-saving levels for programs targeting low-income households. 3. Using utility billing histories as a proxy for creditworthiness in programs targeting low and middle-income families.
Marketing	1. Targeting specific demographic groups and speaking directly to their needs. 2. Explain the purpose and benefits of energy efficiency programs in a simple manner. 3. Highlighting key messages, such as potential money saving, thermal comfort improvement, and indoor air quality and health conditions improvements. 4. Providing a simple and clear explanation about program funds sources, the program's structure and repayments, and any hidden charges associated with administration fees. 5. Using multiple marketing channels to reach out to potential participants

Introduction

Residential buildings are a significant source of greenhouse gas (GHG) emissions; finding ways to improve the energy efficiency of Canada's existing housing stock is thus crucial for climate change mitigation. Historically, this goal has been difficult to achieve since it requires homeowners to invest in often expensive and time-consuming energy efficiency improvements of their homes. Municipalities can play a critical role in addressing GHG emissions in their jurisdictions by creating innovative and equitable programs that help homeowners to overcome these barriers.

Energy efficiency programs and financial incentives such as Local Improvement Charge (LIC) financing, also known as Property Assessed Clean Energy (PACE) financing, are tools that allow municipalities to address affordability issues and promote energy efficiency and GHG emission reductions in residential homes. However, several factors are preventing widespread participation in these programs, reducing their effectiveness.

This report examines the features, design, and implementation of LIC/PACE financing in Canada. It explores the challenges confronting several energy efficiency programs and financial incentives and successful strategies to overcome these challenges. The report concludes with a series of recommendations for future programs.

Background

This study was conducted as part of a project to develop "A Toolkit for Affordability Driven Home Energy Efficiency Retrofits Through Local Improvement Charge Programs," which received funding from the Canada Mortgage and Housing Corporation (CMHC) under the National Housing Strategy Demonstrations Initiative. This project draws upon Toronto's experience with affordable renovations and LIC-based energy efficiency loans to demonstrate and develop packaged energy efficiency, health, and safety measures. Volta Research led it in collaboration with Royal Roads University, among other project partners. Accordingly, this report aims to identify the challenges municipalities and energy efficiency program administrators face in delivering residential energy efficiency retrofit programs and financial incentives such as LIC/PACE programs. It also identifies factors that might dissuade homeowners from participating in these programs and suggests best practices for future programs.

Study Methodology

To understand LIC/PACE programs and outreach approaches, the authors first performed a desktop study to source and reviewed relevant literature published between 1980 and 2022. By using the keywords "energy affordability programs," "energy incentive services," and "energy efficiency policies",128 academic and non-academic publications related to energy efficiency programs and financial incentives in North America were identified.

The literature was then reviewed to identify programs that include:

- Seniors and low-income households,
- LIC and PACE programs supported at the municipal level,

- Energy efficiency policies with a focus on climate change mitigation and affordable housing,
- Utility and federal incentive programs, and
- programs focusing on specific technologies like solar photovoltaics (PV), heat pumps, and home battery storage systems.

Geographic and demographic components of energy efficiency programs and financial incentives were also identified.

Next, reports and articles were shortlisted for further investigation and classified according to four major categories: context, programs, policies, and strategies. To manage and archive this vast information resource, an annotated bibliography of the literature reviewed in this report is also available upon request from the authors.

Overview of Report Sections

Section 1 reviews Canadian climate change mitigation policies with a specific focus on energy efficiency programs targeting/addressing the residential sector. Financial incentives as a key component of energy efficiency programs are also explored and reviewed.

Section 2 includes a review of LIC and PACE programs in Canada, their general features, eligibility criteria, the application process, and program outcomes.

Section 3 identifies the challenges confronting energy efficiency programs, financial incentives, and LIC/PACE programs.

Section 4 identifies the potential factors that may motivate and drive households to participate in energy efficiency programs.

Section 5 explores the lessons learned from existing North American programs and identifies opportunities, strategies, and practices to address barriers for future programs.

Section 6 makes recommendations for decision-makers and other key stakeholders.

SECTION 1. Climate Mitigation Policies in Canada

Residential Sectors and Climate Mitigation Policies

According to Natural Resources Canada (NRCan) (NRCan, 2018), the residential sector accounts for 17% of energy consumption and 12% of greenhouse gas (GHG) emissions within Canada. Heating, ventilation, and air conditioning (HVAC) account for over 60% of energy consumption and 80% of residential GHG emissions (NRCan, 2018). The residential sector is a significant contributor to Canadian energy consumption and GHG emissions, making improving the energy efficiency of Canada's existing housing stock an essential component of climate change policy (Gamtessa, 2013).

Canadian policy on climate change has evolved since the 1988 International Conference on the Changing Atmosphere held in Toronto, when scientists, policymakers, politicians, and environmental specialists called for a 20% reduction in GHG emissions by 2005 (World Meteorological Organization (WMO), 1988). The goal was to enhance energy efficiency by 10% through conservation and 10% by switching to less carbon-intensive fuels (WMO, 1988). On this basis, the City of Toronto became the first municipal government to adopt an emissions reduction target in 1990, setting the 2005 target as 20% below 1988 levels (Harvey, 1993; Kousky & Schneider, 2003; Parker et al., 2005).

In 1998, the Office of Energy Efficiency (OEE) was created by NRCan to create a series of energy efficiency promoting programs (OEE, 1999). One such program was the EnerGuide label developed by NRCan and the Canada Mortgage and Housing Corporation (CMHC) and formally launched by OEE in April 1998 (OEE, 1999; Parker et al., 2005; Parker & Rowlands, 2007; Gamtessa, 2013). The EnerGuide label for a home energy rating was consistent with home energy audits that informed homeowners about their current energy consumption, wastage, and available energy savings options (Gamtessa, 2013). The program was rooted in the crucial observation that residential building energy retrofits might offer substantial potential for energy savings and reduced GHG emissions (Gamtessa, 2013).

A significant step in the evolution of Canadian climate change policy was the Kyoto Protocol, ratified by the government to the United Nations Framework Convention on Climate Change (UNFCCC) on December 17, 2002. It acknowledged that Canadian scientists, policymakers, and the public recognized the threat of climate change to both ecological and economic systems (UNFCCC, 2004). Based on this ratification, Canada pledged to reduce GHG emissions by 6% by 2012 (UNFCCC, 2004). This action prompted more than 100 Canadian municipalities to join the International Council for Local Environmental Initiatives' (ICLEI) Cities for Climate Protection campaign through the Federation of Canadian Municipalities (FCM) Partners for Climate Protection (ICLEI, 2004; FCM, 2004). The cities agreed to initiate a five-milestone framework to review, document, and implement the GHG emissions reduction plan from their operations and wider communities. Actions taken at the local level play a key role in pursuing national sustainable development goals (Kousky & Schneider, 2003; Parker et al., 2005), revealing the central importance of cities in climate change mitigation.

Following the 2015 Paris Agreement and the 2016 Pan-Canadian Framework, federal, provincial, and local governments in Canada have designed various climate mitigation policies

to accelerate energy efficiency and renewable energy investment to limit global temperature increases to 1.5°C above pre-industrialized levels (Perera et al., 2018). These include incentive programs like Local Improvement Charge (LIC) and Property Assessed Clean Energy (PACE) financing that support energy efficiency retrofitting, upgrading rooftop solar photovoltaics (PV), and home battery storage systems. The following section discusses these types of energy efficiency programs.

Energy Efficiency Programs

Energy efficiency programs are essential components of climate mitigation policy to promote reduced energy consumption and GHG emissions, supporting sustainable development and addressing energy poverty (Cluett & Amann, 2016). Several factors should be considered in the design of energy efficiency programs, including the target and intention of the program, the type of household served, and household characteristics (Cluett & Amann, 2016; Drehobl & Castro-Alvarez, 2017). While some energy efficiency programs, like Bill Payment Assistance programs, are designed to help low-income households pay their utility bills, others provide financial incentives for homeowners to make physical improvements to their homes to reduce energy consumption and GHG emissions (Cluett & Amann, 2016; Das et al., 2022).

The term ‘financial incentives’ refers to energy efficiency financing programs and financial instruments that are a significant part of energy-related programs and are key in promoting sustainable development and carbon mitigation practices (Rana et al., 2021). Financial incentives in Canada can generally be divided into four categories - loans, taxes, grants, and rebates, and can be offered through federal, provincial, and local governments (Rana et al., 2021).

Loan Incentives: loan incentives are a common financial incentive offered by governmental organizations and commercial banks (Curtin et al., 2017). The amount of the loan, the interest rate, and the payback period vary depending on economic conditions and from one loan incentive program to another (Curtin et al., 2017). These kinds of loans are offered by CMHC, banks, utility companies (e.g., Heat Pump Loan offered by Fortis BC), and municipalities (CMHC, 2017; RBC Energy Saver Loan, 2018; FortisBC, 2018).

Tax Incentives: tax incentives are one of the most popular financial instruments in promoting green buildings (Adamaley et al., 2016). These incentives often take the form of tax exemptions to promote, for example, green building construction. For example, British Columbia has a 100% tax exemption for housing providers for energy upgrades that result in a Gold or Platinum Leadership in Energy and Environmental Design (LEED) certified design (Ministry of Community Services Government of BC, 2008). Tax incentives can also be used as disincentives to discourage unsustainable practices (Adamaley et al., 2016). Carbon taxation is one of the most common disincentives that successfully mitigate carbon emissions (Rivers, 2015; Vera & Sauma, 2015).

Grant Incentives: Grants are another financial instrument for improving the adoption of green buildings at an individual and community level (Curtin et al., 2017). These incentives are applied to a certain percentage of per capita costs. Due to the large amount of capital needed for grant

incentives, they are most suitable as a part of regulatory incentives at the provincial or national level (Bond & Devine, 2016).

Rebates: Rebates are financial gains received by building owners or developers, usually when the energy improvement is implemented in the building. Globally, the deployment of rebates has successfully achieved high energy savings. In Canada, rebates offered by utility programs exceed available loans and grant incentives for buildings (Lee & Yik, 2002; Rana et al., 2021).

Financial Incentives in Canadian Regulatory Regimes

Environmental responsibilities and climate mitigation policies span different levels of government in Canada. The federal government of Canada can sign and ratify international environmental and climate change conventions, including environmental standards and impact assessment procedures (Parker & Rowlands, 2007). Authority over natural resources, energy consumption, and GHG emissions reductions are also subject to decisions by the federal government (Parker & Rowlands, 2007). Provincial governments have constitutional authority over natural resources as well as local matters. Although there is often overlap between the federal and provincial governments over environmental responsibilities, provincial governments can implement different standards and regulations than the federal government to promote and achieve their provincial targets regarding energy efficiency and GHG emissions reduction (Parker & Rowlands, 2007). Municipal governments can directly affect transportation, land use, and housing regulations and standards. Approving building plans and ensuring their compliance with the building code and policies are subject to decisions by municipalities. For example, municipalities in Waterloo Region introduced water efficiency measures that exceeded the provincial standards to achieve their water conservation goals (Parker et al., 2005). All three levels of government thus have the authority to make decisions related to energy consumption and emissions reductions; that said, due to complex multilevel governance relationships, leadership does not necessarily flow from the national level (Parker & Rowlands, 2007).

Energy efficiency programs and financial incentives can also be designed and implemented by all three levels of government:

Federal Government: At the federal level, different financial incentives are offered, like grants (e.g., Greener Homes grant); however, most financial incentives for residential buildings are in the form of loans offered by financial institutions (NRCan Grant, 2017). The number of incentives offered depends upon the life stage and the type of green building certification (GB certification is a measure to determine building energy performance) (Rana et al., 2021). Federal incentives cannot, however, be utilized in every region of Canada because of differences in demographics, weather, types of construction, local resources, technologies, and certification procedures (NRCan Grant, 2017).

Provinces: Provincial incentives are commonly offered by provincial governments or utilities as rebates on individual energy upgrades. Alberta, Nova Scotia, and Prince Edward Island offer the most significant financial incentives (Energy Efficiency Alberta, 2018; Efficiency Nova Scotia, 2018; Government of Prince Edward Island, 2018), while British Columbia, Manitoba, and Saskatchewan offer a wider variety of financial incentives (Rana et al., 2021).

Municipalities and Cities: Financial incentives utilized at the municipal level target the energy efficiency of existing housing stock. These incentives are based on local conditions and, consequently, are most effective in generating green buildings, improving energy efficiency, and promoting household retrofit projects (Vergragt & Brown, 2012; Drehobl et al., 2018). In addition to incentive strategies, local governments can use behaviour change strategies in their energy efficiency programs to improve understanding of energy efficiency and increase program participation to achieve long term energy savings (Drehobl et al., 2018). Behavioural change strategies are based on behavioural science approaches to understanding and influencing human decision-making and behaviour that have emerged from the fields of psychology and behavioural economics. Using these strategies independently or combined with energy retrofit can help local governments achieve energy efficiency objectives such as saving energy and reducing GHG emissions (Drehobl et al., 2018).

According to Cipriani et al. (2020), financial mechanisms designed by local governments and municipalities to improve building energy efficiency and reduce GHG emissions within their municipalities also include LIC/PACE incentive programs which are described in the next section and are the programs of focus in this report.

SECTION 2. Review of Canada's LIC/PACE Programs

Definitions

Local Improvement Charges (LICs) are temporary loans that provide financing for property owners to improve their property conditions through retrofit projects to save energy and reduce GHG emissions (Dunsky Energy Consulting, 2013; Cipriani et al., 2020). Traditionally, LICs have been used to finance various projects, including street repaving, installing street lighting, constructing traffic calming measures, and expanding sewage infrastructure (Cipriani et al., 2020). However, LICs have been used to finance building energy efficiency initiatives, renewable energy projects, and water conservation measures for over a decade ago (Dunsky Energy Consulting, 2013; Cipriani et al., 2020).

Recent LIC programs, delivered by municipalities or non-profit organizations, provide homeowners with a loan to carry out retrofit projects on their property (Dunsky Energy Consulting, 2013; Cipriani et al., 2020). These loans are added to a property tax bill and repaid by homeowners through their property tax bill. The programs can operate at minimal cost to the municipalities because they utilize existing systems (Dunsky Energy Consulting, 2013; Cipriani et al., 2020).

LICs may be effective incentive tools available to municipal governments to promote energy efficiency retrofits in buildings since municipalities have fewer legislative and financial constraints than their federal and provincial counterparts (Dunsky Energy Consulting, 2013; Cipriani et al., 2020). However, municipalities need to ensure the relevant existing legislation regulating local governments in their province or territory permits them to use LICs to finance energy efficiency improvements on private property. Otherwise, provinces or territories must modify existing legislation or adopt new enabling legislation (Pembina Institute, 2004; Dunsky Energy Consulting, 2013).

Property Assessed Clean Energy (PACE) programs are like LICs and enable property owners to make their homes and businesses more energy efficient and resilient (Kennedy et al., 2020; AMO, 2021). PACE programs have the potential to unlock private capital for building retrofits, improving energy efficiency, reducing GHGs emissions, and making buildings more resilient (Kennedy et al., 2020; AMO, 2021). Municipalities can, however, only use such mechanisms if provincial legislation has been changed to permit their use (Kennedy et al., 2020). Like LIC programs, PACE loans can be repaid monthly or annually via the property tax bill systems (AMO, 2021).

Types of LIC/PACE Program Administrators

LIC/PACE programs can be launched and delivered through either public or private administrators. In public programs administrated by local government, municipalities finance and administer the programs. This requires the government to invest resources into designing and implementing the program, including marketing, setting eligibility criteria, and managing finances (Leventis et al., 2018). This model was common in early LIC/PACE programs and had the benefit of strong alignment with municipal priorities and lower interest rates because the

financing is often provided through grants or municipal funding envelopes (Leventis et al., 2018). One example of these LIC/PACE programs is those administrated by the City of Toronto (i.e., the Toronto Home Energy Loan Program). However, the administrative requirements for this model make it prohibitive for smaller municipalities and inefficient to roll out on a provincial scale (Leventis et al., 2018).

Further, public programs can be administrated by a third-party provider that partners with local governments to offer services, such as program initiation, marketing, and ongoing administration (Leventis et al., 2018). This model allows multiple local governments to use a single administrator, making it more efficient and allowing smaller municipalities to efficiently deliver LIC/PACE programs (Kennedy et al., 2020). An example of this model is the Clean Foundation's LIC/PACE programs in Nova Scotia.

In private programs with private administration, the private sector offers a one-stop-shop for LIC/PACE programs, including design, set-up, administration, and access to private capital and recapitalization (Kennedy et al., 2020). In this model, local governments are only responsible for enacting enabling bylaws, registering, and adding LIC/PACE assessments to the property tax roll (Leventis et al., 2018). The private sector administrator often serves as an aggregator, bundling several LIC/PACE assessments into securities that institutional investors can purchase, thus re-capitalizing the fund (Leventis et al., 2018). With this model, interest rates are often higher due to administration costs and private financing; however, access to unlimited private capital has allowed the programs to scale, and superior marketing and outreach have led to significantly greater uptake than all other models (Leventis et al., 2018). Berwick Green Energy Program is administrated and delivered through this model.

LIC/PACE Features

The unique feature of LIC and PACE programs is that the loan is connected to the property, not the individuals (Cipriani et al., 2020; Kennedy et al., 2020; AMO, 2021). This ensures that when a home with outstanding loan payments is sold, the new homeowner assumes the responsibility for repaying the loan and receives the benefits of the energy improvements (Cipriani et al., 2020; AMO, 2021).

The process for accessing financing is another key feature of these programs, enabling low to middle-income owners to qualify for loans (Cipriani et al., 2020; Kennedy et al., 2020; AMO, 2021). Other features are long financing terms and low interest rates, allowing participants to repay the loan throughout the useful life of the energy efficiency or renewable energy measures implemented with the loan (Cipriani et al., 2020; Kennedy et al., 2020; AMO, 2021). In Canada, the interest rates for PACE and LIC loans have been between 1% and 5%, a rate that is competitive or lower than those offered by major Canadian banks (Cipriani et al., 2020; Kennedy et al., 2020).

Current LIC/PACE Programs in Canada

To date, in Canada, five provinces and one territory, including Alberta, Nova Scotia, Ontario, Prince Edward Island (PEI), Saskatchewan, and the Yukon, have passed LIC/PACE enabling legislation which allows LIC/PACE financing to be used for building energy efficiency retrofits or

renewable energy installation(Figure 1) (Cipriani et al., 2020; Khanal, 2019; AMO, 2021). While Quebec initiated a LIC/PACE pilot program, it was cancelled in 2019. The program was cancelled due to the existing legislative context not providing sufficiently clear direction on the ability to undertake PACE programs; as such, the non-profit program administrator ceased operation (Cipriani et al., 2020). Though the province does not currently have LIC/PACE legislation in place, British Columbia has implemented two LIC/PACE pilot programs (AMO, 2021).

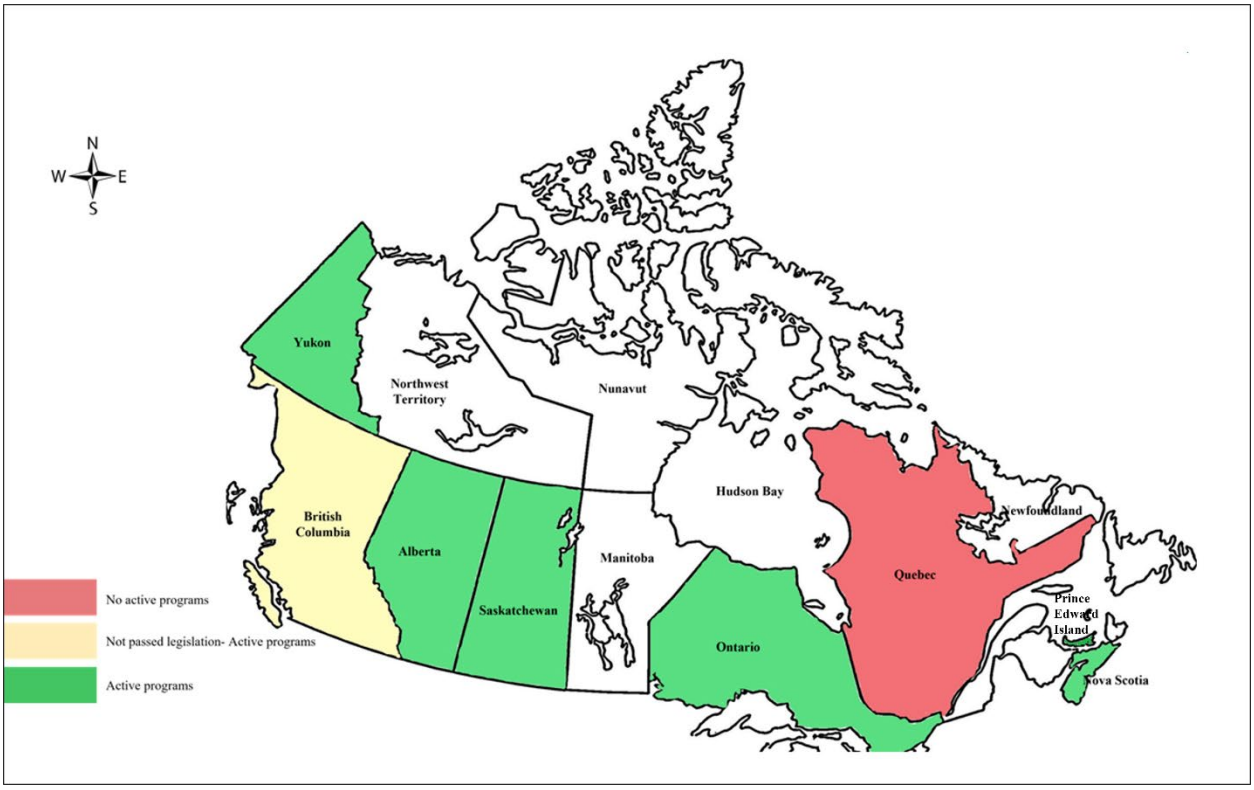

Figure 1 – five provinces and one territory, including Alberta, Nova Scotia, Ontario, Prince Edward Island, Saskatchewan, and Yukon, have enabling legislation and are running LIC/PACE programs. British Columbia is running two pilot programs but does not currently have enabling legislation.

Alberta PACE Programs

Alberta PACE-enabling legislation was passed in June 2018 and took effect on January 2019 (PACE Alberta, 2021). At that time, Energy Efficiency Alberta (EEA) was appointed as the administrator of PACE programming in the province; however, the United Conservative Party of Alberta (UCP) has since dissolved EEA, and the role of PACE administrator was transferred to the Municipal Climate Change Action Center (MCCAC). Accordingly, municipalities who wish to develop and deliver their PACE program can work with MCCAC (PACE Alberta, 2021).

Under this regulation, some municipalities developed their PACE programs, including the cities of Calgary, Edmonton, and Leduc and towns of Canmore, Devon, and Rocky Mountain House (PACE Alberta, 2021). These are explained in the following sections.

City of Calgary Home Energy Improvement Program

To improve energy efficiency in buildings and reduce GHG emissions, the City of Calgary is creating a home retrofit program offering financial incentives through the PACE mechanism for property owners (City of Calgary Clean Energy Improvement Program (CEIP) Program Design Study, 2021). Under this program, the City allocated $15 million to address the issue of the high upfront costs of retrofit improvements in residential buildings and is expected to finance approximately 720 retrofit projects over four years (City of Calgary CEIP Program Design Study, 2021). Energy efficiency upgrading and renewable energy initiatives will be eligible through the program; detailed eligibility criteria for each upgrade will be available on the program's website when the program launches in Calgary (City of Calgary, 2021).

The program provides loans of up to $50,000 or 15% of the property's value at a fixed interest rate of 1% to 3%, which must be paid back over 15 to 20 years. Moreover, the program is administered by Alberta Municipal Services Corporation (AMSC) and will be delivered by the Municipality (City of Calgary CEIP Program Design Study, 2021).

The program is anticipated to open to homeowners in late fall 2022, depending on the funding approval timeline (City of Calgary, 2021).

Program Eligibility:

To qualify for this program, properties and homeowners must meet the requirements. This program is available for owners of detached, semi-detached houses, and row houses in the City of Calgary. The property owners must also be in good standing with respect to city utility bills, taxes, and other municipal charges (City of Calgary CEIP Program Design Study, 2021).

Application Process (City of Calgary CEIP Program Design Study, 2021):

1. Interested homeowners must submit all program forms and supporting documentation to the AMSC and the City of Calgary.
2. Participants must also work with an energy advisor and a qualified contractor to collect all required information.
3. Participants must enter into the two program agreements, the Clean Energy Improvement (CEI) Agreement with the City of Calgary and the Project Agreement with the AMSC and the qualified contractor.
4. Upon project completion, participants will be required to repay the Clean Energy Improvement Tax over the period defined in the CEI Agreement.

City of Edmonton Clean Energy Improvement Pilot PACE Program

Edmonton's PACE program, the Clean Energy Improvement Pilot Program, was passed on August 2021, offering up to 20-year, low interest loans to residential property owners to make energy efficiency upgrades or add renewable energy installation to their properties (City of Edmonton, 2021). It is noteworthy that upgrades must have a minimum cost of $3,000 and not exceed $50,000 to qualify for financing (City of Edmonton, 2022). Further, the interest rate provided by the City of Edmonton for eligible CEIP projects will not exceed 3.5% (City of Edmonton, 2022).

This pilot program is designed for two years and targets financing approximately 80 residential upgrades and retrofits; however, it can be recapitalized if successful (City of Edmonton, 2021).,

The City of Edmonton was awarded $9.6 million from FCM on December 2020 to develop and launch this program (City of Edmonton, 2021).

Program Eligibility:

This program will first be available for residential property owners. Commercial properties and farmlands will be eligible in the following phases (CEIP, 2022a). Participants in this program must also be legal property owners in the Municipality and be in good standing on property tax payments (CEIP, 2022a). Additionally, if there is a mortgage on the property, participants must obtain the consent of their mortgage lender to participate in the program if required by their mortgage lender (CEIP, 2022a).

The City of Edmonton's residential Clean Energy Improvement Program is currently at capacity and has closed to pre-qualification submissions. Applications that are currently on the waitlist will be processed on a first-come, first-served basis as space becomes available (City of Edmonton, 2022).

Application Process (CEIP, 2022a):

1. Interested participants are required to complete and submit the pre-qualification form for homeowners, which is available on the CEIP's website.
2. Homeowners select a qualified contractor for the project, complete an Energy Home Assessment, and provide it to CEIP.
3. The application form and supporting documents are submitted, and upon approval, applicants complete the Clean Energy Improvement Agreement and the project agreement.
4. CEIP will pay the contractor upon project completion, and a repayment loan schedule will be prepared for the owners.

City of Leduc Clean Energy Improvement Program

The City of Leduc Clean Energy Improvement Program opened in May 2022 to provide low-interest-rate loans for homeowners to improve their building energy efficiency (CEIP, 2022b). This program is administered by Alberta Municipalities and delivered by the City of Leduc (CEIP, 2022b).

The total financing amount available to a single property is a maximum of $50,000 per property that must be repaid within 20 years. The interest rate provided by the City of Leduc for eligible retrofit projects is a fixed blended rate. In this regard, the fixed rate will be calculated by delivering 73% of the financing at a 0% interest rate and 27% of the financing at the applicable prime rate set by the Bank of Montreal annually (CEIP, 2022b). Participants' payments will be re-calculated annually to reflect the adjusted interest rate (CEIP, 2022b).

To develop and launch this program, the City was awarded $4.1 million from FCM on April 2022 (City of Leduc, 2022).

Program Eligibility:

The program is available for low-rise residential properties, such as detached, semi-detached, and townhouse properties. Multi-residential buildings with three stories or fewer and not more

than 600m^2 in building area will also be eligible for this program (CEIP, 2022c). Properties must also be insured with at least $1 million in coverage (CEIP, 2022c). Participants in this program must also be legal property owners in the municipality and be in good standing on property tax payments (CEIP, 2022c). Additionally, if there is a mortgage on the property, participants must obtain the consent of their mortgage lender to participate in the program if required by their mortgage lender (CEIP, 2022c).

Application Process (CEIP, 2022c):

1. Interested applicants must complete the pre-qualification form and provide their property details to the City of Leduc and Alberta Municipalities to confirm that they and their property meet the basic program eligibility criteria.
2. Once the pre-qualification form is approved, applicants must complete an EnerGuide Home Evaluation using an NRCan-registered Energy Advisor. Participants must use the Renovation Upgrade Report provided by the Energy Advisor as a guide to decide which eligible upgrades will be financed through CEIP.
3. Applicants then select their contractors from the Qualified Contractor List, complete the Project Application Form, and submit it to Alberta Municipalities.
4. If the Project Application is approved, the administrator will provide the Clean Energy Improvement Agreement and the Project Agreement for signature.
5. Alberta Municipalities will send an Installation Authorization Notice, and upgrade installations can begin.
6. Homeowners must submit an Upgrade Completion Form to Alberta Municipalities when projects are completed. Alberta Municipalities will pay contractors and schedule loan repayment upon the form's approval.

Town of Canmore PACE Program

The Town of Canmore PACE program is being developed under the Clean Energy Improvement Program. This program opened in November 2022 and is designed to help residential property owners; however, commercial properties may be added to the program in the following years (Town of Canmore, 2021). To develop and launch this program, grant and loan funding from the FCM offsets program administration and upfront costs for the first four years (Town of Canmore, 2022).

This program will be delivered by the Alberta Municipal Service Corporation (AMSC) in partnership with municipalities across Alberta (Town of Canmore, 2021). It offers financing of up to 100% of the home energy efficiency upgrades and renewable energy installations with a competitive interest rate on a 25-year repayment term (Town of Canmore, 2021).

Program Eligibility:

This program will be available for residential property owners in its first phase. Participants in this program must also be legal property owners in the municipality and be in good standing on property tax payments (Town of Canmore, 2022). Additionally, if a mortgage is on the property, participants must obtain the consent of their mortgage lender to participate in the program if required by their mortgage lender (Town of Canmore, 2022).

Application Process (Town of Canmore, 2022):

1. Interested participants are required to complete and submit the pre-qualification form, which is available on the CEIP's website.
2. Homeowners select a qualified contractor for the project, complete an Energy Home Assessment, and provide it to CEIP.
3. The application form and supporting documents are submitted, and upon approval, applicants complete the Clean Energy Improvement Agreement and the project agreement.
4. CEIP will pay the contractor upon project completion, and a repayment loan schedule will be prepared for the owners.

Town of Devon Clean Energy Improvement Program

The Town of Devon Clean Energy Improvement Tax Program was authorized in 2019, accepting applications as of early 2022(Town of Devon, 2019). This program is designed to finance eligible properties to improve energy efficiency or upgrade their renewable energy installations (Town of Devon, 2019). The loan will have a maximum 25-year term, be repayable through the existing tax bill system, and have a maximum 4% interest rate (Town of Devon, 2019). The town was awarded $2 million from FCM to develop and launch this program (CEIP, 2022d).

Program Eligibility:

This program is currently limited to residential properties with less than five units within the Municipality (Town of Devon, 2019). Commercial, industrial, farmland, and non-profits properties will be included in the next phases of the program (Town of Devon, 2019). Participants in this program must be legal owners of a property located in the Municipality and be in good standing on property tax payments (CEIP, 2022d). Additionally, if a mortgage is on the property, participants must obtain the consent of their mortgage lender to participate in the program if required by their mortgage lender (CEIP, 2022d).

Application Process (CEIP, 2022d):

1. Interested participants are required to complete and submit the pre-qualification, available on the CEIP's website.
2. Homeowners select a qualified contractor for the project, complete an Energy Home Assessment, and provide it to CEIP.
3. The application form and supporting documents are submitted, and upon approval, applicants complete the Clean Energy Improvement Agreement and the project agreement.
4. CEIP will pay the contractor upon project completion, and a repayment loan schedule will be prepared for the owners.

Town of Rocky Mountain House PACE Program

The Town of Rocky Mountain House PACE program aims to provide an affordable way for homeowners to make energy efficiency improvements and achieve the town's sustainable goals. It was launched in 2019 (CEIP, 2022e). This program offers property owners a maximum

of $50,000 to cover project costs (CEIP, 2022e). Loans have 20-year terms with an interest rate of 1% and are repaid through the property tax bill system (CEIP, 2022e).

Program Eligibility:

This program is available for insured, low-rise residential properties within the boundaries of the Municipality (CEIP, 2022e). In addition to the property, participants in this program must also be legal owners of a property located in the Municipality and be in current good standing on their property tax payments. Participants must attest they are current on any outstanding property-secured debt associated with the property on the Pre-Qualification form and may be required to submit a letter from their financial institution confirming this (CEIP, 2022e). Additionally, if a mortgage is on the property, participants must obtain the consent of their mortgage lender to participate in the program if required by their mortgage lender (CEIP, 2022e).

Application Process (CEIP, 2022e):

1. Interested participants are required to complete and submit the pre-qualification form by the property owners, which is available on the CEIP's website.
2. Homeowners select a qualified contractor for the project, complete an Energy Home Assessment, and provide it to CEIP.
3. The application form and supporting documents are submitted, and upon approval, complete the Clean Energy Improvement Agreement and the project agreement.
4. CEIP will pay the contractor upon project completion, and a repayment loan schedule will be prepared for the owners.

British Columbia LIC/PACE Programs

According to the recent report published by AMO (2021), British Columbia (BC) does not currently have PACE legislation; however, BC municipalities have called on the province to pass enabling legislation (AMO, 2021). Moreover, some legal opinions point out that local governments' residential PACE (R-PACE) financing is already permissible under the BC Community Charter, using Local Area Service Charges. Under this premise, the District of Saanich and the District of Central Saanich launched their PACE program named "Oil to Heat Pump Financing Program" in April 2022 (City Green Solutions, 2022).

Several municipalities and districts across the province have also received funding to design or conduct feasibility studies on implementing residential energy efficiency retrofit programs for homeowners within their jurisdictions (FCM, 2021a).

City of Kelowna Home Energy Retrofit Program

As part of the response to climate change, the City of Kelowna developed a Community Energy Retrofit Strategy that will assist residents in improving their building's energy efficiency (City of Kelowna, 2021). The strategy will help guide policies and programs to improve energy efficiency in Kelowna's existing buildings (City of Kelowna, 2021). In this regard, the City was awarded $140,000 by the FCM to undertake a feasibility study for developing this program (FCM 2021b). As the first step to conducting this study, Kelowna's residents were asked to participate in an

online home energy retrofit survey. The survey is now closed, and results are under evaluation and review (City of Kelowna, 2021).

City of New Westminster Pilot Heat Pump Program (Push Program)

With funding support from the FCM in 2021, the City of New Westminster, in collaboration with the District of Squamish and the Resort Municipality of Whistler, has been working on the design of a "one-stop-shop" service model to help increase the adoption of air source heat pumps in existing homes (Resort Municipality of Whistler, 2021). FCM contributed $154,400 to support the design of a pilot program in 2022, targeting electric heat pump retrofits in 20 Whistler single-family homes, 40 Squamish homes, and 40 New Westminster homes (Resort Municipality of Whistler, 2021).

City of North Vancouver

In January 2021, the City of North Vancouver launched a new program to encourage homeowners to switch to low-carbon and energy-efficient heat pumps for home heating and cooling to build net-zero emissions homes and reduce GHG emissions by 45% by 2030 (District of North Vancouver, 2022a). The City received $169,000 in grants from the FCM to study the transition to zero-carbon buildings (FCM, 2021b).

“Jump on a New Heat Pump” is a new program that helps homeowners switch to heat pumps for home heating and cooling (District of North Vancouver, 2022b). In this program, eligible participants can receive up to $13,000 in combined rebates from the City and Clean BC Better Homes to switch from fossil fuels to an electric air source heat pump (District of North Vancouver, 2022b). Participants can also receive a free virtual Home Energy Check-Up with an Energy Expert to evaluate which home energy upgrades best fit their goals and priorities (District of North Vancouver, 2022b).

Program Eligibility:

This program is available for single-family homes, mobile homes that are permanently fixed, duplexes, triplexes, and row houses connected with a current residential utility services account to FortisBC or BC Hydro (Clean BC Better Homes, 2022a).

These homes must be a year-round primary residence of the legal homeowner and must have completed a pre-and post-upgrade EnerGuide evaluation (Clean BC Better Homes, 2022b).

City of Powell River Home Retrofit Program

The City of Powel River Council has been collaborating with the FCM to investigate the possibility of developing a home energy retrofit program in the community (Galinski, 2020). The City received $61,200 from the FCM to undertake a feasibility study for this program (FCM, 2021b).

City of Vernon

HomeZERO Collective Society, a non-profit organization of renewable energy experts and local citizens, in collaboration with the City of Vernon, is conducting a visibility study on retrofitting 500-800 single-family homes to net zero emissions (Rothwell, 2020). Through this program,

homeowners can implement energy efficiency upgrades, along with heat electrification and an electric hot water tank (Lawless, 2020).

To conduct this study, HomeZERO Collective Society received $174,500 from the FCM in 2021 (FCM, 2021b).

District of Central Saanich Oil to Heat Pumps Financial Program

In March 2021, the District of Central Saanich was awarded $500,000 by the FCM to impellent a pilot project for its Municipal Financing Program for Home Energy Upgrades (AMO, 2021; FCM, 2021b).

With this funding, Central Saanich has launched a pilot PACE program named Oil to Heat pumps Financing Program in April 2022. This two-year pilot program provides eligible homeowners with an interest-free loan of up to $12,000 to replace their oil heating systems or boilers with electric heat pumps. This is a 10-year loan repaid through tax bills (District of Central Saanich, 2022).

Program Eligibility:

This program is available for owners of residential buildings primarily heated by oil, including single-family homes, secondary suites in single-family homes, and row houses, within the municipal boundaries of the District of Central Saanich (District of Central Saanich, 2022). Further, homeowners must be in good standing with their property tax.

Application Process (District of Central Saanich, 2022):

1. To participate in this program, homeowners must prepare a petition form and submit it to the "secure document upload link" on the District website by the intake period deadline. The Local Area Service Bylaw will review this petition form.
2. Once the Local Area Service Bylaw approves the property conditions, participants will be notified, and the process for EnerGuide home evaluation and choosing the preferred contractor will begin.
3. Following this step, the required documents, such as the EnerGuide report and contractor's quote, must be submitted to the District. Afterward, participants will receive a financing agreement via email.
4. Upon completion of the project, the District will pay the contractor, and participants are required to repay the loan over ten years.

District of Saanich Oil to Heat Pump Financing Program

The District of Saanich is launching a pilot PACE program in April 2022 as part of its climate commitment to reduce GHG emissions and carbon-intensive oil heating by 2030 (District of Saanich, 2022). Through this program, eligible homeowners can receive $12,000 in funds with a 0% interest rate to upgrade their existing oil furnace or boiler to an electric heat pump (District of Saanich, 2022). This program is made possible with $350,000 in grant funding from the FCM and $95,000 from the Real Estate Foundation of British Columbia (REFBC) (District of Saanich, 2022).

Program Eligibility:

To be eligible for this program, the property must be in the District of Saanich and the owner's primary residence (District of Saanich, 2022). Further, this program is available to owners of single-family homes, rowhouses, and mobile homes whose property is heated primarily by oil. Property owners must also be in good standing on their property taxes and municipal utility bills (District of Saanich, 2022). Also, 50% of the program's spots are dedicated to income-qualified participants. These participants are recommended to pre-register with the CleanBC Income Qualified Program. This program will pay the contractor directly, and the balance will be eligible for financing from Saanich (District of Saanich, 2022).

Application Process (District of Saanich, 2022):

1. To enroll in this program, interested owners must fill out and submit the registration form and a petition to the District.
2. Once the District gets the petition, Council may adopt a local area service bylaw and secure the participant's spot in the program.
3. Participants must complete the pre-installation eligibility requirements, such as completing the EnerGuide evaluation, getting quotes from an eligible contractor, and notifying their mortgage lender.
4. After reviewing the documents, participants will receive a financing agreement. After signing the agreement, the upgrading process will begin.
5. The contractor will be paid directly by the District of Saanich when the project is completed, and participants are required to repay the money through their property taxes.

Regional District of Mount Waddington (RDMW)- Ecotrust Canada

Ecotrust Canada (EC) and the RDMW have been collaborating to develop retrofit projects in the RDMW to reduce household energy costs (RDMW Agenda Package, 2021). In that regard, EC and RDMW received $79,600 from the FCM in early 2021 to complete a community energy financing program, aiming to explore the interest and efficacy of financing solutions for retrofit projects in the region (FCM, 2021b).

Nova Scotia LIC/PACE Programs

Since 2010, Nova Scotia has amended section 81A(1)(d) of the Municipal Government Act to authorize municipal PACE programs (Cipriani et al., 2020; Kennedy et al., 2020; AMO, 2021). To date, fourteen PACE programs are operating in the province; ten are administered by Clean Foundation, a non-profit third-party administrator, while the other programs are administered directly by the Municipality (Clean Energy Financing, 2021a). These programs are outlined below.

Berwick Green Energy Program (BGEP)

The Town of Berwick launched its PACE program, Berwick Green Energy Program (BGEP), in 2013. The initial administrator was Berwick Municipality. However, in 2019, the program administrator changed, and Equilibrium Engineering (EQ) was retained as the program administrator (BGEP, 2019). The PACE loan is a maximum of 15% of the property asset value, which must be repaid within ten years at a fixed rate of 4% (BEGP, 2019).

At first, this program was available only to residential property owners but later included commercial energy upgrades (BEGP, 2019).

Program Outcomes:

After replacing the program's administrator in 2019, the participation number increased sharply to 66 applications. While the total number of participants in the program between 2013 and 2017 was only 11, 21 applications were approved in six months of 2019 (BGEP, 2019). Furthermore, the program resulted in approximately $200,000 in energy investments and 71,200 Kg CO_2e reductions from May to November 2019 (BGEP, 2019).

Clean Energy Financing Program

The Clean Energy Financing Program is a program that helps Nova Scotia municipalities provide low-interest financing to qualifying homeowners interested in undertaking clean energy upgrades (Clean Energy Financing, 2021a). The administrator of this program is the Clean Foundation on behalf of the municipalities in Nova Scotia (Clean Energy Financing, 2021a).

The Clean Energy Financing Program offers upgrade financing for up to ten years, while the maximum amount of the loan and interest rate vary in each municipality and district (Clean Energy Financing, 2021a).

This program has the advantage of not requiring mortgage lender approval (Cipriani et al., 2020). The loan repayment can be collected monthly instead of annually or bi-annually, as in the case of property taxes (Cipriani et al., 2020). This repayment schedule benefits participants as it better aligns with savings on utility bills and loan repayment (Cipriani et al., 2020).

In July 2021, FCM invested $9.57 million through Green Municipal Fund’s (GMF) Community Efficiency Financing to help Clean Foundation organization support residential energy retrofits in rural Nova Scotia municipalities (FCM, 2021d).

Program Eligibility:

This program is available for detached, semi-detached, or row house owners in good standing with municipal taxes and charges (Clean Energy Financing, 2021a). A home energy assessment and a supplementary assessment are required (Clean Energy Financing, 2021a). The upgrades must also meet a 1:1 debt-to-savings ratio, meaning the project's cost, program fees, and cost of borrowing must be less or equal to the estimated energy cost savings over the financing period (Clean Energy Financing, 2021a).

Application Process (Clean Energy Financing, 2021a):

1. Complete the pre-qualification form and submit it to the Clean Foundation.
2. Once the eligibility is confirmed, a Home Energy Assessment is conducted.
3. The Clean Energy Financing Customer Agreement and the Pre-authorized payment form must be signed.
4. Eligible upgrades are selected, and quotes from contractors are acquired.
5. Upon project completion, Clean Foundation will pay the contractors, and loan repayment starts as per the terms of the agreement.

This program is active in ten municipalities in Nova Scotia: Amherst, Cumberland County, District of Barrington, District of Digby, District of Lunenburg, District of Shelburne, District of Yarmouth, Town of Bridgewater, Town of New Glasgow, and Victoria County.

Completed upgrades under the programs are as follows:

Table 2 – Completed PACE Projects Through 2021 Under Nova Scotia's Clean Energy Financing Program

Municipality	Year of Inception	Active Projects as of 2021	No. of Upgrades Completed through 2021	Completed Projects		
				Estimated GHG Savings per Year (tonnes)	Estimated Annual Energy Savings (GJ)	Total Amount Financed (with fees, $)
Town of Amherst[1]	2019	5	0	0	0	0
District of Barrington	2017	1	2	21.50	134.00	18,635.94
, $Town of Bridgewater	2016	19	22	122.27	1265.01	236,828.28
District of Digby	2016	4	13	68.83	726.13	139,241.30
District of Lunenburg	2016	8	17	102.41	1012.50	144,883.84
District of Shelburne	2016	0	11	85.39	498	93,505.37
Municipality of Cumberland	2020	6	1	5.7	27.69	11,314.35
District of Yarmouth[1]	2019	1	0	0	0	0
Victoria County[1]	Mid-2021	0	0	0	0	0
Town of New Glasgow[1]	Mid-2021	10	0	0	0	0

[1]No projects have been completed to-date

Details of the specific municipal programs are listed in the following sub-sections.

Amherst Clean Energy Financing

Launched in late 2019, the Town of Amherst provides homeowners within the Municipality with a low-interest financing program to improve energy efficiency, upgrade renewable energy, and reduce water consumption. The maximum eligibility amount of the loan is 10% of the total assessed property value or between $15,000 and $25,000, whichever is less. This loan must be repaid at a fixed interest rate of 2% for up to ten years (Clean Energy Financing, 2021b).

Homeowners interested in this program must register with Clean Energy Financing (Clean Energy Financing, 2021b). Eligible homeowners enter into an agreement with the Municipality and then have a LIC on the property equal to the cost of the upgrades, plus lender rate and program fees (Clean Energy Financing, 2021b). Once the upgrades are completed, the homeowner repays the Municipality via the LIC on their property tax bill.

To qualify for this loan, the Town requires a credit check for each homeowner in addition to the general eligibility requirements for the Clean Energy Program (Clean Energy Financing, 2021b).

Although no projects have been completed under the program to-date, there are five active files for the 2021 fiscal year (K. Giles, personal communication, January 27, 2022)

Cumberland County Clean Energy Financing

Cumberland County Clean Energy Financing programs, launched in late 2019, provide a maximum of 10% of the full assessed property or $15,000-$25,000 for detached, semi-detached, or row houses to assist homeowners in upgrading their clean energy options and improving energy efficiency (Clean Energy Financing, 2021e). This loan has an interest rate of 2% for up to ten years and must be repaid through the property tax bill system (Clean Energy Financing, 2021e).

Cumberland County's program follows the general eligibility and application procedures of the Clean Energy Financing Program (Clean Energy Financing, 2021e).

District of Barrington Clean Energy Financing

District of Barrington Clean Energy Financing, started in 2017, offers low-interest-rate loans to homeowners of detached, semi-detached, and row houses within the Municipality (Clean Energy Financing, 2021d). The maximum loan amount is $10,000, which must be repaid over ten years at a fixed interest rate of 4% (Clean Energy Financing, 2021d). The program's eligibility criteria and application process follow that of the Clean Energy Program (Clean Energy Financing, 2021d).

District of Digby Clean Energy Financing

District of Digby's Clean Energy Financing Program, started in 2016, provides a maximum of $15,000 for residential property owners to improve their property energy efficiency or install clean energy options (Clean Energy Financing Program, 2021f). The interest rate of this loan is 4% and must be repaid over ten years through the tax bill process (Clean Energy Financing Program, 2021f).

Program participants must register with the Clean Foundation first to confirm their property eligibility (Clean Energy financing Program,2021f). Homeowners can then apply for Clean Energy Financing based on recommendations from an Energy Advisor assessment certified by NRCan. Once the upgrades are completed, the administrator will pay the contractor, and owners must repay the loan through the tax bill system (Clean Energy Financing Program, 2021f).

District of Lunenburg Clean Energy Financing

The District of Lunenburg's program, launched in 2016, offers loans up to $10,000 to residential property owners to increase energy efficiency or upgrade clean energy options on their properties (Clean Energy Financing, 2021g). The loan's interest rate is 4% per year for the first five years (Clean Energy Financing, 2021g). At the end of the first five years of financing, the administrative charge will be adjusted to the chartered bank's prime rate plus 1.5% for the remainder of the time (Clean Energy Financing, 2021g). The loan must be repaid over ten years through the property tax bill system (Clean Energy Financing, 2021g).

Besides general eligibility criteria for the Clean Energy Financing loan, the District of Lunenburg must also submit a credit check of participants (Clean Energy Financing, 2021g).

District of Shelburne

This program, launched in 2016, offers a maximum loan of $15,000 to residential property owners to improve their property's energy efficiency and upgrade to clean energy options (Municipality of District of Shelburne, 2016). The loan will be repaid through the property tax bill for the selected term (Municipality of District of Shelburne, 2016).

District of Yarmouth Clean Energy Financing

This program, launched in 2019, offers a maximum loan of $15,000 to residential property owners (excluding multi-unit buildings) to improve their property's energy efficiency and upgrade to clean energy options (Clean Energy Financing, 2021j). This loan's interest rate is 1% and must be repaid over ten years via the property tax bill system (Clean Energy Financing, 2021j).

Homeowners interested in applying for eligible measures in this district's Clean Energy Financing Program must register for the program and get confirmation on their property qualification (Clean Energy Financing, 2021j).

To qualify for this loan, all property owners must consent and be in good standing with the tax bill and other related charges (Clean Energy Financing, 2021j).

Town of Bridgewater Clean Energy Financing

The Bridgewater Clean Energy Financing Program started in 2016, is open to owners of residential properties except for those owning multi-unit buildings. Maximum eligible financing for this program is up to $40,000 or 15% of the property's value for homes with fully assessed property values of more than $100,000. For homes with fully assessed property values of less than or equal to $100,000, the maximum eligible amount is $15,000. This amount must be repaid at the 1% interest rate over 15 years through the property tax bill system (Clean Energy Financing Program, 2021c).

The homeowner must take the required steps to apply for this program, including registering, verifying the property and owner eligibility, signing the agreement, completing the upgrades, and repaying the loan through their property tax bill system (Clean Energy Financing Program, 2021c).

The eligibility conditions for the program are the same as the general conditions for the Clean Energy Financing Program (Clean Energy Financing Program, 2021c).

Town of New Glasgow

The Town of New Glasgow PACE program was launched in 2021. It offers maximum financing of 15% of the property's value or $15,000 (whichever is less) with an interest rate of 1.5% to residential property owners (Clean Energy Financing, 2021h). The loan repayment period is ten years, which must be repaid through the property tax bill system.

Victoria County

The Clean Energy Financing program in Victoria County was launched in 2021 (K. Giles, personal communication, January 27, 2022). It provides homeowners with up to $20,000 to improve energy efficiency and upgrade renewable energy technologies (Clean Energy

Financing, 2021i). This loan is offered for up to ten years with a fixed interest of 4% (Clean Energy Financing, 2021i).

Cozy Colchester

This program is built on the existing Solar Colchester Program to provide funds for residential energy efficiency upgrades (Mackie, 2021). This program received $7 million in funds from FCM to support almost 400 energy efficiency projects, including heat pump installation and building envelope upgrading that can save energy and reduce GHG emissions (Cozy Colchester, 2022).

The Cozy Colchester program provides 0% interest financing up to $30,000 or 25% of the property value to eligible homeowners that must be repaid over 10- or 15-year terms, depending on the upgrades (Cozy Colchester, 2022). Further, eligible participants can be eligible for other rebates from Efficiency Nova Scotia and the new federal Greener Homes Program (Cozy Colchester, 2021).

Application Process (Cozy Colchester, 2022):

1. Register for the program by phone or emailing the City.
2. A free Home Energy Assessment from a local contractor is conducted.
3. Participants sign an Owner Participant Agreement with the City.
4. The City authorizes the contractor to start work and issues payment once the work is completed.
5. The city schedules payment and the owners are billed.

Halifax Solar City Program

Halifax Solar City Program provides financing to residential property owners, non-profit organizations, co-operatives, charities, and places of worship (Halifax Regional Municipality, 2021) to install a solar energy system on their property (Halifax Regional Municipality, 2021). This program aims to address the issue of the high upfront costs of solar energy installations, support customers in choosing the most suitable technology, and meet municipal strategies to improve environmental, economic, and social sustainability (Halifax Regional Municipality, 2021). Participants in this program can select a wide range of solar technologies, including solar electricity, solar hot water, and solar hot air (Halifax Regional Municipality, 2021).

The program offers a maximum loan amount of up to 75% of the total property's value that must be repaid over ten years at a fixed interest rate of 4.75%, with the option of early payment without penalty (Halifax Regional Municipality, 2021). Solar City participants are also eligible for other incentives and rebates like those provided by Efficiency Nova Scotia (Halifax Regional Municipality, 2021).

System financing is applied to the property, not the individual, and participants can balance the loan at any time without penalty (Halifax Regional Municipality, 2021).

Program eligibility:

To qualify for this program, no personal credit check is required; however, all property taxes and any other fees invoiced through the tax account must be fully paid (Halifax Regional Municipality, 2021). Also, Solar Pilot Program and any other LICs (i.e., road improvements,

sewer and/or water installations) must be paid in full or in the process of being paid (Halifax Regional Municipality, 2021).

Application Process (Halifax Regional Municipality, 2021):

1. The process application for participating in this program includes online registration to confirm owner eligibility.
2. With guidance from the Solar City administrator, property owners choose their preferred solar energy system and solar contractor. The administrator (the Municipality) provides review and due diligence to help ensure that the proposed solar energy system meets the standards and provides energy and cost-savings over the system's lifetime.
3. The City Solar office executes a Property Owner Agreement.
4. The contractor prepares a project completion report after installing solar technologies. Upon acceptance, Solar City will pay the contractor.
5. The Municipality begins to invoice the property owner for the loan repayment.

Program Outcomes:

Since the program was launched in 2016, 3,060 property owners have shown interest in it by registering their property for consideration, and 747 Participant Agreements have been executed, totalling $19.25 million in financing committed to installing solar energy technologies (K. Boutillier, personal communication, 2022). The installation of these systems has reduced GHG emissions by approximately 5,802 tonnes during this time (K. Boutillier, personal communication, 2022). Complimentary rebate programs, such as SolarHomes, have helped to encourage program uptake. The SolarHomes program assists residential property owners in installing solar electric systems and is federally funded through the Low Carbon Economy Fund and administered by Efficiency Nova Scotia (Halifax Regional Municipality, 2021).

This project has also contributed to the growth of a competitive solar industry. In 2016, five solar contractors participated in the program, while in 2021, there were 32 active solar contractors (Halifax Regional Council, 2021).

The successes and lessons learned from the Solar City program have led to the development of a deep energy retrofit pilot. The program objective is to achieve a 50% reduction in energy demand in residential and non-residential community buildings by 2040, with a target of 5,000 deep energy building retrofits and 45 MW of installed rooftop solar annually. Another program priority will be to offer more equitable financing and be easily accessible to all property owners (Halifax Regional Council, 2021). Funding was sought from FCM's Community Efficiency Financing Program to perform a program evaluation of Solar City through a lens of equitable access, loan product competitiveness, and the ability to scale to meet local climate targets (Halifax Regional Council, 2021). The intended results of the study are to develop minimum requirements to enable the investment needed to implement Halifax's retrofit goals (Halifax Regional Council, 2021). In July 2021, FCM awarded $175,000 to the Halifax Regional Municipality to study the feasibility of expanding Halifax's Solar City program and building a healthier and cleaner future (FCM, 2021d).

A need has been identified to provide homeowners with more assistance between the standard initial energy audit and the completion of retrofits (Halifax Regional Council, 2021). Most

homeowners do not have the time or expertise to find reliable contractors to complete the suggested retrofits. (Halifax Regional Council, 2021). Halifax will explore the feasibility of a 'navigator' role for the program who would act as project manager and be the primary contact for advice and education (Halifax Regional Council, 2021). Additionally, they would be responsible for coordinating all sub-trades, financing, and rebate approvals. A pilot program for a limited number of homeowners performing deep retrofits and administered by Solar City has been recommended to Council (Halifax Regional Council, 2021).

Solar Colchester

The Solar Colchester Program is a new solar energy program launched by the Municipality of Colchester in 2019, allowing qualified residential property owners to install solar PVs with financial assistance from the Municipality (Solar Colchester, 2021). A $300,000 annual budget by the Colchester County Council has been dedicated to loans for ratepayers who want to equip their homes with solar PVs.

This program is available for residential property owners with up to four units, co-ops or non-profit organizations, and charities. To date, Solar Colchester and Cozy Colchester have had over 500 participants enroll and have provided financing for 223 home efficiency projects (Cozy Colchester, 2022). The maximum loan for each property is 25% of the property's value or $30,000, whichever is less, which will be paid to the contractor via the Municipality. Moreover, this program offers 0% interest rates loans, and participants must repay the loan over 15 years (Solar Colchester, 2021).

Participants in this program can also request other rebate sources, such as $6,000 from the Efficiency Nova Scotia Solar Homes program or $5,000 from the new federal Greener Homes Program (Solar Colchester, 2021).

Program Eligibility:

This program is open to residential properties with up to four units. Home Energy Assessment (energy audit) by a qualified EA is also required (Solar Colchester, 2021).

Application Process (Solar Colchester, 2021):

1. Register for the program by phone or emailing the City.
2. Get quotes from local contractors and have a Home Energy Assessment completed.
3. The Owner Participant Agreement with the Municipality is signed
4. The City authorizes the contractor to start work and issues payment once the work is completed.
5. The city schedules payment and the owners are billed.

Switch Wolfville

The Switch Wolfville Program provides flexible, low-cost financing for homeowners in the Town of Wolfville to carry out energy efficiency upgrades on their properties with no upfront costs (PACE Atlantic, 2022c). This program is administrated and delivered through the Town of Wolfville in partnership with PACE Atlantic (PACE Atlantic, 2022c).

The maximum amount that can be financed through this program is 15% of the property's assessed value or a maximum of $40,000 with a 0% interest rate for the entire 15-year term of the loan (PACE Atlantic, 2022c).

The Switch Program will support almost any project that saves energy and reduces GHG emissions, including heat pumps, solar PV installation, and building envelope improvements (PACE Atlantic, 2022c).

Program Eligibility:

This program is open to residential property owners in the Town of Wolfville who pay property tax to the Town and are not in arrears with their property taxes (PACE Atlantic, 2022c). Mobile homes and commercial properties are not eligible for this program.

Application Process (PACE Atlantic, 2022c):

1. Potential participants contact the program administrator to get quotes from local contractors and free Home Energy Assessments.
2. Participants sign the Participant Agreement with PACE Atlantic.
3. Contractors are then authorized to proceed with the projects.
4. Upon completion, the administrator pays the contractor and schedules the repayments for the owners.

Ontario LIC/PACE Programs

In Ontario, regulations under the Municipal Act, 2001 (O.Reg.586/06) and the City of Toronto Act, 2006 allow municipalities to launch LIC/PACE programs (Cipriani et al., 2020; Kennedy et al., 2020; AMO, 2021). Moreover, under these regulations, third parties like charities, community groups, and non-profit organizations are permitted to administer LIC/PACE programs on behalf of municipalities. The regulations also require all programs to ensure mortgage lender approval before imposing any priority liens related to LIC/PACE-based financing. Although many Ontario municipalities have identified LIC/PACE loans as part of their climate action plans, until 2022, these programs had only been implemented in Toronto. Recently several other cities have begun developing their own LIC/PACE programs, and some are currently deploying pilot programs (Cipriani et al., 2020; Kennedy et al., 2020; AMO, 2021).

Brampton-Peel Residential Energy Program

In 2019, Brampton Council declared a climate emergency to reduce GHG emissions by at least 80% by 2050 (The Corporation of the City of Brampton, 2021). On this basis, one of the priority projects was establishing a system to facilitate residential retrofit projects (The Corporation of the City of Brampton, 2021). In January 2021, City staff, in partnership with the Town of Caledon and the City of Mississauga, applied for a grant under FCM for a feasibility study of a home energy retrofit program named Peel Residential Energy Program (PREP) (The Corporation of the City of Brampton, 2021). In May 2021, the application was approved, and the City received a grant amount of $175,000 from FCM to conduct a feasibility study on PREP (FCM, 2021c). Currently, the City of Brampton works closely with partners at the Town of Caledon and the City of Mississauga on the program design study. All partners are required to help develop and implement the program (The Corporation of the City of Brampton, 2021).

Clean Air Partnership

In addition to the programs mentioned above, the Clean Air Partnership (an Ontario-based charitable environmental organization) was awarded $175,000 by FCM for a feasibility study to develop home energy retrofit financing programs in partnership with the County of Dufferin, the City of London, the City of Barrie, the Town of Huntsville, the City of Kawartha Lakes, and the Municipality of Clarington (FCM, 2021c).

City of Burlington Home Energy Retrofit Program

In early 2021, the City of Burlington was awarded $100,000 by FCM to create its Home Energy Retrofit Program (HERO), which will be part of the City's effort to achieve a zero-emissions community by 2050 (FCM, 2021c). To create this program, the City of Burlington is collaborating with the Center for Climate Change Management to design a small-scale program by mid-2023. A website (Better Homes Burlington) will also be launched as a “one-stop-shop” for homeowners (City of Burlington, 2022). In addition, a qualified contractor list will be created and accessible through this website. Further, the City will deliver this program in partnership with a local non-profit organization or nearby municipalities through a delivery center.

This program includes a target of over 50,000 existing homes; however, during the first year (2023-2024), it will target a maximum of 50 homeowners (including detached, semi-detached, and townhouse owners) and provide loans of up to $10,000 to homeowners to upgrade their property's mechanical system to an air source heat pump and to seal leaks to improve energy efficiency. This loan will be offered to homeowners through a LIC financing mechanism (City of Burlington, 2022). Further, participants may be eligible to receive other types of incentives.

City of Greater Sudbury Home Energy Efficiency

Earlier in 2021, the City of Greater Sudbury received $170,00 from FCM to conduct a study comparing home retrofit financing models (FCM, 2021c). As part of this model, the City hosted a virtual workshop, "Helping Homeowners Benefit from Home Energy Efficiency,” to gain residents' insights on home energy efficiency (Greater Sudbury, 2021).

Participants in the workshop were asked to share information about the retrofit upgrades they have already completed, the major obstacles they faced, and helpful financing options or information they can use (Greater Sudbury, 2021).

City of Thunder Bay

Earlier in 2021, the City of Thunder Bay received $116,800 from FCM to conduct a community energy efficiency financing feasibility study to develop and launch a home energy efficiency program for low-rise residential buildings as part of the City’s Net-Zero Strategy (FCM, 2021c). This study aims to identify the opportunities and challenges associated with developing a residential energy efficiency program in Thunder Bay (City of Thunder Bay, 2021).

As the first step of this study, residents were encouraged to complete the Online Home Energy Improvement Loan Survey, available from April 21-May 15, 2022. The survey aimed to collect data on energy use and understand what retrofit measures homeowners have completed or looking to complete in the future (City of Thunder Bay, 2021).

City of Kingston Home Energy Retrofit Program

The Kingston Home Energy Retrofit Program (KHERP) was developed through the Council's 2019-2022 Strategic Plan to extend municipal financing to undertake energy efficiency improvements and water conservation on private residential properties within Kingston (City of Kingston, 2021). This program may be administered by the City of Kingston or in collaboration with a third party and will be delivered through Utilities Kingston (City of Kingston, 2021).

The program will finance retrofit costs of up to 10% of the current property value or $40,000 (whichever is less) that must be repaid within 20 years (City of Kingston, 2021). The loans are proposed to be repaid through property tax bills via the municipal LIC mechanism or third-party financing such as on-bill repayment through local utility providers (City of Kingston, 2021).

Program Eligibility:

In this program, individual property owners of single-family homes built before 1991 within Kingston's municipal boundary will be targeted - this represents 60% of Kingston's housing supply (City of Kingston, 2021).

The program is also open to single-family homes built after 1991 with at least 20% GHG reduction or energy-saving potential (City of Kingston, 2021).

Homeowners must provide their mortgage lender approval and be in good standing with tax property, utility bills, and other payment obligations to the City (City of Kingston, 2021). Homeowners must also provide their pre-and post-retrofit home energy assessment verified by a certified energy advisor (EA) or equivalent, as certified by NRCan (City of Kingston, 2021).

Application Process (City of Kingston, 2021):

1. To participate in this program, homeowners must complete and submit pre-qualification forms, including the property address, property assessments and tax payments, and proof of approval of all registered owners.
2. Once homeowners have been pre-qualified by the City, they must provide the Home Energy Assessments and submit a copy of the report to the City.
3. In the next step, homeowners will engage qualified contractors to implement the retrofit measures identified in the report and submit a funding request form to the City.
4. Following the City's review and approval of the home energy assessment and the Funding Request Form, the homeowner will be required to provide the property owner agreement.
5. The City will provide the final disbursement and schedule loan repayment after the homeowner has provided a copy of the final invoice from the contractor and post-retrofit home energy assessment report.

City of Peterborough Home Energy Efficiency Program

In 2021, the City of Peterborough was awarded $175,000 by FCM to design an equitable energy efficiency program for residential buildings (FCM, 2021c). This program, named the Home Energy Efficiency Program (HEEP), is part of the City of Peterborough's Climate Action Plan (ConnectPeterborough, 2022).

HEEP will be launched in 2024 and provide funds for Peterborough homeowners of detached and semi-detached homes to conduct energy retrofits to reduce energy consumption and GHG emissions. Rental properties will also be eligible for this program.

City of Toronto LIC/PACE Programs

In Toronto, three LIC/PACE programs provide financial assistance for energy efficiency improvements and water conservation to the residential sector: Energy Retrofit Loans Program, the Home Energy Loan Program (HELP), and High-Rise Retrofit Improvement Support (Hi-RISE) Program. Some key barriers confronting deep energy efficiency retrofits, such as high upfront costs, have been addressed through these programs (Cipriani et al., 2020). These programs had committed almost $15 million to support 202 property retrofit projects as of June 2019 (Cipriani et al., 2020). These programs are explained in the following sections.

Energy Retrofit Loans

This program provides low-interest loans for building owners to improve their property's energy efficiency. The City provides financing for up to 100% of the project costs with terms of up to 20 years. The loan interest rate varies based on the City's borrowing costs; specific rates cannot be determined until the loan has been approved since the City's borrowing cost differs daily (City of Toronto, 2021c). Further, participants in this program are eligible for other government rebates and utility companies' incentives.

Program Eligibility:

This program is available for all buildings located in Toronto. It includes multi-residential buildings, commercials, condominium buildings, not-for-profit, community housing, schools, colleges, universities, and hospitals. However, projects must meet technical and financial requirements (City of Toronto, 2022).

Application Process (City of Toronto, 2022):

1. To participate in this program, applicants are required to complete and submit an "Expression of interest energy retrofit loans" form via email or mail to the City.
2. Eligible applicants must provide a detailed application, including project financials, technical details, and two years of audited financial statements.
3. Upon approval of the detailed application, the City creates a Funding Agreement outlining the agreement's terms between the homeowner(s) and the City of Toronto. Both parties must sign the agreement. The interest rate specified in the Agreement will be valid for sixty days. After this time, it will be updated to reflect the City's current cost of borrowing.
4. Funds are disbursed as outlined in the Funding Agreement.

Home Energy Loan Program (HELP)

Launched in 2014, this program provides loans to single-family homes to a maximum of either 10% of the value of the property or $125,000, whichever is less (Kennedy et al., 2020; AMO, 2021). Loans were provided with interest rates falling between 1.78% and 5.81%, depending on the term of the loans (City of Toronto, 2022a). The following rates and terms were valid until

March 15, 2022. From the second quarter of 2022, new applicants' interest rate was as low as 0% (City of Toronto, 2022a). Toronto's HELP program attempts to make it easier and more affordable for homeowners to pay for a wide range of building retrofit projects over time, including improving energy efficiency and renewable energy and accessing rebates offered by utility companies (Cipriani et al., 2020).

Program Eligibility:

To be eligible for this program, the homeowner must own a detached, semi-detached, or row house (City of Toronto, 2021a). Owners of multi-unit residential buildings do not qualify for this program (City of Toronto,2021a). Moreover, all property owners must be in good standing in terms of property tax and utility payments to the city. Mortgage lender approval and a home energy audit are also required for this program (City of Toronto, 2021a).

Application Process (City of Toronto, 2021a):

1. To apply for this program, homeowners must fill out the online application provided on the website. Once the application gets approved, homeowners will receive a letter for the mortgage lender, as mortgage consent is required before the City's approval for the funding.
2. A building energy performance (energy audit) for identifying specific improvements must be completed.
3. Next, the City will approve the necessary funding, and the homeowner must sign a Property Owner Agreement (POA).
4. After completing the improvements by contractors, the total funds to pay the contractor for the retrofit projects will be transferred to the homeowner from the Municipality.
5. Finally, the repayment schedule for the loan will be prepared, and homeowners will pay it through the property tax billing process. Moreover, the outstanding balance without penalty may be paid during the loan term.

Program Outcomes:

From January 2014 to July 2021, 1,158 pre-applications were received by the City; however, only 506 received funding offers, and only 236 retrofits have been completed (City of Toronto, 2021a). During this time, the City spent approximately $5.7 million on building retrofit projects (City of Toronto, 2021a). In terms of GHG emissions reduction, this program resulted in 550 tonnes of GHG emissions reductions from the residential sector by 2019 (Cipriani et al., 2020).

Between 2018 and 2021, this program spent almost $3.3 million on 96 retrofit projects (N, Lashley, Personal Communication, Oct. 28, 2021). Between 50 and 70 projects were projected to be completed by the end of 2022 (N, Lashley, Personal Communication, Jan, 9, 2023). This includes upgrades to heating, ventilation, and air conditioning (HVAC) systems, additional insulation, replacing windows and doors, air sealing, solar PV installation, and toilet replacements. The table below outlines the various combinations of energy efficiency retrofits performed during these three years.

Table 3 - HELP Retrofits Performed, 2018-2021(N, Lashley, Personal Communication, Oct. 28, 2021).

Retrofit[1]	Number Performed
HVAC only	4
HVAC & Insulation	9
HVAC & Air Sealing	2
HVAC, Air Sealing, Windows	2
HVAC, Windows & Doors	13
HVAC, Insulation, Windows & Doors	29
HVAC, Insulation, PV, Windows & Doors	1
HVAC, Insulation, Air Sealing	4
HVAC, Insulation, Air Sealing, Solar PV	1
HVAC, Insulation, Air Sealing, Windows & Doors	6
Insulation, Air Sealing, Windows & Doors	4
Insulation, Windows & Doors	5
Air Sealing, Windows & Doors	1
Windows / Doors Only	9
Solar PV Only	6
Total Retrofits Performed 2018-2021	**96**

High-Rise Retrofit Improvement Support Program (Hi-RIS)

This program, launched in 2014, is available for apartment building owners for measures that improve energy-savings, water conservation, and upgrade renewable energies (City of Toronto, 2021b). Hi-RIS provides up to 10% of a building's assessed value or a maximum of $2 million in loans per building at an interest rate between 2.06% for a five-year term to 5.26% for a 20-year term (City of Toronto, 2021b).

Participants in this program are also eligible for $100,000 in incentives offered by Toronto Hydro (City of Toronto, 2021b).

Program Eligibility:

This program is limited to rental apartment buildings of 3 storeys or more located in the City of Toronto (City of Toronto, 2021b). Moreover, all registered property owners must consent to participate in the program. All owners must be in good standing with payments to the Municipality (City of Toronto, 2021b). Mortgage lender approval and Home Energy Assessment (energy audit) are also necessary for this program (City of Toronto, 2021b).

[1] Only energy efficiency retrofits have been included in this list. Toilet replacements are not included.

Application Process (City of Toronto, 2021b):

1. To participate in this program, participants must complete the interest form (online) and submit it to the Municipality.
2. Property owners must then complete the funding request form and submit it with a copy of the Energy Assessment report (energy audit).
3. The City then prepares a Property Owner Agreement, which the contractor must sign.
4. The contractor starts the project.
5. A loan repayment schedule is determined once the project is completed.

Program Outcomes:

From March 2014 to June 2019, 53 buildings applied to this program (City of Toronto, 2019). Fifteen buildings (2,200 units) have completed retrofit projects, with $10.1 million committed to these properties. This has resulted in 3,500 tonnes of GHG emissions reductions (City of Toronto, 2019).

City of Vaughan Home Energy Retrofit Program

In June 2018, the City of Vaughan was awarded a grant by FCM under the Municipalities for Climate Innovation Program (MCIP) to undertake an operational study on using LICs for residential building retrofit strategy in the City of Vaughan (City of Vaughan, 2020).

The Vaughan LIC study, an initiative demonstrating progress on climate action, was prepared by the Ontario Climate Consortium in collaboration with the City of Vaughan. It consisted of four phases: research and a municipal scan; risk assessment; stakeholder consultations; and development of LIC toolkits, including a draft generic implementing by-law (City of Vaughan, 2020).

This program plans to provide funds up to 10% of the assessed value of properties for retrofit projects, including renewable energy installations, water conservation improvements, and energy efficiency upgrades (Ontario Climate Consortium, 2020).

Program Eligibility:

This program aims to provide loans for owners of low-rise buildings in the City of Vaughan, such as detached, semi-detached, and townhouses.

Homeowners must have a property tax account with the City of Vaughan and be customers of either Alectra Utilities or Enbridge Gas.

Application Process (City of Vaughan, 2020):

1. To participate in this program, applicants must complete the application through the website and provide information such as property address, property assessment roll number, and mortgage lender approval to the program administrator.
2. Once the application is reviewed, and the program administrator prequalifies the owner, a pre-qualification Notice to Proceed letter to the property owner will be provided. Homeowners need to provide the Home Energy Assessments and submit a copy of the report to the City.
3. Then, homeowners can engage qualified contractors to implement the retrofit measures identified in the report and submit a funding request form to the City.

4. Following the Program Administrator's review and approval of the home energy assessment and the Funding Request Form, the homeowner will be required to provide the property owner agreement.
5. In the end, once the improvements are completed, the City will provide the final disbursement and schedule loan repayment.

City of Windsor Residential Deep Energy Efficiency Retrofits (R-DEER)

In 2018, Windsor City Council approved developing a Windsor Residential Deep Energy Efficiency Retrofit (R-DEER) Business Case to investigate the feasibility of the Community Energy Plan home retrofit strategy for Windsor homes (Windsor Law Center for Cities, 2021). This program is designed to offer standardized home retrofit packages to address the issue of high energy consumption in homes (Windsor Law Center for Cities, 2021).

R-DEER will not require homeowners to pay upfront costs for retrofit projects, and the proposal will aim to do away with the requirement for energy audits. In addition, this program will use the 2012 amendments to the Municipal Act, 2001, that will permit municipalities to use LICs (Windsor Law Center for Cities, 2021).

The R-DEER program has not received full council approval yet; however, the Project Working Team recommended the City proceed to establish an entity as a Municipal Service Corporation to administer the program to minimize municipal liability and better leverage private sector investment (City of Windsor Residential Deep Energy Efficiency Retrofits, 2019).

Program Eligibility:

The R-DEER primarily targets single-family homes, semi-detached homes, townhouses, and multi-unit properties that are 20 years or older (City of Windsor Residential Deep Energy Efficiency Retrofits, 2019).

Further, participants in this program must be the property owner; however, the Program Administrator would establish their eligibility criteria during the final program design (City of Windsor Residential Deep Energy Efficiency Retrofits, 2019).

Region of Waterloo

In collaboration with the Region of Waterloo, REEP Green Solutions, an environmental charity helping people live sustainably, received $175,000 from FCM to complete an energy retrofit program design study on residential properties (FCM, 2021c). This energy retrofit program design study aims to develop an initial four-year residential energy retrofit program targeted at single-family homes (REEP Green Solution, 2021).

Town of Cobourg Green Energy Retrofit

In May 2021, the Town of Cobourg was awarded $71,500 by the FCM to conduct a study to evaluate the feasibility of Green Energy Retrofit Financing that can achieve environmental, social, and economic benefits in low-income neighbourhoods (Corporation of the Town of Cobourg, 2021).

This study was undertaken in 2022 and evaluated the potential opportunities, resources, and tools available to retrofit multi-residential buildings with energy-efficient and renewable energy technologies to reduce GHG emissions from the residential sector (Have Your Say on Sustainability, 2022).

Upon completion of this action and to continue the forward momentum for energy-efficient building development and retrofitting, the Town of Cobourg will pursue the creation of new funding pathways to support this effort by mid-2023. It may include but is not limited to pursuing the next step in FCM's Community Energy Financing (CEF) initiative focused on program design (Town of Cobourg, 2022). At the time of writing, CEF offers grant opportunities covering up to 80 percent of eligible project costs to a maximum of $175,000. Program design will be developed by 2023, including identifying the target audience, participant eligibility, funding sources, municipal budget allocations, terms and conditions for recommended financing models, program activities, program setup and management, and risk management (Town of Cobourg, 2022).

Town of Newmarket Energy Efficiency Retrofit (NEER)

The Newmarket Energy Efficiency Retrofit (NEER) is a municipal project designed to encourage Newmarket residents to retrofit their homes and save energy (Town of Newmarket, 2021). This program aims to implement Newmarket's Community Energy Plan by creating a system that will deliver high-quality retrofit solutions through local contractors and public/private financing mechanisms (Town of Newmarket, 2021).

In 2019, the Newmarket Energy Efficiency Retrofit Business Case was developed with the oversight of a Project Working Team consisting of members from Town staff and consulting partnerships under the leadership of Garforth International LLC. (Newmarket Energy Efficiency Retrofit Business Case, 2019). The NEER Business Case has two tracks. One track will analyze the many factors involved in building energy efficiency upgrades, and the second track will be a process that informs and consults with community stakeholders (Newmarket Energy Efficiency Retrofit Business Case, 2019).

The NEER Business Case was proposed to occur by 2021, and the program set-up costs are estimated at $1,620,000. In that regard, the Town of Newmarket received $133,700 in 2021 for a feasibility study on the Newmarket NEER Business implementation plan (FCM, 2021c).

This program will be administrated through a Municipal Services Corporation (MSC) to reduce municipal liability, minimize the program delivery risks, and improve the leverage of private sector investment. Further, the MSC would be better positioned to enter partnerships with the private sector, like contractors, material suppliers, and investors, compared with the Municipality (Newmarket Energy Efficiency Retrofit Business Case, 2019).

Moreover, the NEER Business Case's proposed financial model is designed to be flexible. In this model, funding sources would include loans from lender partners, property taxes, government and utility incentives, and interest on unused loans that all would be expended on contractor payments, entity operational costs, lender capital repayments, and lender interest payments (Newmarket Energy Efficiency Retrofit Business Case, 2019).

Program Eligibility:

The NEER Business Case will be available for owners of single-detached, semi-detached, and townhouses 20 years or older. Moreover, multi-unit properties will be eligible for this program after the second year of operation (Newmarket Energy Efficiency Retrofit Business Case, 2019).

The program administrator would establish participant requirements during the final program design (Newmarket Energy Efficiency Retrofit Business Case, 2019).

Town of Oakville Home Energy Retrofit Program

The Town of Oakville and Oakville Hydro are collaborating to conduct a feasibility study to understand the possibility of developing a home energy retrofit program that uses LICs to encourage homeowners to undertake retrofits, increase energy efficiency, and reduce energy costs (Town of Oakville, 2022). In 2021, the Town received $70,000 from FCM in 2021 to complete this initiative (FCM, 2021c). Oakville detached, semi-detached, and townhome owners were invited to participate in the new home retrofit survey to provide their input about their interests, experiences, and goals related to home energy improvement (Town of Oakville, 2022). The survey was conducted in March 2022, and the results were incorporated into the final report and recommendations presented to the Council in the summer of 2022. (Town of Oakville, 2022). The survey result shows that 91 percent of respondents are willing to spend more on building improvements. Further, the top three deterrents to completing energy retrofits were identified as high project costs, difficulty finding a good contractor, and lack of knowledge on the subject (Town of Oakville, 2022).

Prince Edward Island PACE Program

In 2021, the Town of Stratford and Charlottetown was granted $14.1 million from the FCM to provide cost-effective options for residential energy efficiency and renewable energy projects – including heat pumps, solar systems, and insulation (FCM, 2021e).

The Switch Charlottetown and Switch Stratford, administrated by PACE Atlantic and Efficiency Prince Edward Island (PEI), were launched in 2021 in response to this investment (PEI, 2022). These programs will provide financing for homeowners with 0% interest that must be repaid over 15 years (PEI, 2022).

The program details are as follows:

Switch Charlottetown

The Switch Charlottetown Program offers residents 0% interest financing of up to $40,000 for energy efficiency improvements to their property with a repayment period of up to 15 years (PACE Atlantic, 2021a). The program will finance renewable energy projects, such as heat pumps and solar PVs, and building envelope improvements (PACE Atlantic, 2021a).

This program is administered by PACE Atlantic Community Interest Corporation (CIC) and funded through FCM and efficiencyPEI (FCM, 2021e).

Program Eligibility:

This program is available to residential property owners in the City of Charlottetown who pay property tax to the City and are in good standing with their property taxes or municipal utility accounts (Pace Atlantic, 2021a).

Application Process (Pace Atlantic, 2021a):

1. Interested participants contact PACE Atlantic or the Municipality for a free Home Energy Assessment from local contractors.
2. Home Energy Assessments are sent to efficiencyPEI for pre-approval.
3. After reviewing applications by efficiencyPEI, letters of approval are provided, along with the consent to release funds to the participants and PACE Atlantic.
4. Upon completion, PACE Atlantic pays the contractor and schedules repayments for homeowners.

Switch Stratford

This program, launched in 2021, provides financing of up to $40,000 or 15% of the property value with a 0% interest rate to homeowners to improve their property's energy efficiency. This loan must be repaid within 15 years (PACE Atlantic, 2022b).

This program will fund projects that save energy and reduce GHG emissions, such as heat pumps and building envelope improvements.

Program Eligibility:

This program is open to residential property owners in the City of Stratford who pay property tax to the City and are in good standing with their property taxes or municipal utility accounts (Pace Atlantic, 2021b).

Application Process (Pace Atlantic, 2021b):

1. Interested participants contact PACE Atlantic or the Municipality for a free Home Energy Assessment from local contractors.
2. Home Energy Assessments are sent to EfficiencyPEI for pre-approval.
3. After reviewing applications by EfficiencyPEI, letters of approval are provided, along with the consent to release funds to the participants and PACE Atlantic.
4. Upon completion, PACE Atlantic pays the contractor and schedules repayments for homeowners.

Saskatchewan LIC/PACE Programs

Saskatoon Home Energy Loan Program

The City of Saskatoon launched its Home Energy Loan Program (HELP) in September 2021 with $2.5 million of capital funding to loan program participants (City of Saskatoon, 2021; City of Saskatoon, 2022). This program provides loans of up to $40,000 to improve energy efficiency, upgrade to clean energy options and improve water conservation (City of Saskatoon, 2021). If participants can provide proof that their project will reduce energy consumption by 50% or more, then the loan can increase to $60,000 (City of Saskatoon, 2021). This loan's interest rate varies depending on the term length, including 1.45%, 2.31%, and 3.41% for 5, ten years, and 20

years respectively (City of Saskatoon, 2021). The loan repayment will occur annually or monthly through the tax payment service (City of Saskatoon, 2021).

Program Eligibility:

This program is available for single-family residential homes, including detached homes, semi-detached properties, and row housing within the City of Saskatoon (City of Saskatoon, 2021). The owners of these properties must also be individuals and in good standing regarding City utility bills, taxes, and any other municipal charges (City of Saskatoon, 2021).

Application Process (City of Saskatoon, 2021):

To take part in this program:

1. Participants must complete the initial online application to determine eligibility for the program.
2. Once the initial form is approved, participants must schedule a Home Energy Assessment with a registered Energy Advisor.
3. They must then select a qualified contractor, complete the online funding request form, and sign an agreement with the City.
4. Participants must complete an installment request form if the project costs are over $20,000.
5. Once the project is completed, the City will pay the contractor and provide the participant with the total loan and repayment schedule details.

Program Outcomes:

As of January 4, 2021, the program has received over 335 applications, with an average loan request of $29,700. At the time of publication, 69 applicants have been approved for funding, 256 have been waitlisted, five have been deemed ineligible, and five have dropped out voluntarily (City of Saskatoon, 2022). One participant is currently targeting a net zero-ready renovation (greater than 50% reduction in energy consumption) (City of Saskatoon, 2022).

Quebec LIC/PACE program

Quebec LIC/PACE program, Innovative Financing for Efficient Municipalities (IFEM), was operated without having enabling legislation (Cipriani et al., 2020) because the current legislative context does not provide adequate clear direction on the ability to undertake this program (Cipriani et al., 2020). The IFEM program ran in three small municipalities named Varennes, Vercheres, and Plessisville between 2016 and 2017; however, this program was cancelled in 2019 as their non-profit administrator ceased operation (Cipriani et al., 2020).

With this program, qualified homeowners could receive a loan of up to $20,000 for retrofit measures, such as upgrading lighting and adding insulation (FCM, 2022a). This program had a minimum 20% improvement in the energy efficiency target; however, it achieved 29% improvements in energy saving and 1.35 tonnes in CO_2e reductions per renovation (Cipriani et al., 2020; FCM, 2022a). A total of 24 households participated during the two years of operation of this program, and the average loan amount for these participants was $12,000. The total capital for the three municipalities that operated this program was $500,000 from budget

surpluses leading to an interest rate of 1% for up to 20 years (Cipriani et al., 2020). Mortgage lender approval was not required for this program due to its small size (Cipriani et al., 2020).

Recently, FCM has invested approximately $200,000 through FCM's Green Municipal Fund (GMF) to reduce GHG emissions and boost cost savings in Quebec communities (FCM, 2022b). Through this investment, the City of Candiac and the City of Lac-Megantic will receive $135,000 and $64,000 to design a home energy upgrades incentive program and study the feasibility of implementing innovative tools to encourage energy-efficient home renovations (FCM, 2022b).

These investments highlight how GMF continues to build on its 20-year record of supporting transformative environmental initiatives at the community level, enabling municipalities to support projects that leverage local resources to drive innovative solutions (FCM, 2022b).

Yukon LIC/PACE Program

Yukon is the first Canadian jurisdiction to expand LIC/PACE program to fund individual off-grid alternative energy power systems (Cipriani et al., 2020). The Rural Electrification and Telecommunications Program (REPT), started in 1984, is an innovative financing program that allows rural property owners to upgrade their energy infrastructure with $0 down and repay the loan alongside an annual property tax bill (Yukon Municipality, 2021). This program was initiated to assist residents living in rural areas to receive services by expanding the electrical grid and landline services to their property. Following the program's popularity, it was expanded in 1998 to fund individual off-grid alternative energy power systems, telecommunication systems, and domestic wells drilling (Pembina Institute, 2004).

Program financing is limited to 25% of the total value of the property or a maximum of $50,000. The loan must be repaid for up to 15 years at a fixed interest rate (1.75%) (Yukon Municipality, 2021).

Property Assessment and Taxation administer this program, a Department of Community Services branch under the Government of Yukon. This program differs from other Canadian PACE programs, as it is administrated by the territorial government to fund rural residential properties outside Yukon municipalities (Cipriani et al., 2020).

Program Eligibility:

This program is available for rural residential property owners whose property is outside of Yukon municipalities and are in good standing with property taxes (Yukon Municipality, 2021).

Application Process (Yukon Municipality, 2021):

Application process steps include:

1. Contact the program's administrator via email or phone to check program eligibility.
2. Fill out and submit the application form to the administrator of the program.
3. Review and approval of the application by the administrator.
4. Complete the project.
5. Pay the invoices by the program administrator after project completion. Schedule the repayment on the annual property tax.

SECTION 3. Challenges and Barriers

Programs involving energy efficiency investments and energy-related financial incentives are cost-effective means to minimize energy consumption, improve building comfort, and reduce utility bills. Although these programs benefit both investors and communities, several challenges and barriers hinder program success and effectiveness (Stern, 1986; Parker et al., 2005; Bell et al., 2011, Gamtessa, 2013; Mohareb et al., 2022).

Stern (1986) defines an energy efficiency program's effectiveness as the rate of participation in a program because most programs can save comparable amounts of energy per participant. Further, participation rates can reflect the total energy saved by the program such that a higher participation rate leads to a higher percentage of energy savings and energy efficiency that can be achieved over the program (Stern, 1986). Bell et al. (2011) also assessed an energy efficiency financing program's effectiveness through widespread participation rate and household monetary and energy savings. The authors argue that a low participation rate is a major obstacle hindering program development and limiting potential monetary and energy savings. Gilleo et al. (2017) identified key success factors by examining low-income energy efficiency programs, reviewing the literature, and interviewing industry experts. They argue that a successful and effective energy-related program will maximize participation rates, deliver deep energy savings to participants (based on KWh), and maximize financial savings. More recently, Cipriani et al. (2020) analyzed Local Improvement Charge and Property Assessed Clean Energy (LIC/PACE) programs in Ontario and concluded that the main barrier to energy efficiency incentive program success is low customer demand. They suggest that because it is difficult to quantify how much money will be saved due to energy savings over the long term, the participation rate can be an effective indicator to evaluate the success of a program over time.

Many factors contribute to the low participation rate in an energy-related program. The following section outlines these:

Participant Challenges

Prospective participants in energy-related financial programs often face unique barriers and challenges. In reviewing the literature, these barriers may be classified into four groups: monetary factors, social factors, policy factors, and technical factors.

Monetary Factors

Cost and Payback Period. High upfront costs, access to capital, and repayment time are barriers that can make it difficult for eligible households, especially low-income households, to participate in energy efficiency programs. Painuly (2001) argues that the high upfront cost of many energy efficiency programs, especially those that offer solar PV installation, is the main barrier limiting participation. Emphasizing high upfront costs and extended repayment times associated with the installation of renewable energy, Adachi (2009) argues that customers may be unable or unwilling to invest a large amount of money in these or wait for a long term return on their investment. Hidden costs like transaction fees, administration fees, and home renovations required before installing the systems may increase the total cost, making the investment unfeasible for many households (Adachi, 2009). Sovacool et al. (2017) similarly

emphasize that the cost of installing smart technologies and their associated financial burden over the repayment period limit participation in energy efficiency programs. Examining barriers confronting participants in California's energy efficiency program, Scavo et al. (2016) revealed that the high upfront cost of energy efficiency investment is a major barrier to participation. Brown (2020) points out that "access to capital and lower credit rating" is a barrier that makes it difficult for low-income households to acquire solar systems. Although this group can establish an agreement with the third party to avoid high upfront costs, third parties may reject a low-income household due to a low credit score (Brown et al., 2020).

Social Factors

This category includes cultural perceptions and values, social influences, and psychological and behavioural factors that affect customer engagement in energy efficiency programs.

*Consumer Perception and Values***.** Inaccurate, irrational, or unrealistic beliefs can influence consumer perceptions and values. These beliefs may lead consumers to identify technologies, programs, or policies as too costly, risky, or unproven, resulting in low program engagement (Bell et al., 2011; Drehobl et al., 2018). Chen et al. (2017)'s investigation of 248 low-income households reveals that consumer perceptions influence energy conservation behaviours, including purchasing clean energy options, adopting solar technologies, and investing in energy-saving programs. The authors identify a lack of personal values and individual perceptions regarding clean technologies as a significant barrier to participation in energy-saving programs.

Social influences. Social influences may also affect individual decisions to participate in energy efficiency programs or energy-related financial incentives (Chen et al., 2017). Social influences can include the presence of a champion promoting the technology, previous experience with the technology, negative experience with other technologies, and the resultant communal perception of technology. Kraft-Todd et al. (2018) examined the impact of social norms on the acceptance of energy efficiency programs, focusing specifically on how advocates motivated residential solar PV installation in 58 towns in the United States. The authors found that approximately 63% more residents were recruited by campaign leaders who themselves installed solar PVs through the same programs. These results suggest that actions spread beliefs more effectively than words alone because actions provide information about an actor's true beliefs (Frederiks et al., 2015; Kraft-Todd et al., 2018).

Environmental Responsibility. Acting in a socially responsible manner to reduce environmental impacts (e.g., climate change, air pollution) for current and future generations may either motivate or prevent individual adoption of energy efficiency programs or financial incentives (Chen et al., 2017). Attitudes and concerns around environmental responsibility substantially affect the intention to adopt renewable energy technologies (e.g., solar water heaters) among households in the U.S. (Chen et at., 2017). This attitude refers to a person's sense of accountability and responsibility for environmental conservation, as some people expect the government to take action, not individuals (Chen et al., 2017; Hansla et al., 2008; Sovakool et al., 2017).

Demographics. Household characteristics, including income, age, gender, household size, education level, and language, can all influence the participation rate in energy efficiency

programs (Brown et al., 2020; Chen et al., 2017; Das et al., 2018; Gamtessa, 2013; Sovacool et al., 2017). Gamtessa (2013) investigated the impact of household size, income, age, and education levels on energy efficiency investments, demonstrating that a large household size implies a lower likelihood of retrofit investment. Homeowners with no high school education, who are therefore likely earning less income, are more apt to engage in retrofit programs than those with a high school or higher education due to a desire to save energy (Gamtessa, 2013). Gamtessa (2013) also found that high-income households are less likely to undertake retrofit investments since energy expenditure accounts for a very small share of their income, making retrofits a low priority for many of these households (Gamtessa, 2013). However, Das et al. (2018) found that higher-income households are more likely to adopt energy-saving measures than lower-income households. Their findings also support the correlation between higher education levels and more energy efficiency adoption (Das et al., 2018). In other research, Sovacool et al. (2017) investigated social barriers and challenges confronting the adoption of smart technologies by reviewing literature published between 2008 and 2017. They explain that misunderstanding information offered by programs or the proper use of innovative technologies among seniors, low-income, and non-English speaker households can be significant barriers to engagement in these programs and adopting new technologies. Brown et al. (2020) similarly argue that non-English speakers might have trouble making informed decisions about solar installation because language barriers may impede learning. Doris (2020) emphasizes the effects of age on individual perceptions of climate change resilience and energy efficiency. Interviews with 27 senior citizens from Ottawa revealed that some had an “unlimited access” mindset about energy and were unaware of the environmental damage associated with that mindset; those who expressed these attitudes typically disregarded energy efficiency strategies (Doris, 2020).

Institutions and Policies

Laws, Regulations, and Policy Frameworks. While effective policy tools, laws, and regulations should be designed to support participation in energy efficiency programs, some have the opposite effect. Bell et al. (2011) examine the impact of “customer creditworthiness” requirements on participation in “on-bill financing” energy efficiency programs offered by utility providers in the U.S. This requirement was found to be a significant barrier for widespread participation in this program and receiving financing for improving building energy efficiency. Low credit scores in low and middle-income (LMI) households can also challenge individuals needing access to financial capital to participate in energy efficiency programs (Heeter et al., 2018). In this regard, LMI households may face higher interest rates or not meet credit criteria to qualify for loans to meet up-front subscription costs (Heeter et al., 2018). Andrews and Poe (2019) investigated the impact of two policies on LMI households’ participation in the "WarmChoice program" launched and run by Ohio’s Columbia Gas. The authors argue that a "property owner contribution policy" that required property owners to invest in energy efficiency programs decreased the program participation rate. They found that despite many renters in the program service territory, the percentage of the population who received services through the WarmChoice program was significantly skewed toward owners due to the policy requirement of property owner contribution. Consequently, when the property owner's income does not qualify, it will create a barrier for rental customers who wish to participate in the program (Andrews &

Poe, 2019). A second policy limited program participants to residential structures with no more than four units. This policy decreased the participation rate in the WarmChoice program because it prevented residents of multi-unit buildings from participating in the programs (Andrews & Poe, 2019).

Policies that result in “split incentives” may also prevent widespread participation in energy efficiency programs and financial incentives (Cipriani et al., 2020; Gillingham et al., 2009; Gilleo et al., 2017; Rana et al., 2021; Ross et al., 2016). “Split incentives” occur when one party is responsible for an energy efficiency measure's cost, while the savings resulting from that measure will benefit another party (Cipriani et al., 2020; Gillingham et al., 2009; Gilleo et al., 2017; Rana et al., 2021; Ross et al., 2016). Ross et al. (2016) explain that a “split incentive” usually arises in apartment buildings where the property owner is responsible for paying for upgrades while the residents are the primary beneficiaries of these energy savings through reduced utility bills. This situation may make property owners reluctant to invest in energy-efficient measures (Gilleo et al., 2017; Ross et al., 2016). Cipriani et al. (2020) emphasize that the split incentive between property owners and tenants has significantly decreased the participation rate in energy efficiency investment programs in Ontario. After a comprehensive review of barriers confronting financial incentives across Canada, Rana et al. (2021) identified split incentives as the main barrier confronting widespread participation in these programs, concluding that the split incentive is significant in rental housing.

Another factor that may prevent LMI households from participating in energy efficiency programs is the imposition by regulators and program administrators of specific energy savings requirements or thresholds for adopting retrofit measures. This policy, which is sometimes part of a program’s cost-effectiveness evaluation, may limit the qualification of LMI households to adopt approved retrofit measures in energy efficiency programs (Berg & Drehobl, 2018).

Mortgage lender approval is another program requirement that limits applicants’ engagement in energy-related financial incentives (i.e., PACE/LIC programs) (Cipriani et al., 2020). Mortgage lenders and insurers have expressed concern over the priority lien position of LIC/PACE administrators relative to the mortgage provider (Cipriani et al., 2020). In Ontario, mortgage lender approval is a requirement for participating in the LIC and PACE programs. This approach has resulted in low uptake in Toronto because CMHC will not approve LIC/PACE assessments on homes with CMHC-insured mortgages (Kennedy et al., 2020). Although mortgage lender approval has been a barrier to half of the initial program applicants, CMHC or Canadian banks have issued no official policy to extend mortgage insurance to cover LIC loans (Cipriani et al., 2020).

In the United States, Fannie Mae and Freddie Mac (government-sponsored mortgage providers) issued guidance in 2010 that identified PACE assessment as a mortgage contract violation. Consequently, Fannie Mae and Freddie Mac could refuse to subsidize home mortgages with PACE liens, resulting in the suspension of PACE programs in most U.S. jurisdictions (Bell & Kalvas, 2018). The Federal Housing Authority issued guidelines in 2016 removing the barrier to Fannie Mae and Freddie Mac insuring mortgages with PACE liens, requiring that only the delinquent portion of the PACE assessments be paid before the mortgage. These guidelines were, however, subsequently reversed, ensuring that homes with a PACE assessment could no longer have their mortgages insured (Bell & Kalvas, 2018). As a result of this reversal,

homeowners can no longer transfer their PACE assessment with their property to a buyer using a Fannie Mae or Freddie Mac loan; both buyer and seller must instead negotiate the payoff during the home purchase.

Awareness and Availability of Program Information. Potential customers need access to clear and detailed program information, policy tools, and regulation. Lack of information regarding feasibility and program costs, existing subsidies, regulations, and policies may dissuade potential applicants. As such, interested applicants may have to undertake lengthy investigations to find where to obtain what they need. This added burden on prospective applicants may be a disincentive (Adachi, 2009; Bell et al., 2011; Andrews & Poe, 2019). A lack of information about the availability of energy efficiency programs and asymmetric information (where one party involved has more information than the other) are some problems associated with these programs and negatively affect the participation rate (Gillingham et al., 2009). On this basis, “poor marketing” and ineffective outreach strategies may also decrease participation rates by leaving potential applicants unaware of available programs (Brown et al., 2020; Cipriani et al., 2020; Ross et al., 2016).

Program Administration Process. Robust institutional infrastructure, policies, and procedures are required to administer programs effectively and efficiently. In many LIC/PACE programs, particularly those targeting seniors and fixed and low-income households, administrative burdens, interactions with numerous administrative bodies, and cumbersome administrative procedures and requirements (e.g., the need to submit multiple applications) can create lengthy and frustrating delays in processing applications and confuse prospective applicants, adversely affecting the participation rate (Adachi, 2009).

Ross et al. (2016) investigated the impact of multiple levels of approval on the implementation of energy efficiency improvements in multifamily buildings. When it comes to making decisions about building energy efficiency improvements, property owners, building managers, maintenance staff, and residents all have different levels of authority: owners must approve projects and, at times, financing; managers and maintenance staff might develop the scope of work and coordinate implementation, while residents may be required to provide access to their units. Running decisions up and down the chain can be time-consuming and challenging for program administrators seeking to enroll a property within a program cycle (Ross et al., 2016). Further, depending on a property's investment structure, especially in the subsidized affordable sector, arranging approval for upgrade financing can be particularly challenging. Decision-making also varies depending on the types of measures a program offers. For example, property managers might have the authority to approve low- or no-cost installation measures but not purchase new equipment or more comprehensive projects (Ross et al., 2016). Program administrators must sometimes obtain the owner's approval and work with the property manager and building maintenance staff to deliver the program, ensuring the project is appropriately timed around other maintenance activities and building upgrades. When a building has a single owner, the owner or manager often decides to enroll in a program and make common area or in-unit upgrades (Ross et al., 2016). However, delivering these programs in condo buildings or cooperatives where units are individually owned can be more complicated. Typically, in these situations, common area measures must be approved by the homeowner's association, condo board, or voted on by unit owners, while in-unit measures must be approved by each individual

owner (Ross et al., 2016). All these complexities must be considered in the administrative process to simplify the process participants. If the administrative process does not work effectively and efficiently, these complexities will make the retrofit process lengthy and frustrating.

Housing Deficiencies and Technical Factors

Homeowner participation in energy efficiency programs may also be limited by both major and minor housing deficiencies. Cluett et al. (2016) argue that both on a small and large scale, outstanding home repairs and health and safety issues present an obstacle to implementing energy efficiency measures. Major issues (including health, safety, moisture, durability, and structural problems) that require repair before energy efficiency improvements can be made can render households ineligible for these programs, while more minor issues may add to the cost of energy efficiency improvements (Cipriani et al., 2020). These issues can prevent LMI families from participating (Cipriani et al., 2020).

In addition to low customer demand, there are several other challenges confronting energy efficiency programs and financial incentives which may limit their development, success, and effectiveness:

Program Financing

A wide range of financial barriers can limit the development and success of energy efficiency programs and financial incentives. Acting like a financial institution by providing financing can increase the burden of program administrators (Bell et al., 2011; Cipriani et al., 2020). Another financial challenge, as Bell et al. (2011) suggests, is the risk of non-payment of loans by participants; however, this risk is low in theory, as default on property taxes is uncommon (Kennedy et al., 2020). Another financial-related challenge is finding sources of capital. Many municipalities struggle to secure funds for programs, services, and infrastructure improvements because they lack the internal financial resources to develop and fund a program and often must pursue external funding support. Further, some municipalities express their reluctance to act as banks. While third-party financing at the federal level or by the private sector may be attractive strategies to municipalities unwilling to act as banks, it is often challenging to attract a third party due to uncertainties regarding the return on investment (Bell et al., 2011; Cipriani et al., 2020).

Legislation may also limit municipalities' ability to secure funding. For example, municipalities in Ontario have limited ability to borrow money because they have legislated debt limits (Cipriani et al., 2020). Furthermore, the Ontario Municipal Act does not explicitly allow or prohibit third-party financing, which can confuse municipalities and limit their ability to collaborate with third parties (Cipriani et al., 2020).

Diversity of Stakeholders

The diversity of the stakeholders involved in the market for energy efficiency improvements is another barrier to developing an energy efficiency program (Bell et al., 2011). Municipalities, local contractor and renovator groups, utilities, and financial institutions engaged in PACE/LIC

programs are apt to have different priorities and needs related to environmental protection, energy savings, and economic development (Dunsky Energy Consulting, 2013; Cipriani et al., 2020). Bell et al. (2011) suggest that program design and implementation should take this diversity into account and address the success and economic growth of each stakeholder.

Customer Outreach and Marketing

One of the biggest challenges for any energy efficiency program is capturing the public's attention to explain the program and its benefits. The challenge of gaining access to prospective participants can be even more pronounced among LMI households due to language barriers, limited internet access, and a lack of established communication channels between program administrators and these communities (Heeter et al., 2018). Multifamily building owners, managers, and their residents are another challenging group in terms of marketing, as they may not be aware of the programs offered (Ross et al., 2016). The diversity of the multifamily market poses additional challenges for effective marketing and outreach: owners and managers of apartments, student housing facilities, assisted-living buildings, and condominiums have different drivers and barriers to participating in energy efficiency programs (Ross et al., 2016). Moreover, Cipriani et al. (2020) suggest that limited municipal budgets and marketing expertise may contribute to low awareness of energy efficiency measures among the public and relevant stakeholder groups such as contractors and real estate agents.

Staff Capacity and Trained Contractors

The lack of qualified and skilled contractors for retrofit installation and energy efficiency renovations is another barrier to the success of energy efficiency programs. Contractors may be reluctant to seek training in energy efficiency retrofits due to concerns about garnering sufficient business in the field (Cipriani et al., 2020). They may also have limited access to energy efficiency training programs. Some contractors have also been dissuaded from entering the market because residential energy efficiency programs often entail demanding data collection requirements and difficult-to-use modelling tools, thereby adding to the time and cost of the job (Cipriani et al., 2020). A shortage of energy advisors providing pre- and post-retrofit energy evaluations delayed the processing times of the Federal Greener Homes Grant, creating additional challenges for both homeowners and the government (NRCan, 2022). The lack of certified energy auditors in some regions and high demand and interest in the program has increased application processing times from 40 to between 60-90 days. The Federal Government has responded to these capacity issues by investing $903,000 to train an additional 2,000 energy advisors to speed up retrofitting (NRCan, 2022).

Lack of Strong and Committed Leadership

Spillman et al. (2016) emphasize the importance of high-level leadership in fostering collaboration between various partners and stakeholders in energy-related programs. Following the Paris Agreement, as cities have declared climate emergencies and identified their own climate change targets, interest in LIC/PACE programs has grown. However, despite increasing

interest, it can still be difficult to get critical partners to the table to design and implement an effective program without strong and committed leadership (Spillman et al., 2016).

SECTION 4. Participant Motivations

In addition to identifying the barriers limiting participation in energy efficiency programs and financial incentives, it is also important to better understand the range of factors apt to motivate public participation (Adachi, 2009). These motivations include:

Financial Variables

LIC/PACE and energy efficiency financing programs are designed to address the financial barriers associated with retrofit projects (Adachi, 2009). These financial incentives play a key role in motivating people to engage in these programs. Gamtessa (2013) conducted an econometric analysis to investigate retrofit behaviour in a multivariable context and estimate the specific roles of various factors related to energy efficiency and economic characteristics in determining the probability and intensity of retrofit investments. This investigation demonstrated that financial incentives are essential in motivating people to participate in energy efficiency retrofit programs. According to the study, homeowners who expect a greater financial rebate are more likely to participate in energy efficiency programs (Gamtessa, 2013). Perera et al. (2017) and Das et al. (2018) also found that government incentives, rewards, and tax policies are important in encouraging participation in energy efficiency programs. Gilleo et al. (2017) investigated the impact of providing incentives for energy efficiency programs for low-income households (a household with an income below 50% of the median household, which was $40,630 in 2020 (Government of Canada, 2022), concluding that these incentives are essential in motivating these customers to participate in the programs.

In addition to initial incentives, longer-term economic benefits resulting from enhanced energy efficiency, such as monthly energy savings and lower operating costs, may encourage participation in these programs. On this basis, Parker et al. (2005) surveyed 420 households in Kitchener, Ontario, to identify and assess the most important factors affecting energy-related decisions. Their investigation revealed that the economic benefits of lower energy bills were the most important driver of energy efficiency decisions among these households (62% of survey respondents). Gamtessa (2013) also suggests that the expected energy cost savings from retrofit measures encourage engagement in energy efficiency programs (Gamtessa, 2013).

Social Variables

Social variables, including internal values and perceptions, sustainability concerns, and environmental attitudes, can influence people and motivate them to participate in energy efficiency programs and financial incentives (Adachi, 2009). Chen et al. (2017) studied the social factors driving decision-making around energy efficiency in low-income households. Their study suggests that internal values and perceptions were a strong factor associated with energy conservation intention, reduction of household energy consumption, and participation in energy efficiency programs. Environmental attitudes and sustainability concerns are other variables that have strong positive effects on motivating people toward energy efficiency decision-making (Adachi, 2009; Chen et al., 2017). This attitude refers to a person’s evaluation of the positive or negative outcomes of acting on environmental issues (Chen et al., 2014; Hansla et al., 2008). Adachi (2009) argues that participants’ self-identified sustainability-oriented attitudes and

sustainability-related concerns (e.g., climate change and livelihood of future generations) are prominent drivers toward energy efficiency decision-making.

Demographic Variables

Many studies have examined socio-demographic variables—including age, gender, income, knowledge and experience, and social context—and how they affect personal energy decision-making (Scott et al., 2000). Ferguson (1993) studied the impacts of income and age on energy retrofit decisions in Canada. His study demonstrated that energy retrofitters in Canada are more likely to be older and wealthier. Seniors and parents of young children are more likely to make energy efficiency decisions to improve indoor thermal comfort and air quality (Schwarz and Taylor,1995). Chen et al. (2017) investigated the role of gender and income on energy-related decisions. They found that when gender was considered a sole predictor, women had greater intentions to participate in energy conservation programs than men. Their study also showed that income positively influences people's decisions, indicating that higher-income people are more likely to invest in energy efficiency measures like increasing insulation and replacing appliances. Energy literacy was also found to impact low-income households' energy-related decisions (Hernandez and Bird, 2010). Greater energy literacy might motivate low-income households to participate in energy efficiency programs as it can improve awareness about energy-related issues and provide insight to support the transition to net-zero emissions (Sovacool et al., 2017).

Administrative Assistance

Participation in energy efficiency programs is known to increase when a community-based, cooperative group provides a support service that assists consumers and guides them through the administrative process (Adachi, 2009; Andrews & Poe, 2018). Bell et al. (2011) argue that community organizations could play an important role in implementing and administering energy efficiency programs since they have invested time and energy into gaining trust and credibility and providing support to potential customers. These organizations could also assist program administrators in addressing stakeholder needs by offering their community knowledge and expertise (Bell et al., 2011). Sanchez et al. (2018) emphasize that working with community-based organizations can improve participation in energy-related programs since cooperation with these organizations can build trust and address access to funding.

Consumer Awareness

The impact of consumer awareness on engagement in energy efficiency programs has been widely studied. Awareness of energy efficiency programs and their associated benefits is apt to encourage consumers to initiate contact and participate in these programs (Stern, 1986). Providing people with information about the energy efficiency measures offered in a program and the differences between them may result in higher participation rates by providing prospective applicants with the insight to make a conscious decision (O'Dwyer, 2013). Craig (2016) examined the influence of public awareness of energy efficiency programs on participation rates by surveying 2,450 U.S. residents and analyzing the theory of planned

behaviour. His findings suggest that residents aware of energy efficiency programs are more likely to participate in and support using clean energy technologies. Gillingham and Bollinger (2017) also show that public information campaigns, social networks, and locally trusted sources can have a powerful influence on public engagement in energy efficiency projects and clean energy options like solar technology.

SECTION 5. Lessons Learned and Promising Strategies

Lessons Learned

Energy efficiency programs, financial incentives, and the policy context for Canadian climate change programs are rapidly changing. The lessons learned from previous programs and policies may apply to future programs, helping inform their development and implementation.

Based on a review of existing local improvement charge (LIC) and property assessed clean energy (PACE)-style energy efficiency programs and other financial incentives offered by municipalities and utilities in North America, the success and effectiveness of these programs depend on various factors. This includes a program's ability to reach its intended audience through understandable and credible communication methods and its efforts to minimize applicants' difficulty and risk in making energy efficiency investments (Stern, 1986). Accordingly, it is necessary for administrators and program designers to identify program goals and target populations at the outset (Dunsky Energy Consulting, 2013; Drehobl et al., 2018). Program designers and policymakers should also consider socio-demographic variables when designing energy efficiency programs because these factors can motivate or hinder participation, especially among low-income households and seniors. For example, the savings associated with increased energy efficiency are the top motivation for low-income households, suggesting that retrofit measures leading to greater cost savings should be prioritized in energy efficiency programs designed for low-income households (Gamtessa, 2013; Parker et al., 2005). It is also essential to consider thermal comfort and long term savings when designing programs for seniors or households with young children (Chen et al., 2017).

Another important factor affecting program success is reliable capital resources. The role of financial incentives in influencing home energy efficiency improvements is clearly recognized, especially among low-income households struggling with constrained financial resources and poor-quality housing conditions (Gamtessa, 2013; Kravatz et al., 2018). On this basis, preliminary research to identify program funding is required (Drehobl et al., 2018). Determining available funding early can help program designers develop a budget and narrow the program scope (Drehobl et al., 2018). Common funding sources include local and national businesses, non-profit organizations, utilities, municipalities, and federal governments (Drehobl et al., 2018). Healthcare organizations are other organizations that can share costs with energy efficiency programs and integrate them into co-funded programs targeting low-income households (Kravatz, et al., 2018). Low-income households living in older or poor-quality housing conditions often suffer from higher rates of asthma, respiratory infections, and mental health problems, increasing healthcare demands and costs (Kravatz et al., 2018). Therefore, addressing the home as a social determinant of health is necessary. This approach allows health program administrators to leverage their existing knowledge to make a connection between poor housing conditions and health care burdens, share costs with energy efficiency programs, and move quickly by combining experienced staff in energy efficiency programs with staff in healthy housing to deploy programs that aim to reduce both healthcare and energy costs and demands (Kravatz et al., 2018). Accordingly, policymakers and energy efficiency program designers

should consider collaboration with healthcare organizations to improve the co-benefits of the programs and reduce program costs.

Marketing is another significant determinant of program success. Dunsky Energy Consulting (2013) notes that individualized marketing channels and approaches may be necessary to target different audiences and meet their information needs. For example, realtors, affordable housing providers, large portfolio owners, and low-income households may each require a specifically targeted marketing and outreach strategy. Recognizing the target audience's unique needs and challenges and designing a marketing program accordingly is thus essential for increased success (Dunsky Energy Consulting, 2013). Individuals from vulnerable groups (including low-income households, those with lower education levels or no formal qualifications, and those who live with someone with a long term health condition or disability) are likely to need more help to navigate the application process and use new technologies (Sovacool et al., 2017). Therefore, policymakers and program administrators must consider participants' education and background and expand the available information to facilitate participation among vulnerable groups (Cluett & Amann, 2016; Craig, 2016). This could include technical experts providing educational components in marketing campaigns (Cluett & Amann, 2016; Craig, 2016). It is also important to have committed leaders and staff with the internal motivation to facilitate communication between program administrators and potential applicants and encourage community members to participate in the program. In that regard, Kraft-Todd et al. (2018) highlight that those programs with promoters or champions engaged in these programs (e.g., solar ambassadors who install solar PVs through the solarize program) are more successful at persuading others to participate because their actions are more convincing than words alone. The fact that promoters engage in such activities provides a credible signal that they believe the action is beneficial, which is a strong signal to other prospective participants (Kraft-Todd et al., 2018).

Program implementers should conduct a pilot program to measure the efficacy of a program and its policies and identify unforeseen challenges before rolling it out to target groups (Cipriani et al., 2020). A pilot program allows policymakers, program administrators, and program designers to test the chosen strategies and determine their effectiveness in achieving the program objectives. Pilot programs—which should be rigorously evaluated—may also identify unexpected challenges that program designers and implementers can address before a full-scale launch. Those policies that do not support participants' engagement or prevent widespread participation can also be recognized and addressed in advance (Drehobl et al., 2018; Cipriani et al., 2020).

Transparent, independent, third-party evaluations are important for determining the effectiveness of an energy efficiency program and ensuring that the program is meeting its intended goals (Todd et al., 2012; Cipriani et al., 2020). Barbier (2014) notes that the energy efficiency program's impacts on its target audience should be evaluated in both positive and negative ways. He suggests that rather than considering the immediate effects of climate mitigation and policies on poverty and low-income households, assessing program design and implementation must be based on their potential long term impacts and trace more complex consequences that can occur after policy implementation (Barbier, 2014). For example, the property owner contribution policy, a required criterion for participating in the WarmChoice

program, created a barrier to the participation rate when the property owners were not financially qualified or refused to cooperate (Andrews & Poe, 2019). Removing this requirement in 2017 and developing and implementing a strategy specifically targeting rental customers increased the participation rate to 67% from 15% (Andrew & Poe, 2019).

Even when not required by regulators, a third-party evaluation helps the program administrator determine if the program has met its objectives through accurate calculations of appropriate outcomes (e.g., energy savings and greenhouse gas reductions) (Cipriani et al., 2020). Evaluations should measure energy use before and after the program and other socioeconomic outcomes the program aims to achieve (e.g., quality of life, engagement, health) (Drehobl et al., 2018; Cipriani et al., 2020). Finally, in evaluating program outcomes, municipalities or other program administrators should identify specific indicators for measuring impressions, engagement, attitudes, behaviours, and environmental and energy impacts (Drehobl et al., 2018). It is recommended that 10% of the total administration fees of PACE/LIC programs are dedicated to the evaluation budget (Cipriani et al., 2020).

Promising Strategies and Practices

This section considers strategies and opportunities for future LIC/PACE and energy efficiency financing programs. The following strategies and practices are derived from an examination of factors that contributed most to the success of a range of existing programs:

Simplified Administrative Processes

An analysis of existing North American LIC/PACE programs, including the Sonoma County Energy Independence Program (SCEIP) in California and the Halifax Solar City program, underlines the value of a clear and straightforward application process, flexible terms and conditions, alternative qualifying metrics for LMI households, and a simple and clear communication process between applicants, administrators, and contractors (Dunsky Energy Consulting, 2013). Gilleo et al. (2017) also suggest that simplified program administration is critical to success.

Heeter et al. (2018) identify strategies and approaches that could be implemented to improve access to energy efficiency programs among LMI households with low credit scores:

Loan Loss Reserve Mechanism. Programs can establish a loan loss reserve account for each LMI participant to cover losses if participants are unable to repay their loans. For example, the Mass Solar Loan Program in Massachusetts established a loan loss reserve account for each participating lender in the program. Loan loss reserve mechanisms allow LMI households to obtain financing at lower interest rates despite low credit scores. The funds in the loan loss reserve account will not be used if no losses occur (Heeter et al., 2018; Kennedy et al., 2020). In Canada, the City of Kingston, Ontario, also plans to establish a loan loss reserve for its Kingston Home Energy Retrofit Program (KHERP) to minimize the concerns of mortgage lenders (City of Kingston, 2021).

Alternative qualifying metrics. Establishing new qualifying options (e.g., utility bill payment history) that allow LMI households to demonstrate creditworthiness in ways other than a credit score can expand access to energy efficiency programs. In the U.S., the Solstice Initiative (a

community solar developer) with the Department of Energy (DOE) Solar Energy Technologies Office gathered customer data on income and utility bill repayment history to test whether new qualifying metrics would expand access to community solar to additional households (Heeter et al., 2018). For energy efficiency programs aimed at multi-residential buildings, Ross et al. (2016) highlight the "single point of contact" or "one-stop-shop" strategy as a more effective way to reach target groups.

Single point of contact. This approach combines all the behind-the-scenes services required for an energy efficiency program and places them under “one roof”, streamlining the implementation process and addressing customers' needs. The single point of contact can assist the property owners and managers of multi-residential buildings through each program step and ease the process (Gilleo et al., 2017; Ross et al., 2016).

Market Segmentation and Targeted Program Offerings

Several LIC/PACE programs administrated by U.S. utilities offer a portfolio of low-income energy efficiency programs focusing on different types of customers, including high-energy users, seniors’ customers, renters, and multifamily building owners. This segmented approach to program design, marketing, and communication allows program administrators to get information about efficiency programs more effectively from their target markets (Gilleo et al., 2017).

For programs targeting multi-residential buildings, Ross et al. (2016) note that program administrators need to contact the people who can make decisions and devote time to oversee projects and ensure completion (e.g., building owners), and increase participation in programs.

Leveraging Diverse Funding Sources

This strategy emphasizes the value of combining funding sources to address a comprehensive set of measures at each project site that otherwise may not be feasible with just one funding source (Gilleo et al., 2017; Parker & Rowlands, 2007; Ross et al., 2016). For example, utilities (both electric and gas) and municipal program implementers can carefully combine funding streams to provide health and safety services in cases where efficiency upgrades may not be possible before structural issues such as roof leaks are resolved (Gilleo et al., 2017). In the U.S., many utility-led programs leverage federal rebates and other state or local funds to maximize flexibility in dealing with non-cost-effective structural issues (Gilleo et al., 2017). In Canada, climate and energy-focused programs such as the EnerGuide program also encourage municipalities to partner with utilities and other interested parties to share costs and help sustain popular climate change programs (Parker & Rowlands, 2007).

A co-funded program model, such as collaborations between healthcare providers and energy efficiency program administrators, benefits both partners and the vulnerable populations they serve (Brown et al., 2020; Dryden et al., 2018; Kravatz et al., 2018; Spillman et al., 2016). In the U.S. context, Spillman et al. (2016) suggest that Medicaid funding could be used to educate residents about the health benefits of home energy upgrades, such as improving heating, cooling, and air conditioning (HVAC) systems, installing air filters, plugging air leaks, and improving insulation.

Marketing Strategies

Marketing plays an essential role in improving program participation and engagement. To effectively reach their target audiences, energy efficiency program administrators need to identify the channels their audiences use to gather information, who they trust to assist them with making decisions, and which messages are most apt to encourage them to join the program and become more energy efficient (Dunsky Energy Consulting, 2013). Multiple strategies and approaches can be used to extend the reach of program marketing and delivery:

Formation of partnership with third parties: (market push mechanisms or co-marketing approach). Marketing collaboration with a third party (e.g., local healthcare organizations or community-based organizations) that regularly contact homeowners can help program administrators reach key communities, target audiences, and hard-to-reach groups (Cipriani et al., 2020; Gilleo et al., 2017). The most promising partners are those that are trusted and have frequent touchpoints with the target audience to leverage existing outreach efforts and channels (Heeter et al., 2018). Other local actors for co-marketing may include contractors, suppliers and installers of insulation, home improvement retailers, building supply stores, energy auditors, architects, (other) building professionals, and local influencers (Cipriani et al., 2020). This strategy requires training these partners on program details and benefits, providing them with marking materials, and listing these partners on the program website (Cipriani et al., 2020). For example, to connect LMI households, it can be effective to approach them with a bundle of several related programs and use existing outreach for related offerings. These partners, who include community LMI groups, existing LMI programs, and housing authorities or providers, are often known within the LMI households and have the trust of community members, which is important for gaining participation (Heeter et al., 2018).

Focus marketing and outreach on a specific segment of the market. Targeting various segments through marketing and outreach efforts can help program administrators better reach customers. A successful strategy will help decision-makers in different segments understand the potential costs and benefits of an energy efficiency program for their properties (Ross et al., 2016). For example, it may be best to reach out to customers with lower education levels with simpler messages, such as basic information about renewable energy technologies (Heeter et al., 2018). In this regard, Andrews & Poe (2019) highlight an innovative marketing strategy in Ohio for the “e3 smart program.” This program provides free instructional materials focusing on the science of energy efficiency to teachers in the 4th through 12th grades. Students also receive free energy-efficient products to install in their homes, including an energy-efficient showerhead and kitchen and bathroom aerators. The initiative helped raise awareness about energy efficiency programs among households with children (Andrews & Poe, 2019).

Messaging strategies. Effective messaging is important for high participation in energy efficiency programs (Ross et al., 2016). Investments and improvements to properties must provide owners with benefits to encourage them to invest and implement energy efficiency measures. While energy savings and cost reductions are typically emphasized in marketing materials, programs must also market the non-energy benefits (e.g., thermal comfort, indoor air quality, etc.) from energy efficiency improvements (Ross et al., 2016). However, messaging that emphasizes only the benefits may increase skepticism about the program's legitimacy among potential participants (Heeter et al., 2018). Instead, messaging should convey both the program's

benefits and costs. Messaging with cost information reinforces the program's legitimacy and reduces perceived risks. With transparent cost structures, participants can be confident that no hidden contractual terms could hurt them in the long term (Heeter et al., 2018). In addition to the multiple benefits of energy efficiency and the program's costs, messages need to include actionable guidance—clear steps to learn more about program services and information on how to enroll (Ross et al., 2016).

Use of effective communication methods (Market pull). Using appropriate communication methods to reach each market segment can improve awareness and engagement with the program (Heeter et al., 2018). Special events, community campaigns, and community programs are some effective channels. Utility companies may be good partners due to their ability to raise awareness with promotional material, bill inserts, and website links (Cipriani et al., 2020). Utilities may also be able to help target the program to neighbourhoods with high utility costs or higher usage rates. Community groups, such as faith communities, sustainability-focused organizations, and schools may be able to help communicate the benefits of energy efficiency retrofits and the energy efficiency programs such as LIC/PACE financing (Cipriani et al., 2020; Dunsky Energy Consulting, 2013; Gillingham & Bollinger, 2017; Heeter et al., 2018). Here, Andrews and Poe (2019) identify a different strategy to extend awareness about the WarmChoice program. This strategy involved providing reusable grocery bags with program material inside to local food markets. This approach builds on the credibility of the local social services and is delivered in a familiar and positive way (Andrews & Poe, 2019). Face-to-face contact (door-to-door canvassing or neighbour-to-neighbour communications) is another effective method for contacting potential participants (Dunsky Energy Consulting, 2013). To maximize the impact, this method can concentrate on a neighbourhood scale for a limited timeframe (Dunsky Energy Consulting, 2013).

Technical Scope

Gilleo et al. (2017) emphasize ongoing training for contactors and implementing quality controls to address the technical issues that can arise due to a lack of trained staff. Dedicating funding to regular training and having strict quality control requirements for all projects helps contractors to perform high-quality work (Gilleo et al., 2017).

Policy Scope

Policymakers play an essential role in the future of energy efficiency programs. It is important to understand the applicable laws and regulations, emphasize promotion policies, and reduce the impact of barriers related to existing laws and regulations (Bell et al., 2011). Based on these priorities, two different strategies can be considered:

Policies that promote participation drivers. Future strategies and programs developed by policymakers, program designers, and others involved in adopting energy efficiency programs should focus on promoting those factors that drive program participation, as opposed to a more traditional focus on reducing barriers to participation (Adachi, 2009). This strategy can include the following policies:

- Energy literacy promotion policies**.** Low-income households can be more proactive if they have an expanded knowledge base regarding energy conservation efforts through retrofit projects. Policies promoting greater awareness of energy conservation, ways to lower utility costs, and a basic understanding of how energy works and renewable energy technologies can reinforce a shift towards greater energy efficiency. These efforts can be facilitated with the help of non-profit and community-based agencies or by utility companies that offer discounted rates and other services to those experiencing financial hardship (Hernandez & Bird, 2010).
- Incentive policies**.** Various incentive policies (including local, provincial, and federal incentives) can be used to share the investment cost and encourage potential participants to switch to greener initiatives (Perera et al., 2018). Federal, provincial, and municipal governments should encourage incentives for vulnerable groups such as Indigenous communities, seniors populations, new immigrants, etc. (Rana et al., 2021).

Policies that address barriers to participation. Certain existing policies, including those that require property owner contributions, limit services to dwellings with a specific number of units or require mortgage lender approval, present barriers to participation in energy-related programs. Policymakers are encouraged to change these policies for future programs to foster greater program participation (Andrews & Poe, 2019).

SECTION 6. Recommendations

Energy efficiency financing programs such as local improvement charge (LIC) and property assessed clean energy (PACE) can provide critical assistance to populations struggling with poor housing conditions and their adverse effects, helping them to improve their housing conditions and save energy. These programs may also help municipalities tackle climate change within their jurisdictions. However, these programs face numerous challenges and barriers, which can adversely affect the programs' development and impact. This study provides insight into the challenges and barriers confronting participants and stakeholders and investigates successful strategies to provide greater support to LMI households. The following sections provide recommendations for future programs:

Program Design

A successful program begins with effective program design. For effective program design, the following recommendations should be considered:

- Major stakeholders' perspectives should be considered when designing energy efficiency programs to minimize the associated risks and difficulties between stakeholders (Rana et al., 2021).
- Household socio-demographic conditions, including income, age, level of education, household size, language, and gender, should be taken into account in program design since these factors affect an individual's decision to adopt green initiatives, their energy-related behaviour (such as their overall energy use), and their housing conditions (e.g., low-income households often experience poorer-quality housing conditions) (Cluett & Amann, 2016; Rana et al., 2021). All these variables should be considered in designing different components of a program, including eligibility criteria, terms and conditions, eligible retrofit measures, and marketing processes.
- When considering the role of customer driver variables, future strategies and programs developed by policymakers, program designers, and others involved in the adoption of energy efficiency programs should focus on promoting those factors that drive program participation, as opposed to a more traditional focus on reducing barriers to participation (Adachi, 2009).
- Programs should be designed with the flexibility to address minor health and safety issues. Collaboration with local housing rehabilitation organizations to address more significant problems, including durability improvements to the homes of low-income participants prior to energy efficiency retrofits, is also recommended (Cluett & Amann, 2016).
- Energy efficiency programs should be designed to offer a wide range of eligible measures (e.g., upgrading the HVAC system, improving insulation, changing doors and windows, draft proofing including caulking, weather stripping, duct sealing, and additional electric plug loads) so they can address a wider range of challenges beyond simply achieving energy savings, such as health and safety issues, home durability,

arrearage reduction, and electricity terminations and reconnections (Berg & Drehobl, 2018; Cluett & Amann, 2016; Dunsky Energy Consulting, 2013).

- Program administrators should assess the positive and negative effects of the program design and implementation on the target audience in the short and long term. They should also trace more complex consequences, such as financial qualification requirements acting as barriers to participation, that can occur after policy implementation (Barbier, 2014; Rana et al., 2021).

Policies and Regulations

- Certain existing policies, including those that require property owner contributions, limit services to dwellings with a specific number of units or require mortgage lender approval, present barriers to participation in energy-related programs. Policymakers are encouraged to change these policies for future programs to foster greater program participation (Andrews & Poe, 2019).
- Low-income households can be more proactive if they have an expanded knowledge base regarding energy conservation efforts through retrofit projects. The efforts to build this knowledge base can build trust within low-income households and interest in energy efficiency programs (Cluett & Amann, 2016). In this regard, seniors are an important segment of LMI households that should be educated about changes in climate, their consequences, and the impact of energy efficiency programs (Doris, 2020). Policies that promote a greater awareness of energy conservation and ways to lower utility costs and a basic understanding of renewable energy technologies can reinforce a shift towards greater energy efficiency. These efforts can be facilitated with the help of non-profit and community-based agencies or by utility companies that offer programs and other services to those experiencing financial hardship (Hernandez & Bird, 2010). This education can happen through a mixed-media approach, including television, radio, newspapers, posters, workshops, flyers/mailouts, social media, etc. (Doris, 2020). Public lectures and events in community centers can also be helpful, and such events should be encouraged through policies and regulations (Doris, 2020).
- High household income levels could negatively affect participation in energy efficiency programs, as energy costs comprise a smaller proportion of their monthly expenses, suggesting that policymakers may need to target low-income households for better program participation (Gamtessa, 2013). Policymakers should consider the influence of social and health factors on program participation and should emphasize policies and funding programs that aid housing retrofits in terms of the co-benefits of addressing environmental priorities and social and public health concerns (Tsenkova, 2021).
- Prioritizing energy retrofit incentives for residential buildings and providing households with appropriate incentive levels can encourage customers to participate in programs (Perera et al., 2018). On this basis, the financial incentives policy should follow the changes in population demographics and changes in the costs of different technologies, systems, and anticipated operational cost savings (Rana et al., 2021). Moreover, special emphasis should be placed on providing incentives for new technologies and systems

that yield maximum environmental benefits and cost savings for occupants (Rana et al., 2021).

- For multi-residential buildings, it is recommended that policymakers promote policies and regulations that encourage property owners, building managers, and residents to make improvements in units and common areas. Programs should provide incentives and rebates to reduce the cost of both in-unit measures and centralized energy efficiency equipment (Cluett & Amann, 2015). Incentives and rebates can be used to replace building systems such as the core HVAC system or in-unit appliances. To further encourage the installation of in-unit and common area measures, some programs require that in-unit measures be installed before building owners are eligible to receive rebates for measures installed in common areas (Cluett & Amann, 2015). This approach ensures that tenants who pay their own utility bills benefit from in-unit measures while building owners become eligible for common area measure rebates (Cluett & Amann, 2015).

Administrative Process

- Administrative requirements and the processes required to meet them must be simplified and clarified (Adachi, 2009; Andrews & Poe, 2019).
- Changing requirements for energy savings targets or setting minimum savings levels for low-income energy efficiency programs may improve participation (Berg & Drehobl, 2018). Accordingly, program administrators can quantify associated non-energy or co-benefits into the cost-effectiveness calculation to demonstrate the value of these programs (Berg & Drehobl, 2018).
- Using utility billing histories as a proxy for creditworthiness may allow LMI program applicants with poor credit scores to qualify for financing, thereby expanding the pool of eligible program participants (Bell et al., 2011).

Marketing

- Marketing strategies should target specific demographic groups and speak directly to their specific needs (Berg & Drehobl, 2018; Drehobl & Ross, 2016).
- The purpose and benefits of LIC/PACE financing should be explained in a transparent and simple manner, particularly in areas where these types of programs are a new concept (Adachi, 2009).
- To design an effective energy-saving campaign targeting low-income households, seniors, and families with young children, the money-saving potential, improvement of thermal comfort and indoor air quality, and improvement of health conditions should be all highlighted (Chen et al., 2017). Some key messages to emphasize in marketing material include (Cipriani et al., 2020; Dunsky Energy Consulting, 2013):

    - Retrofits improve home performance and make homes more comfortable. Adding insulation and air sealing can reduce drafts and create more consistent temperatures throughout the home.
    - Retrofits can modernize the home by bringing it up to modern standards, close the energy efficiency gap with newly built homes, and improve the market value of a home.
    - Energy-efficient homes are healthier - well-insulated, air-sealed homes have improved air quality and ventilation and are less likely to have mould issues and drafts.
    - Energy-efficient homes save money on utility bills because utility bill savings will always be uncertain and dependent on occupants' use patterns. Thus, marketing materials should avoid giving concrete values.
    - Comprehensiveness matters - there are more benefits from whole-home retrofits than individual measures, and energy-efficient homes are more resilient to power outages and generate fewer greenhouse gases (GHGs).
- Program materials should detail the sources of program funds, the structure of the program and repayments, and any hidden charges associated with administration fees (Dunsky Energy Consulting, 2013). The “small print” for the program should be accessible to applicants and easily understood. This information should include the following:
    - Homeowner eligibility requirements.
    - Eligible projects and measures.
    - Loan terms and repayment schedules.
    - How loans are repaid.
    - Any upfront costs.
    - What happens to loan repayments if a home is sold.
    - For LIC/PACE programs, it should be emphasized that loans are tied to the property, not the owner.
- Programs should use multiple marketing channels, including market push mechanisms through local actors and other organizations and market pull mechanisms through education and awareness campaigns (Cipriani et al., 2020).
    - In addition to using mainstream media channels, such as TV, local media, and direct mail, programs should also reach out directly to LMI households by including informational and promotional materials with utility bills (Cipriani et al., 2020; Heeter et al., 2018).
    - Program administrators are encouraged to develop relationships with key local partners and community-based organizations that have already invested time

and energy in gaining trust and credibility within the community (Stern, 1986; Bell et al., 2011; Cluett & Amann, 2016; Dunsky Energy Consulting, 2013; Gillingham & Bollinger, 2017; Tsenkova, 2021). Community-based marketing can be a highly effective complement to conventional mass marketing tools, helping to achieve higher uptake rates for cost-effective energy improvements (Dunsky Energy Consulting, 2013). These third parties can be local food markets, contractors, suppliers and installers of insulation, home improvement retailers, building supply stores, energy auditors, architects and (other) building professionals, and local influencers (Cluett & Amann, 2016; Cipriani et al., 2020). The healthcare sector can also be a strong partner in improving the energy efficiency of households, particularly low-income households. Because energy-inefficient homes are often associated with several adverse health conditions, collaboration and co-funding across the energy and healthcare sectors create new opportunities and benefits for organizations in both fields and the vulnerable populations they serve (Brown et al., 2020).

- Workplaces, faith communities, unions, clubs and organizations, community groups, and schools offer additional channels to reach target audiences. Other methods (such as posters or signs at retrofit sites, information tables, and social network pages combined with localized branding to create visibility and a community buzz for the program) may make participation ‘fashionable’ and a social norm (Dunsky Energy Consulting, 2013; Gillingham & Bollinger, 2017).

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