Community Engagement Project:

Stimulate and advance the best practices for residential renewable energy technology in the City of Burlington

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Abstract

The global climate change issues highlight the urgent need for policy changes at all orders of government to shift from fossil fuel to renewable energy. The City of Burlington declared a climate emergency in 2019, which included an aim of developing a renewable energy framework that would target and assist its residents cut emissions by 2050. This study evaluates the best practices for renewable energy technologies, systems and incentive tools and recommends a policy framework that can be adopted by the City of Burlington to help its community respond to the climate emergency. A combination of primary and secondary research tools consisting of literature reviews, case study analysis, an online survey, stakeholder engagement and focus group meetings were used to develop this framework. Key variables that are analyzed include current city initiatives, resident engagement, and demographics, along with availability of renewable energy technologies. Our findings show that Burlington needs to better address the needs of its residents to meet its goal. Burlington residents want to learn about renewable energy alternatives, their technical details, the environmental and economic advantages, and information on skilled workforce that can help with installations. In addition, financial incentives in the form of grants, tax exemptions, and interest-free loans would help with the upfront costs and encourage residents to adopt renewable energy systems.

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Acknowledgements

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We would also like to extend our gratitude to all the residents, private and public members, and other stakeholders we engaged with, without whom this report would not be possible.

With this report, our student team aims to help and inform the creation of a Renewable Energy Program in the City of Burlington.

1.0 Introduction

The City of Burlington declared a climate emergency in 2019, unveiling the development of a Climate Action Plan (Climate Action Plan, 2021). This plan was approved by the city council which emphasized the transition from traditional systems to renewable technologies, particularly in residential buildings to overall help the city reduce its emissions and use of fossil fuels by 2050. In efforts to accelerate this goal, the city is looking for ways to engage with its residents to assist them in installing renewable energy technologies and systems.

The primary aim of our research is to investigate the best practices for residential renewable energy technology for the City of Burlington and find ways to accelerate and stimulate the adoption of these technologies among residents. Our research identifies the key drivers that will encourage residents of Burlington in adopting renewable energy technologies and systems and provides the City of Burlington with a policy framework on what they can do to accelerate implementation by residents.

The Organization for Economic Co-operation and Development (OECD) calls cities “engines of national growth” (OECD iLibrary, n.d). This reflects the huge role cities have in helping nations meet their economic, social, and environmental goals. The installation of renewable technologies in buildings is an effective strategy for cities to decarbonize their energy supply, achieving up to 40% reductions in energy sector emissions (C40 Cities Climate Leadership Group, n.d.). This can be done through the utilization of different design strategies such as the inclusion of active and passive architectural components. Research suggests that municipalities are key players in carrying out this transformation in buildings and accelerating implementation of renewable technologies is only possible if the municipalities take a holistic approach (Quest Canada, n.d). Raising awareness, adopting renewables in municipal buildings, promoting long-term benefits of the technologies, introducing financial subsidies in the shape of loans, tax returns, and rebates, all while instilling positive attitudes in community members about the development of renewable energy could best be pursued by municipalities.

Currently, the City of Burlington does not have any program that specifically targets residents or encourages them to adopt renewable energy technologies and systems, therefore our research is unique in the information it gathers and presents to the city. Further several other municipalities are looking to reduce fossil fuel consumption and transition to green energy alternatives. Thus, the findings from this study can inform cities similar to Burlington, Ontario.

2.0 Literature Review

Presently, all energy uses, including production, storage, conversion, and consumption in residential and commercial sectors account for more than 70% of greenhouse gas emissions which requires a straightforward and sustainable transition. (Karaca, Dincer, 2020).

Renewable energyresources currently provide 18.9% of Canada's total primary energy supply (Canada G. o., 2017). Moving water, is themost important renewable energy source in Canada and accounts for 59.3% of Canada's electricity generation followed by wind energy at 3.5%, and biomass at 1.4%. Wind and solar photovoltaic energy are among the fastest growing sources of electricity in Canada (Canada, 2017).

Designing a sustainable energy future that includes efficient energy usage and renewable energy technology necessitates the cooperation of stakeholders, local ownership, and acceptance (Tanay Sidki Uyar, 2017). Stakeholder support has been advocated by Alanne & Saari (2005) with a focus on small-scale and decentralized systems. They emphasize that decentralization entails not just the use of innovative technology but also greater social engagement. These innovative distributed energy resources can be combined into local communities to produce integrated community energy systems (ICESs) (Li et al., 2021).

ICESs are a novel approach to reforming local energy networks which enable the integration of distributed energy resources (DERs) and community participation at the same time (Koirala, 2016). Canadian communities are tapping into greener ways to heat, cool and light their buildings using district energy systems. Many energy sources employed in district energy systems, such as biomass, sewage, lake water, or seawater on a local scale are not practical or cost-effective. The energy source for a district heating system is decided by considering the dynamics of the region, the availability of local resources (which has an influence on pricing), and community willingness (International District Energy Association, 2019).

Research published by Energy Sage confirms that photovoltaic (PV) panels have a strong potential to become one of the main energy generation elements in local energy communities (LECs). It further reiterates that a sharp drop in the price of PV panels and increase in PV efficiency, reaching 47.1% in 2020 could be the predominant factors (Matasci, 2022). However, concerns for uninterrupted implementation of solar projects still persist. These include upfront costs, management of distribution network, and issues of solar curtailment (reduction of generated electricity below the level it would otherwise have produced) which need to be further considered. To foster the concept of solar communities and make ICES run more smoothly, the City of Burlington can play the role of a regulator like other municipalities in the province of Alberta where "The Renewable Electricity Act" is an overarching piece of legislation that focuses on the promotion of renewable energy generation in the province (Solar law in Alberta, 2021). The city might find it useful to examine some of the issues identified by Lazdins et al. (2021) such as financing issues, policy support, social acceptability, and an appropriate management structure.

Community Energy Plans (CEPs) are found to be successful at the nexus of municipal support, stakeholder interest, and citizen participation. In any renewable energy adoption, the city needs to plan a framework to action its goals. For instance, the Town of Cochrane, Alberta, created a renewable energy framework to transition to renewable energy programs, and listed short-, medium-, and long-term goals they must achieve to meet their target action goals (Renewable energy framework, 2015). In the Town's council plan, strategies included engaging with residents to get feedback on renewable energy transition and level of interest. The feedbackwas incorporated in their framework revision prior to establishing the final action plan.

Incentive tools are a major focus in policy recommendation for catalyzing the transition to green energy. The purpose of economic instruments is to encourage receivers to voluntarily change their behavior (Taylor et al., 2012), as well as to deliver a viable market signal (Liu et al., 2021). In the case of Burlington, the goal will be to encourage residents to pursue a low- carbon living scenario with adoption of renewable energy technologies in their homes.

There are several categories of financial incentives or disincentives including "tax, loans, grants, and rebates" (Rana et al., 2021) and "noncompliance penalties and non-performance penalties" (Blackman et al., 1980). However, not all of them are suitable for municipal deployment given degrees of power, administration costs, and resources. For example, grants are more appropriate at the federal level due to the need for significant funding (Curtin et al., 2017; Rana et al., 2021). It is necessary for a municipality like City of Burlington to compare those models and determinetheir feasibilities with respect to regional conditions.

Existing disincentives should also be analyzed. For instance, the price of fossil fuels such as natural gas and oil are rising (Botterill et al., 2021), with annually growing carbon pricing add-ons to the fuel expense (Environment and Climate Change Canada, 2021). Using traditional combustion fuel as an energy source will continue to raise residents' expenses. To avoid this, the City of Burlington could accelerate the transition to renewable energy sources byproviding financial incentives to their residents. While the performance of those rebate or refund programs could fluctuate based on the availability of funding, cost for equipment and electricity, they have shown to successful in encouraging the switch by residents to renewable energy technologies (Bennear et al., 2013; Sun et al., 2022).

Municipal policy approaches to renewable energy programs strongly depends on available financial resource and financial scale. Those municipalities with considerable income are more likely to invest more in renewable transition (City of Edmonton, 2020)). However, cities smaller in size rely more on federal and external funding to launch their projects (City of Markham, 2018;2020). Without consistent funding, it is commonly seen that their projects are limited in time with relatively narrow coverage. Burlington, as a medium size municipality, would require continual financial resources to sustain an incentive policy. Sponsorship from non-profit organization and other orders of government, along with collaborations with private sector should be considered as possible financial resources for the Burlington's program (Federation of Canadian Municipalities, 2022; Government of Ontario, 2021).

3.0 Methodology

The methodological approach for this research consisted of a combination of primary and secondary research analysis through literature reviews, case study analysis, stakeholder engagement, an online survey, focus group meetings and document review of municipal, provincial, and federal policies and frameworks. This mixed methodology is to capture the complex municipal policy making based on the localized conditions of public attitude, environment, and corresponding resources.

An in-depth feasibility assessment analyzed case studies consisting of cities around Canada that have already implemented and developed a renewable energy program/framework. Efficiency in energy generation varies by location and geographic characteristics of a region. and influences renewable energy selection. Therefore, assessing the geographic parameters of Burlington was a qualitative method used to estimate the potential of each possible green energy. Secondary data such as carbon consumption, greenhouse gas emissions, wind availability and hours of sunlight per year was obtained from existing databases including Natural Resources Canada and the City of Burlington. Case studies were analyzed in terms of their policy focus, program scale and coverage, collaboration models with private sector and financial resources. We hypothesized that there is a significant relationship between a city's availability of funds and quality/coverage of program. The actual practice of public private partnership may also result in the uniqueness and diversity of a program.

Furthermore, to understand and examine the public attitude of Burlington residents regarding transitioning to renewable energy systems and technologies, a survey was conducted to collect primary data set for quantitative analysis. The survey was launched on the official website of the City of Burlington through a survey tool used by the city called EHQ (Engagement HQ by Bang the Table Ltd). The survey questions were designed to understand the familiarity of the general population of Burlington with renewable energy. The questions gathered information on resident's income, experience in renewable energy, their expectations for possible future programs, and how the city can help.

These responses allowed us to determine the feasibility of certain renewable energy systems/technologies with the local population and check if they align with some initial hypothesis. For instance, it is possible that residents with lower incomes may be more hesitant to adopt domestic renewable technology due to affordability, while citizens who have previously installed renewable energy technologies/systems may have had negative experiences that discourage others to adopt renewable energy.

Key words such as renewable energy, integrated community energy systems, community energy planning, municipal and environmental planning, solar and wind energy, and sustainable building initiatives were incorporated into various search engines including PubMed, Google Scholar, and Google. Document to review policies and plans that shape renewable energy transition and implementation at all orders of government, to corroborate the results from the survey

responses and case studies.

To further validate the findings of our research and obtain responses from different perspectives, we conducted informal interviews with a variety of stakeholders. The stakeholders represented the local utilities, city's planning and policy development departments, contractors, consultants, residents, and developers. Seeking more diverse opinions and feedbacks, a focus group discussion was held with members from industries and local community as well as the previously interviewed individuals. Their firsthand information, industrial experience and professional knowledge were shared in order to refine our policy recommendations.

4.0 Results

4.1 Case Study Analysis

Solar and geothermal energy programs were the two most common renewable energy programs in municipalities across Canada that target residents. Halifax, Nova Scotia, and Edmonton, Alberta have successful solar energy programs with many participating residents. These municipality offer property owners solar energy options which arefinanced through the municipality itself (About Solar City, 2021). Both Halifax and Edmonton work with separate Energy Efficiency Utility partners who assist in the implementation of energyefficient projects (About Solar City, 2021). This partnership allows for the city to focus on achieving their climate goals by distributing procedural responsibilities across multiplestakeholders. These programs offer financial assistance through rebates; Edmonton has allocateda portion of their annual city budget (Solar rebate program, n.d.), while Halifax applied for the federal Low Carbon Economy Fund to finance the rebates (About Solar City, 2021).

Key variables to consider when evaluating feasibility of solar technology in municipalities are the demographics of the population, availability of sunlight, and type of housing. Some solar energy technology like solar panels that can be mounted on home rooftops require a lot of sunlight, which Edmonton receives. This can be attributed to why the program has been successful (Solar rebate program, n.d.).

Other renewable energy initiatives in Canada include geothermal energy programs in the Blatchford District Energy System in Edmonton, Alberta, and the Bercyz Glen Community in Markham, Ontario (Blatchford Renewable Energy Utility: City of Edmonton, 2020; City of Markham, 2018). These programs follow a similar model of a central energy system that distributes thermal energy to multiple neighborhoods in the same area (City of Edmonton, 2020). While this model is promising, these centralized energy systems are typically built and integrated in new-construction homes. A community energy planning study by Denis and Parker (2009) found renewable energy transitions were easier to implement on a local community level than regional levels. While this remains true for the geothermal energyprograms, it does not apply for the solar energy programs.

4.2 Online Survey

On May 11, 2022, we created and launched a survey questionnaire consisting of 18 questions which was made available on the City of Burlington's official website, "getinvolvedburlington." The survey was set to expire on May 31st, 2022, but it was extended for an additional week to increase promotion, participation, and feedback. The survey is attached in Appendix A.

Given the city of Burlington's population of over 200,000, a response of roughly about 500 people was our target. However, poor participation in the online survey with only 205 participants resulted in a statistically insignificant sample to extrapolate the outcomes. The responses though did depict some interconnected trends as seen in Table 1.

Table 1: Results of the online survey

Details		**Number**	**Percentage**
Specifications	Total Respondents	205	100%
	Own their own houses	193	94%
	House owners with installed renewables	23	11%
Building Type	Homes	17	76%
	Cottages	4	16%
	Businesses	2	0.50%
Technology Type	Solar PV	18	77%
	Geothermal	4	18%
	Solar Thermal	3	13%
	Wind Turbine	1	0.5%

Out of 94% of total respondents who owned their own houses, only 11% had installed some type of renewable technology. Further study of those who have installed these technologies reveal that 76% installed them in their homes, 16% in their cottages, and only 0.5% in their businesses. Analysis of the type of renewable technology showed that solar PV was the most popular type with 77% followed by geothermal at 18% while solar thermal and wind turbine were the least installed types respectively with only 13% and <1%. The deployed survey explored the difficulties individuals had encountered as well as the hurdles for those who had not yet placed the technology. The identified constraints included but were not limited to the need for awareness, proper dissemination of information, availability of financial incentives, and lack of access and shortage of skilled workforce as the major impediments to making the switch. The survey was also aimed at gathering information about the experience of users with the installation process, and whether they would suggest such technologies to their friends. The response of 99% of respondents was about their pleasant experience of using green technology and their willingness to recommend it to their friends.

The survey asked respondents to provide open-ended comments and recommendations related to green technology in the city of Burlington. Most of the residents were of the view that the city government should take the lead by integrating green technology in public buildings.

4.3 Stakeholder Engagements

Stakeholder views were acquired by interviews with members from multiple sectors and industries, including homeowners implementing green technologies in their homes, builders and developers, contractors and consultants, and city staff. Despite the diversity in interviewees' background, surprisingly they shared some common challenges in the adoption of renewable transition. Table 2 summarizes stakeholder views regarding the barriers in implementing sustainability technologies.

Particularly regarding solar energy, the issues about getting approval from Burlington Hydro and the city's building department were commonly raised by the private sector and residents. The local hydro company requires all the applicants with solar power output over 10kW feeding back to the grid to have pre-connection assessment. Such a requirement has caused additional expenditure and delays in project progress. Furthermore, a building permit is also required in order to install the solar panel on the rooftop and there were some complaints about the long processing time for the permit application. Those barriers may impede other landlords to implement solar energy.

Apart from the time-consuming assessment and administration procedure, both homeowners and developers agreed the high upfront cost to be another reason for their hesitation. A significant amount of financial investment is necessary to install renewable technologies, while it usually takes more than a decade to reach the return on investment. The interviewees seek assistance from the city with financial incentives. The regional builders would favour easing the restrictions on building density in exchange of greener energy retrofit, and so their extra cost in related building design work could be compensated. Similarly, landlords seek city assistance financially in format of rebates, grants, and loans. Some of the interviewees did not know about the currently available sponsorship programs for homeowners, such as the existing incentive program offered by the federal government and the net metering services provided by Burlington Hydro. The resident's raised issues of the lack of considerable assistance from the city in accessing this corresponding information. Those interviewed noted difficulties in finding suitable contractors with service coverage to Burlington. Based on the interviews, Burlington should improve accessibility of information, could provide a list of local contractors, and should establish municipal incentive programs.

Table 2: Summary of stakeholder interviews about the barriers in implementing sustainability technologies

	Pre-connection assessment for >10kW solar output on grid	Long processing time for building permit	High upfront cost for implementation of renewable energy	Poor information access	No contacts of local contractors
Homeowners	**Y**		**Y**	**Y**	**Y**
Builders & Developers			**Y**		
Contractors & Consultants	**Y**	**Y**			
City Staff	**Y**		**Y**		**Y**

Remark: Y= yes to stakeholders suggesting this is a barrier

4.4 Focus Group Meeting

To further validate our findings, a focus group meeting with 24 experts from industry was conducted. The data and information from our research were presented to the focus group. The experts agreed with our results and findings and provided feedback/suggestions. During the meeting, there was also new information that was brought to light. A solar contractor had highlighted that the City of Markham does not require building permits for rooftop solar installations on residential buildings. This was surprising as most cities, Burlington including, do require building permits. The contractor further noted that building permits take a while to get approved and have long and complicated application processes. This was an obstacle for the contractors as well as for residents who were interested in installing renewable energy technologies.

In addition, the experts expressed concerns regarding the idea of the city providing a list of approved contractors or skilled workforce, whom residents can contact for the installation of renewable energy technologies and systems. This is because the City can face liability issues if something goes wrong in a resident's homes with a contractor the city recommended. Further, there can be political interests and biases on the recommended skilled workforce list that can again cause issues for the City. Instead, some experts suggested the use of existing third-party associations that the residents can examine.

Minor changes and revisions were suggested by the focus group to hone the final policy recommendations.

5.0 Discussions

. There were similar trends and patterns that consistently emerged from all the analyses. The data and information were aggregated, and three recurring themes were formulated. These include: 1) information sharing and summarizing, 2) availability of information about the skilled workforce, and 3) incentive programs.

5.1 Theme #1: Information Sharing and Summarizing

There is not enough information regarding renewable energy systems and technologies or the process of adopting them on the City of Burlington website. This poses a challenge for residents who are interested/considering making the switch to green energy alternatives.

There are different renewable energy technologies that can be adopted and installed at the household scale. Factors including geographic location of a city or house, availability/access to renewable energy type, economic status, social preferences, and environmental knowledge all influence whether citizens decide to adopt renewable technologies.

Several cities across Canada including Edmonton, AB and Halifax, NS have successfully initiated Solar PV programs that encourage residents to install this technology in their homes. The increased participation of residents in this program is first and foremost attributed to the abundance of information on possible renewable energy technologies/systems available to residents on their respective city websites. The city works with the utility to make the process of installation accessible and provides information from education to financing and posts an adoption checklist on their website.

Based on our interviews with residents and consultants, we learned that they believed they lacked support that could have helped them if the information on the city website clarified the process and financing methods to enable them to switch to renewable energy technologies and systems. The City of Burlington website, in their opinion, did not provide a clear guide as to what needs to be done or who can be contacted to start the process. Moreover, they reported limited information on the types of renewable energy systems/technologies that residents can consider. One of the most complex steps as heard from residents when making the switch was trying to figure out what documentation, permits and licensing were needed or had to be applied for. Some of the permits/licensing required to make changes to a household requires permission from the city and can take months, thereby slowing down the whole adoption process.

Furthermore, from our engagement with a few residents, and representatives from the local utility as well as the city, there appeared to be misunderstanding on the allotted energy generation capacity for solar PV applications on residential properties. The local utility requires renewable generation projects to be limited at 10 kW, thereby restricting any residential owner or renewable energy contractor installing anything higher, even if they have the funds or resources to do so. When this was mentioned to the local utility, there were gaps in the information that was obtained about this restriction, with some members acknowledging this regulatory limitation

and others not being aware of it. This was addressed in the focus group meeting, and it was agreed by experts that there is an imminent need for better communication and partnership between key stakeholders like the city and the local utility to provide accurate information on the process of installing renewable energy systems and technologies.

This theme was regarded as the top priority for the city. Burlington needs to reconsider its ways of engagement and communication. Traditional methods of trying to attract residents through the website portal did not appear the most effective as seen from the low survey responses and this communication gap needs to be overcome to gain participation and involvement from residents. By using new interactive systems/activities on the website to publish information, the city can attract more traffic on its website, which can also enable better data collection during any future survey deployment and other response gathering methods. This would help the city incorporate resident voices when addressing issues and creating policies.

5.2 Theme #2: A list of local contractors

Investigating the current energy source and consumption, checking local codes and requirements, deciding whether or not framework needs to operate on and off grid, approaching the right installer/contractor to finish installation reasonably, and understanding renewable technology options for the pertinent site are all part of the decision-making process (Planning for Home Renewable Energy Systems, n.d). One of the findings of our research is that residents lack information and access to the pertinent skilled labor-force, the contractors, installers, and consultants.

Contractors, developers, and consultants who design, inspire, educate residents, and implement technologies in residential domains are significant players in helping cities decarbonize the energy system. Accessing the appropriate, experienced, and competent workforce can help consumers better understand and select the appropriate green technologies. A lack of awareness of who to contact to install green technologies was mentioned by over half of the respondents in the online survey as a substantial obstacle to renewable energy adoption.

Subsequent meetings with the other stakeholders also revealed similar challenges. One of the residents talked about the time that he would have saved, had there been a list of approved skilled forces for solar and geothermal. Building on the same challenge, another resident explained how this struggle to find the local skilled workforce impels them to look outside the city of Burlington at the expense of time, energy, and money. One of the residents believed that had there been a mechanism for acquiring information related to such experts, switching to green technology would go more smoothly.

In response to the above-mentioned discussion, one of the focus group members shared that the city outsources to third parties such as the West End Home Builders' Association, who have established a website to help consumers find certified professionals in their region (WE HBA, 2022). This website is quite beneficial and serves as a platform for obtaining information about Halton region's contractors, builders, and suppliers. However, the website does not explicitly give

information on contractors or consultants that specialize in renewable energy installations. Moreover, this website is not mentioned nor easily found on the City's website.

To provide solutions to residents' inaccessibility to easy information, Burlington needs to reconsider, review, or update this method of communicating. For the residents of Burlington, the city website is the first point of information. It should have well planned and well formatted content about green technology that is easy to scan for users who might not be experts in using the web. Easy navigation to find contractors and consultants with expertise in renewable energy on this website could expedite the transition to green Burlington.

5.3 Theme #3: Incentive programs

From the result of our survey a financial incentive is a dominant factor for homeowners in considering renewable technology implementation. The success of Edmonton in solar energy promotion also demonstrates a positive outcome with the public pursuing home retrofits with municipal financial assistance. An incentive program, therefore, could be one of the possible solutions for Burlington in accelerating the renewable energy transition at the residential scale.

There are various formats of financial incentives or disincentives which the city may reference, for example, funding green initiatives by loans and grants or charging non-compliant penalties (Blackman et al., 1980; Rana et al., 2021). However, in comparison with province and federal government, a municipality usually has limited resources and therefore the feasibility varies among the incentive measures. For instance, grants require a significant amount of funding which is more practical at federal level (Curtin et al., 2017).

The loans programs can target residents with ownership of properties including detached homes, duplex, and townhomes. Increasing the supply of green residential units would be essential to improve accessibility and deliver a signal to the regional housing market. Consequently, a program that specifically incentivizes the real estate sector in implementing more low carbon alternatives could be another possibility.

To support the building/development sector to implement renewable technologies in new residential developments, the city has provided indirect compensation to cover the corresponding additional costs. Municipalities in Ontario are authorized to implement zoning bylaws and may increase the permitted building height and density in exchange of community benefits, according to Section 37 of the Planning Act (Government of Ontario, n.d.). "Provision of green technology and sustainable architecture" was included in pursuance of local benefit, which Burlington City Council has approved projects with proposal implementing "either LEED certification standards and/or compliance with the City's Sustainable Building and Development Guidelines" (City of Burlington, 2018). Nevertheless, the province passed Bill 108 More Homes, More Choice Act in 2019 and the S37 Planning Act will be soon transited to Community Benefits Charges later this year. Under the new by-law regime, the city will be no longer able to offer bonus density as an incentive for low-carbon buildings. Hence, the city has to look for other possibilities to incentivize the builders and developers.

6.0 Recommendations

6.1 Theme #1: Information Sharing and Summarizing

The City of Burlington can host educational campaigns on types of renewable energy systems and options that are available/accessible to residents to adopt when considering the switch to greener alternatives. Many residents are not aware of what green energy alternatives are and only a few of them take time to visit the city website to try to learn more. Thus, in order to create awareness among residents, it would be beneficial to provide interactive and public events to promote adoption and increase their knowledge/interest. Additionally, considering the poor response rate from the survey, Burlington can further their efforts to enhance resident engagement through various communication venues. These can include social media platforms that target the younger aged population, email, and other communication platforms for the older generation.

Burlington can also provide additional information on their website on the process of installation. This can be accompanied with the pros/cons of switching to green energy alternatives, financial incentives/programs available (federal, provincial, municipal), any utility related information (net-metering/credit/rebates for energy generation/usage) and include a FAQ section. The city could outline the types of renewable energy systems/technologies available and make suggestions for the feasibility of installation based on consumer variables (affordability, type housing, location, goal). Further, the city could describe the step-by-step guide from start to finish of how to make the transition to renewables. This can include necessary building permits, licensing, assessments, and safety requirements needed to be met as per city and utility guidelines.

6.2 Theme #2: A list of local contractors

The city of Burlington could reference, or themselves compile a list of pre-approved contractors who specialize in solar, geothermal, and other renewable technologies. Detailed information on all reputable installers, their work profiles and history of work, contact information and reviews given to them by clients will be beneficial.

The city may also consider posting contact information for consultants and design architects of green technology, with a concentration on solar, and geothermal. The list of approved developers will assist citizens in understanding the regulations and compliance issues. This will also support them in contacting the relevant company, which will help them in calculating the net cost, including purchase and installation, as well as educating them on energy and money savings. With this recommendation, the City would need to examine ways to avoid the potential liability issues of providing a list of contact information for skilled workforce.

6.3 Theme #3: Incentive programs

Interest-free loans in addition to the existing federal program would relieve the financial pressure for low-income families by helping with the upfront costs. The Canada Greener Homes Initiative provides up to CAD 5,000 grants and CAD 40,000 loans with a decade repayment term to eligible applicants in home retrofits. The grants will only be available after completion of post-retrofit evaluation, and the local landlords can only access 15% of loan funds in advance (Government of Canada, n.d.). In other words, a maximum CAD 6,000 of loans will be delivered at the early stage of the retrofit project which may not fully cover the amount of cost incurred by the residents. For those who have marginal current asset, such barrier may restrict their accessibility in any retrofit upgrades with strict requirement on down payment or green technology with better performance but higher expense. The city could help residents with additional loan covering the deviation between the upfront cost and the federal loans, which a maximum amount up to CAD 4,000 as proposed in the defined parameters setting of the following calculation.

Table 3: Demonstration of municipal loans in assisting the upfront cost

	Case A: Total cost >40,000	Case B: Total cost < 40,000	Remark
A. Total Cost of retrofit B. Down payment	$60,000.00 $12,000.00	$28,000.00 $5,600.00	 assume 20%
C. Canada Greener Homes Loan	$40,000.00	$28,000.00	assume C=A with maximum 40,000
D. Early release E. Gap in down payment (B-D)	$6,000.00 $6,000.00	$4,200.00 $1,400.00	15%, max 6,000
F. Proposed municipal loans G. Down payment (E-F)	$4,000.00 $2,000.00	$1,400.00 -	max 4,000

Table 3 demonstrates how the municipal loans can support payments. Burlington residents could enjoy free payment for the deposit up to CAD $10,000. Because of the limited amount of money that is borrowed from the city, the repayment period could be set at 2 years. The actual calculations and parameter settings could be optimized according to the allocation of financial resources and targeted coverage. As an add-on incentive, the applicants could show their eligibility by providing their application record and status of Canada Greener Homes Initiative. That paperwork requirement could also help Burlington to easily process the administration and approval progress of their own program.

The municipal incentive program requires a significant number of financial resources, and the Community Benefits Charges (CBC) could be one of the possible solutions. CBC is a new development charge targeting high density development, which enables municipalities to have extra funding for the capital cost related to development and redevelopment (Government of Ontario, 2018). The estimated income from CBC is over $4M according to the city's strategy, and

the corresponding bill is still in the stage of consultation (City of Burlington, 2022).

CBC will be an extra expense to the developers and therefore exemption or refund of the charge in green infrastructures could be another approach to incentivize the builders and developers in implementation of sustainable technologies. From the city's strategy plan, it was suggested maximum prescribed rate of 4% of land value as the charging parameter for CBC (City of Burlington, 2022). The new taxation as an additional cost would create financial barriers to the industry, causing a much stronger hesitation in applying more environmentally friendly but expensive designs such as geothermal exchange. Under the circumstance, CBC refund could be a compensation to persuade the sector to comply with voluntary guidelines of green development.

Incentive programs have an unavoidable dependence on the economic status of the city, which is a possible challenge to the city. Discontinuity could happen under the circumstances of funding reduction or instability in financial income. Because of the limited resources, the coverage in applicants and the sponsorship per application could be highly restricted. Therefore, a practical strategy planning with detailed calculation in funding distribution and prediction of cost-effectiveness would be recommended.

7.0 Next Steps

Based on the information gathered and reported, the City of Burlington should review the policy suggestions and determine what initiative is priority on their agenda. The research findings can be presented to Burlington's council committee and if determined, further follow-up research on the policy recommendations may be required. In addition, in the focus group meeting with experts, there was new information that was presented regarding varied building permit regulations for solar energy installations across municipalities in the Greater Toronto Area. Due to time constraints, additional inquiry on this topic was not completed and we suggest Burlington undertake further research in this regard. The city will also need to consider what challenges need to be overcome when implementing any of the policy recommendations. We suggest the City of Burlington strengthen their partnerships with key stakeholders and better engage with residents to build more resilient communities.

Stakeholders in the interviews and focus group discussion were from several sectors but did not cover all aspects of renewable energy systems for households. For example, the invited contractors mainly offer services in solar energy and geothermal exchange but not include all the available green building technologies. The focus group gathering could be expanded to improve coverage and be considered as a venue for regular sharing of information and updates among various stakeholders, to collectively problem solve.

8.0 Limitations

The low response rates from the survey suggests they may not be representative of Burlington's population. This also suggests the limited effectiveness of posting the survey questionnaire on the city's website for collection of public opinions. Note that only the citizens who previously registered on the platform would be notified by the email and have quicker access. The coverage of the local residents is consequently narrow. The city could consider diverse approaches, including but not limited to town hall meetings and social media, to improve the information access and public engagement.

9.0 Conclusions

Through primary and secondary research, we have identified challenges and barriers that discourage residents from transitioning to renewable energy technologies and systems and determined possible ways the city can help. These include how residents lacked knowledge on information of the various technologies that can be installed and still meet their home energy needs, absence of incentives and subsidies, high capital costs, poor support from the local utility and city with regards to who to contact to facilitate implementation (contractors, developers, builders). These drivers are important for the City of Burlington to understand and acknowledge when determining the best methods to encourage the transition to renewable energy with the provision of more support to residents.

Future work in this area should investigate the new information that was provided regarding the absence of building permits required in other municipalities in the Greater Toronto Area. Burlington can consider whether this change is possible within its regulatory oversight. From our research, it is evident and encouraging that both the City of Burlington and its residents are interested in advancing implementation of green energy alternatives.

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11.0 Appendices

11.1 Appendix A: Online Survey Questionnaire

1. What is your postal code?

   _____

2. Are you a homeowner?
   1. Yes
   2. No

3. Which of the following describes your place of residence?
   1. Single detached house
   2. Semi-detached house
   3. Row house
   4. Apartment in a building that has fewer than 5 storeys
   5. Apartment in a building that has five or more storeys
   6. Movable dwelling
   7. Other (please specify) _____

4. Which of the following best describes your total household income last year, before taxes, from all sources for all household members?
   1. Under $20,000
   2. $20,000 to $59,000
   3. $60,000 to $99,000
   4. $100,000 to $139,000
   5. $140,000 and above
   6. Prefer not to answer

5. Have you installed renewable energy at your home or business?
   1. Yes
   2. No

6. If the answer to question 5 is yes, please check off all that apply.
   1. Solar PV system (roof mounted)
   2. Solar PV system (ground mounted)
   3. Solar thermal system
   4. Geothermal (geo-exchange) system
   5. Wind turbine
   6. Other _____

7. If the answer to question 5 is no, which of the following sources of renewable energy for residential homes are you familiar with?
    1. Solar PV system (roof mounted)
    2. Solar PV system (ground mounted)
    3. Solar thermal system
    4. Geothermal (geo-exchange) system
    5. Wind turbine
    6. Other _____

8. What was your motivation to install a renewable energy system (check off all that apply)?
    1. Reduce greenhouse gas emissions and climate change impact
    2. Offset increase cost in energy
    3. Encouraged by friends or family
    4. Thinking about the future for the younger generation
    5. Government incentive program
    6. Other _____

9. How did you find the process for installation and/or connection of your renewable energy system at your home?
    1. Positive experience
    2. Negative experience
    3. Other _____

10. If the answer to question 9 is option 2 (negative experience), would you please explain, why?

    _____

11. How satisfied are you with the operation of your renewable energy system?
    1. Very Satisfied
    2. Satisfied
    3. Somewhat Satisfied
    4. Not Satisfied
    5. Not sure

12. If you are dissatisfied/unhappy with the system you have installed, what are the reasons?
    1. Technology not performing as expected
    2. Difficult to understand how to operate system efficiently
    3. Contractor promised efficiencies that I'm not seeing
    4. Too expensive and payback is too long

5. Contractor did not install properly
6. Other _____

13. Would you recommend your system to family and friends?
    1. Yes
    2. No
    3. Not sure

14. What are the challenges you face in deciding to switch to green energy home technologies? Select all that apply
    1. I am not a homeowner, and do not have control over my place of residence.
    2. I do not have the necessary income to switch.
    3. Switching to renewable energy seems to have high upfront costs
    4. I am not interested at this time; it is not a priority.
    5. I do not know how to access government incentives or other financial incentives to switch.
    6. I don't know where to start
    7. Other _____

15. Which of the following would improve the likelihood that you would switch to renewable energy in your home? Select as many that apply.
    1. Interest-Free Loan
    2. 50% grant, 50% loan
    3. Tax Reductions
    4. Rebates
    5. Other _____

16. Is there anything that the City of Burlington could do to help encourage you to implement renewable energy measures in your home (or business)?
    1. _____
    2. _____

17. Are there any general comments you would like to provide related to the use of renewable energy in Burlington?

_____