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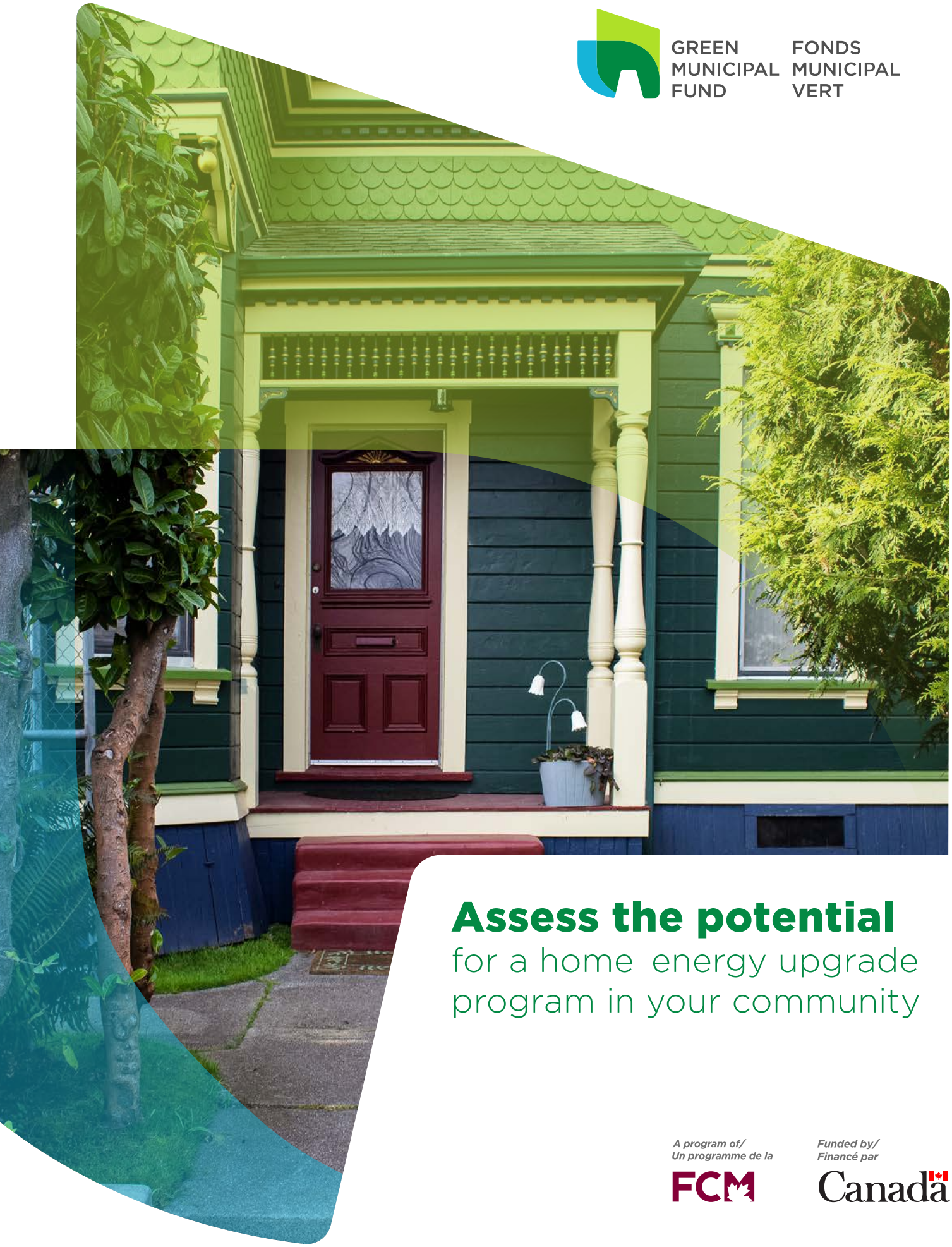

Assess the potential

for a home energy upgrade program in your community

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Delivered by the Federation of Canadian Municipalities, the Green Municipal Fund (GMF) is a $1.65 billion endowment from the Government of Canada. GMF helps municipalities implement sustainability projects and emission-reducing policies—creating lasting environmental change, improving your quality of life, and driving sustainable economic growth in your community and across Canada.

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INTRODUCTION

Home energy upgrade programs offer tailored financing options and other services to help homeowners improve the energy performance, comfort and value of their homes through energy efficiency measures, renewable energy installations and other improvements.

Local home energy upgrade programs are a win–win for municipalities and residents because they:

- reduce greenhouse gas (GHG) emissions to help meet national, provincial/territorial and local emissions targets
- provide energy cost savings for residents through lower utility bills
- make buildings more resilient and durable for facing increasing extreme weather conditions
- provide healthier, more comfortable homes for residents
- help to develop the local economy and create local jobs

FCM's Community Efficiency Financing (CEF) initiative supports municipalities and their partners with funding and resources to implement local financing programs for home energy upgrades. This user guide is part of a suite of resources that can help your municipality develop one of these programs.

Who this guide is for

We created this guide to help municipalities and their partners across Canada to assess the potential for a local home energy upgrade program in their communities. Completing the steps in this guide will help you determine whether a local home energy upgrade program makes sense for your municipality and assist you in building a case for one to present to your local council.

This guide focuses on assessing the potential for the types of home energy upgrade programs that would be eligible under FCM's CEF initiative, but the steps in it are still relevant to other residential upgrade programs.

These are the key questions this guide will help you answer:

- What are the **overall size and characteristics of the housing stock** in your community, and who would your home energy upgrade program serve? (In other words, who is the target market?)
- What level of **program uptake** could you expect? That is, what is a realistic number of homes in your community that would participate in a local home energy upgrade program if one was offered?
- What **potential impact** could the program have? How many greenhouse gas emissions would it reduce? How many jobs would it create?

FCM's Community Efficiency Financing (CEF) initiative

CEF supports municipalities and their partners in designing local financing programs for low-rise residential properties. These programs offer financing to cover the full upfront costs of home energy upgrades, which are paid back over time. See the **CEF application guide** for more information.

How to use this guide

We'll take you through the recommended types of research, methods and data sources you'll need to help you determine how feasible a local home energy upgrade program would be in your community. The information you collect in these steps will be the foundation for further feasibility work that can help you build the case for your program.

The guide is organized around four main steps:

1. **Assessing the market landscape:** What other programs, if any, are already available in the marketplace? What have they achieved?
2. **Examining local housing stock:** Is the housing stock in your community suitable for home energy upgrades?
3. **Understanding the perspective of residents:** Who are the residents in your community and how likely are they to participate in a home energy upgrade program?
4. **Putting it all together:** Using the information you gathered in steps 1–3, you'll now be able to identify your program's target market, estimate program uptake, and calculate program impact.

Each of these steps will be explained in-depth in its own section and broken down into smaller steps. Steps 1, 2 and 3 don't necessarily need to be done in the order listed here. There will be a checklist at the end of the sections for Steps 1–3 to help you keep track of the most important information to gather. Some of this information will be vital for completing Step 4.

How you complete this assessment will also depend on your municipality's local priorities, so keep these in mind as you work through the steps.

Scope and limitations of this guide

This guide is intended to be a starting point. Our focus is on assessing whether a home energy upgrade program would make sense for your community, so we don't get into some of the more complex work that you would need to do for detailed program design here.

For example, this guide does not cover reviewing relevant legislation around local home energy upgrade programs, but this is an important component of a feasibility study for a local financing program under FCM's CEF initiative.

This guide focuses on the *environmental* impact of home energy upgrade programs, although we do touch briefly on job creation impact (Step 4) and home energy affordability (Step 3). The guide doesn't cover how to plan a program with an equity lens. However, it's important to center equity and inclusion in the planning and design of any new program from the outset. We include several resources that can help you get started in Step 3.

Your council may have other priorities as well, such as energy cost savings, so you may need to do additional research and analysis to determine other impacts. It's important to be aware of your local council's priorities so you can tailor a business case to your local context.

STEP 1:

Assess the market landscape

You may want to start with a high-level scan of the home energy upgrade program landscape. What programs are already available in your community? In nearby communities? In your province or territory? Nationally?

In this step you'll review those programs and assess how well they fit with market conditions and consumer needs and preferences. What has and hasn't worked to date, and why?

Having this kind of snapshot will help you determine what your program could offer. Researching how other municipalities have designed or implemented home energy upgrade programs will show how your program might complement existing programs offered by utility companies, provincial/territorial agencies or the federal government.

Table 1 summarizes this step. We'll be looking at these actions and their outcomes in more detail in the rest of this section.

TABLE 1. Summary: Assessing the market landscape

Steps	Benefits
Program review: • Look at existing home energy upgrade programs available in your province/territory • Review local home energy upgrade programs established in other communities/nationally • Examine the effectiveness of past and current programs (what results did they achieve?)	• Identifies potential gaps and/or limitations in current programs (areas for improvement that your program could address) • Data on program uptake will help you estimate program uptake and impact for your program later
Stakeholder consultation (optional): Consult with a few stakeholders, such as utilities, trades/conwtractors and home energy auditors about their experiences with home energy upgrade programs	• May give you more insight into barriers and opportunities • Establishes relationships with stakeholders who may be key to successful program development and implementation later

Program review

The easiest way to find out about home energy upgrade programs that are already available is to start by searching your provincial or territorial government's website. Natural Resources Canada (NRCan) and Efficiency Canada have also compiled directories that are a great starting point for your research (see the **Key resources** box on this page).

Key resources:

- FCM's CEF Resource Library
- Clean Air Partnership's toolkit for municipalities looking to implement local programs
- NRCan's directory of energy efficiency programs for homes
- NRCan's list of energy efficiency financial incentives by province
- Efficiency Canada's database of energy efficiency programs

For each program you review, take note of the following:

- What is the program's focus or objective?
- What are its eligibility requirements?
- What are its funding limits?
- What kind of resources or tools does it provide to help homeowners make decisions on upgrades?
- What kinds of incentivization does it use?
- What is the overall process that homeowners must navigate to get rebates or other financial assistance?

You should also examine how *effective* each program has been in meeting its goals or targets:

- What are the program's actual uptake and outcomes?
- Which program measures had the greatest impact (energy cost savings, GHG emissions reductions, etc.)?
- What are the program's gaps or limitations?

Rebate/incentive programs versus financing programs

Historically, home energy upgrade programs have offered rebates and incentives to encourage homeowners to make energy upgrades. Now there are a growing number of financing programs that cover the upfront costs of upgrades, including local programs funded by FCM's Community Efficiency Financing initiative and the Canada Greener Homes Loan program. Financing programs complement existing rebate programs and can help homeowners undertake deeper and more costly energy upgrades. When assessing the potential for a new home energy upgrade program in your community, it's important to consider how a new program would fill gaps and complement existing programs that are already out there.

Stakeholder consultation (optional)

To take your assessment of the market landscape to the next level, consider consulting with some of the stakeholders (such as utility staff, tradespeople who work on the upgrades, etc.) involved in delivering the programs you researched to gain some valuable lessons learned. Cultivating relationships with these types of stakeholders earlier in the process is a good idea anyway, because they may inform and/or support your program's development and might even be involved in delivering your program, providing training and helping with promotion and marketing.

For example, holding an engagement session with tradespeople who conduct home energy evaluations and complete home energy upgrades can provide valuable insights on issues such as:

- challenges faced with certain types of homes or upgrade projects
- parts of the program that have and have not worked well
- capacity/competency levels of tradespeople working on energy efficiency/renewable energy upgrades (e.g., is more training needed?)
- potential supply chain constraints
- any early questions or concerns to flag about home energy upgrade programs (administrative process, etc.)

STEP 1 CHECKLIST: ASSESS THE MARKET LANDSCAPE

If you have successfully completed Step 1 you should have the following important information:

- ✓ Gaps and/or limitations in current programs that can help identify what your program should offer and who it should target
- ✓ Past program results/uptake rates to use for estimating participation in your program and calculating its impact

STEP 2:
Examine local housing stock

Another important step is finding out how a local home energy upgrade program would fit into your community. The aim of this step is to gather data on all categories of residential dwellings within your community. You want to find out the total number of residences and the age of that housing stock to get an idea of how many residences could be served by your home energy upgrade program (i.e., your program's potential market size).

You'll start by identifying how many buildings within a community are residential dwellings versus buildings used for commercial, industrial or institutional purposes. Then you'll look within that residential category—there are several types of dwellings, such as apartment buildings and single-detached houses, that could be the focus of a home energy upgrade program. For example, the CEF initiative focuses on upgrades to single-family homes, which include single-detached and semi-attached houses, row housing and permanently affixed mobile homes.[1]

1 Although this guide does not cover reviewing relevant legislation, it's possible that there may be limitations on the types of properties eligible for a home energy upgrade program in your province/territory. For example, mobile homes are specifically excluded from participating in Alberta's Clean Energy Improvement Program. You will want to consider this when defining which types of residences your program will serve.

The *age* of housing is important because of the historical improvements made to building codes[2] over the past several decades. Generally, the older a home is, the less energy efficient it is because older homes were often built to much lower standards than modern homes. This means that the potential for energy cost savings and GHG emissions reductions from energy upgrades will often be greatest in older homes, especially anything built before the 1990s (when building codes were first introduced in some provinces).

You will also be looking at energy data for the local housing stock in this step. You'll need to know the total residential energy consumption and GHG emissions for your community so you can calculate averages per household to show baseline levels that your upgrade program is aiming to improve (we'll be doing this later, in Step 4).

Table 2 summarizes this step. We'll be looking at these actions and their outcomes in more detail in the rest of this section.

TABLE 2. Summary: Examining local housing stock

Steps	Benefits
Identify housing quantity, type and age: Identify total residential dwellings and number of single-family homes (SFH) versus multi-residential buildings within a community sorted by age (period of construction) **Determine home energy use:** • Determine total energy consumption in residential sector (ideally separated by SFH and multi-residential buildings) • Identify primary heating energy source for different categories of dwellings • Summarize past energy upgrades completed in community if data is available	• Provides an initial estimate of the size of the target market(s) for your upgrade program • Provides the baseline data needed to estimate the potential impact of the program
Link information with geocoded data to make map illustrations *(optional)* **Develop housing archetypes (optional):** Use data modelling to identify major groupings of housing types in the community based on the potential for improvements in energy efficiency, GHG emissions and costs	• Visual presentation of data compiled, such as priority neighbourhoods with high density of older homes • Can help identify a target market and break it down into useful market segments (i.e., by home age, GHG emissions, energy rating and consumption, and utility costs) later • Can help create a more accurate estimate of potential program impact later

2 Although the first National Building Code in Canada was released in 1941, the first National Energy Code for Buildings (NECB) wasn't developed until 1997. The NECB was updated in 2011 and included an average performance improvement of 25 percent over the original version. Building codes also vary by province/territory, as do their inclusion of energy efficiency standards.

Identify housing quantity, type and age

Depending on your province or territory, you may use federal, provincial/territorial or regional/local housing data sets for this task (see Table 3). They usually include quantities of different dwelling types as well as age.

There are two databases that make it relatively easy to compile information for this step. Statistics Canada's Canadian Housing Statistics Program (CHSP) and the Canadian Mortgage Housing Corporation's (CMHC) Housing Market Information Portal both draw on national Census data, and you can customize searches to your geographic region. Once you find the data you're looking for, it can be downloaded into a spreadsheet.

TABLE 3. Data sources on housing stock

Data source	Coverage
Statistics Canada's Canadian Housing Statistics Program (CHSP)	Covers British Columbia, New Brunswick, Newfoundland and Labrador, Northwest Territories, Nova Scotia, Nunavut, Ontario, Yukon
Canadian Mortgage Housing Corporation's (CMHC) Housing Market Information Portal	Covers all the provinces/territories above, plus Alberta, Manitoba, Quebec, Prince Edward Island, and Saskatchewan
Provincial housing agencies	Some provinces also have agencies that compile detailed housing data, such as the Municipal Property Assessment Corporation (Ontario) and the Property Valuation Services Corporation (Nova Scotia). Some municipalities may have someone in their planning, building or economic development departments who regularly accesses these databases and can share information from them.[3]
Municipal tax records	If your municipality has a local climate action plan or a community energy plan, check if some of this data has already been compiled using municipal tax records of residential properties.

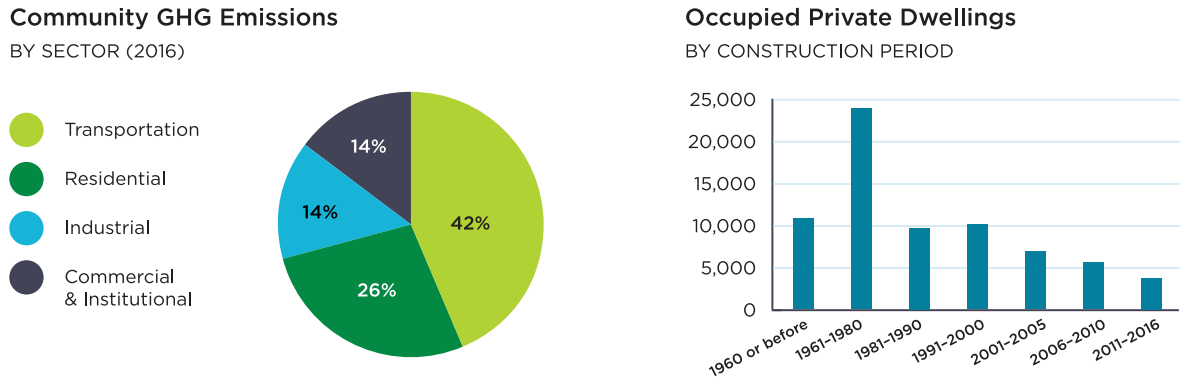
3 Although many municipalities may have access to their local residential property tax databases, it can take a lot of staff time to compile the necessary information for this step. That's why this guide focuses on the two national databases that already have the built-in ability to compile the information needed for this step. If program planners do have access to local municipal property databases and the staff capacity to compile the information, the required data outlined in this section is still the same.

Once you have the data you need, you can produce a visual representation of it. This could be:

- a table listing the quantity/types of homes by decade of construction, or
- a graph illustrating how many homes are over 30 years old, over 50 years old, and over 70 years old (these age groupings are examples)

Figure 1 shows an example of two graphs showing proportions of GHG emissions by source and the distribution of housing stock by decade built in Burlington, Ontario. The figure shows that a high proportion of homes in Burlington were built before 1990, which means they likely account for a significant portion of the emissions from the residential sector in that community. Communities with a long history of residential development, like Burlington, tend to have a high proportion of older (and therefore energy inefficient) homes. This makes them good choices for local home energy upgrade programs because it maximizes program impact.

FIGURE 1. Community GHG emissions by sector and age of housing stock in Burlington, Ontario



Source: Clean Air Partnership, *Accelerating Home Energy Retrofits Through Local Improvement Charge Programs*

Determine home energy use

To properly assess the potential for your program, you'll need to, at a minimum, find out the total residential energy consumption within your community by energy source (i.e., heating fuels and electricity). The main sources of household energy use data are national databases, utility companies and, sometimes, municipalities.

Canadian homes use on average about 80% of total household energy on space and water heating[4]. That's why it's also important to determine what proportion of households use different fossil fuels, electricity, or other energy sources for space and water heating. Understanding the carbon intensity (how many GHG emissions are created per unit of fuel consumed) and costs of those energy sources consumed in your community can help you more accurately estimate the potential for home energy upgrades to reduce emissions and/or save money on energy bills.

The age and location of a home may dictate its primary heating source. Some areas or residences don't have access to natural gas service lines. In these cases, oil or propane are often the fuels used alongside wood and electricity. This is relevant to planning home energy upgrade programs because fuel oil and propane are usually the most expensive *and* carbon-intensive heating fuels used in homes in many parts of Canada.[5]

The more detailed the data you compile for this step, the better your understanding will be of the types of homes your program could target for the greatest household GHG emissions reductions and/or energy cost savings. If your data is detailed enough, you might also be able to pinpoint where these homes are concentrated in your community.

Getting data from municipal sources and utility companies

If your municipality has already compiled a community GHG emissions inventory, start with this. You may already have a total energy consumption figure for all residential buildings available.

Utilities like natural gas and electricity companies have data sets on residential energy use that may be helpful. If your municipality has not completed a GHG emissions inventory, you can try requesting data on your community's residential energy consumption from your local or provincial utility company.[6]

Ask the utility company for:

- Total residential energy consumption, ideally separated by single family homes and multi-residential buildings, as well as by postal code (if possible)
- Results of any recent customer surveys related to energy efficiency and conservation

4 See NRCan's "Energy Use in the Residential Sector" for more on this.

5 If your community uses heating oil or propane for home heating, note that the provincial/territorial level data on these heating sources may be incomplete. You can supplement this information through any existing utility or municipal surveys on household energy use, or by including a question in a survey to residents.

6 Note that due to Alberta's deregulated energy market, Alberta municipalities may have difficulty requesting this data if there are many energy retailers for electricity and natural gas servicing your community. In that case, it may be helpful to work with a third party to compile this data.

Depending on the utility company's policies and your relationship with the company, it may be too time-consuming to try and obtain more detailed energy consumption data from it. If the utility company can't provide what you're looking for, you can take the total residential energy consumption from one of the national databases in the next section and divide it by the number of residential dwellings within your municipality to develop an average household consumption value (in a common unit such as gigajoules). Note that some homes will use more energy (e.g., older and/or larger homes) or less energy (e.g., newer and/or smaller homes) than this average.

Using national databases

You can use national databases to apply provincial/territorial percentages for different variables (e.g., primary heating source) to the number of residential dwellings within your community (as collected in the previous step) to derive a high-level proportional breakdown for your community. Table 4 lists a few examples.

A limitation of this approach is that using provincial/territorial averages may not reflect the characteristics of your local housing stock—this is particularly the case in more rural or less populated regions. But the provincial data can be a good starting point, and you could refine it further if more localized data is available for your community.

TABLE 4. National data sources on residential energy use

Data source	Coverage
Natural Resources Canada's Comprehensive Energy Use Database	Information at the provincial/territorial level detailing residential energy use by: • primary heating source (e.g., electricity, natural gas, fuel oil, wood) • application (e.g., space heating/cooling, water heating, lighting and appliances) • building type (e.g., single-detached, single-attached or semi-detached homes; apartments) • age of dwelling construction
Statistics Canada: Primary heating systems and type of energy	Household data on primary heating systems and type of energy sources for several larger cities (note that this data is currently limited or unavailable for many other types of communities)

The national EnerGuide Rating System (ERS), developed and maintained by Natural Resources Canada, is also a very rich data source.[7] ERS measures and collects data from home energy evaluations that is used in developing many energy efficiency programs across Canada. It tells you the amount of energy consumed by a home, the efficiency of equipment and systems within the home, and the types of energy sources utilized. All are important for assessing the potential impact of a home energy upgrade program. Tens of thousands of EnerGuide evaluations have been completed over the past 25 years.

Data on the number of completed evaluations, amount of GHG emissions reductions from completed upgrades, and the age of homes evaluated can be very helpful for program planning. You can request this data in summary form from NRCan's Office of Energy Efficiency.[8] If your community is part of the Green Communities Canada network, you can also request summary data on existing EnerGuide home energy evaluations from one of its member organizations.

Table 5 provides an example of summary EnerGuide results. These could also be compiled by the first three digits of the postal code and then shown on a map.

TABLE 5. Summary of EnerGuide home energy audits in Kingston, 2007–2020

Year Home was Built	Number of Energy Audits		Average GHGs (Tonnes/year)			Total GHGs reduced (Tonnes/year)	
	Pre-retrofit	Post-retrofit	Before	After	Reductions		
2000–2020	237	191	4.8	4.7	-2%	19	0%
1975–1999	2,237	1,975	6.1	4.9	-20%	2,370	30%
1950–1974	1,879	1,595	7.5	5.7	-24%	2,871	36%
pre-1950	1,091	905	9.9	7.0	-29%	2,625	33%

Source: City of Kingston, *Kingston Home Energy Retrofit Program Rationale and Design Study (2020)*

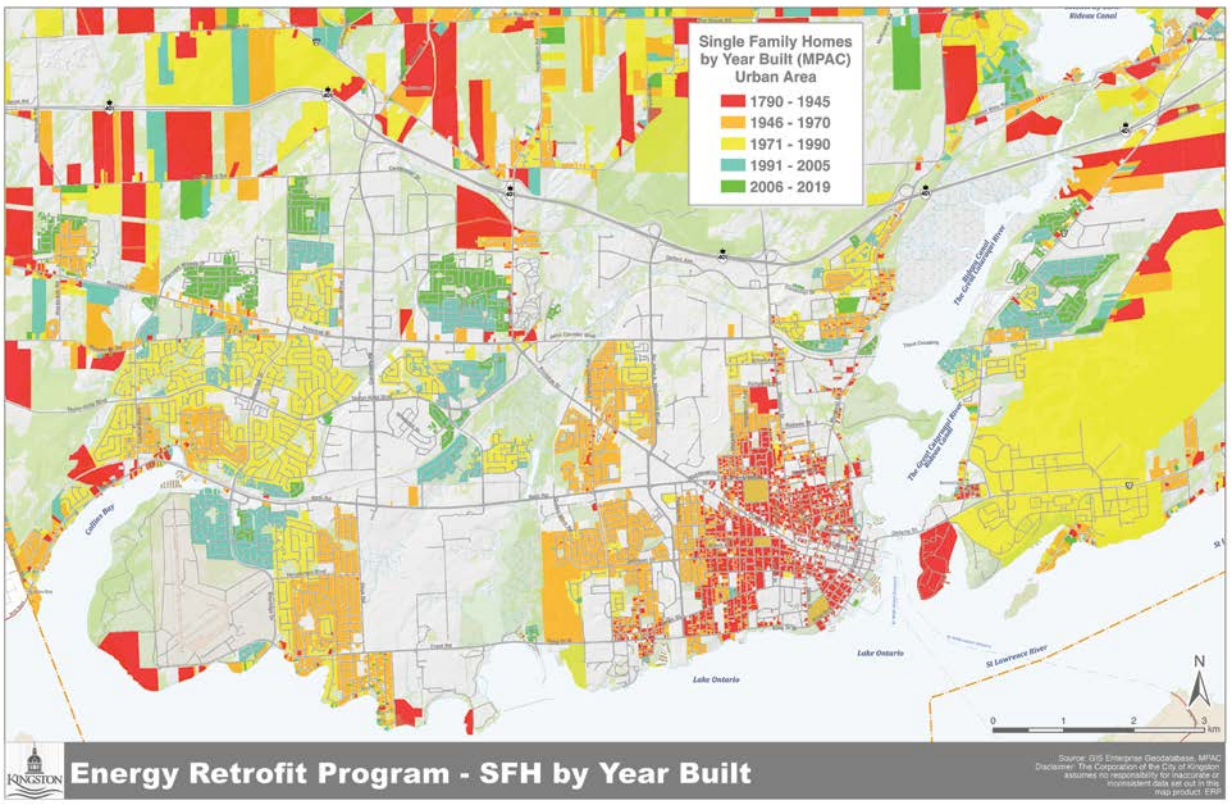
7 For some smaller or remote communities, there may be very limited or no home energy evaluation data available from ERS. In these cases, look at EnerGuide data at the provincial or territorial scale.

8 To do this, you'll need to contact the office by email and put in your request.

Map geocoded housing data (optional)

Municipalities with in-house GIS (geographic information system) staff could map geocoded housing data to show the location of homes within a community by age of construction, as the example in Figure 2 shows. Mapping can be useful for targeting specific neighbourhoods for further consideration in the program design stage but is not critical. If your municipality has the in-house capacity or resources available to hire a consultant to do this, consider completing this step. Another option is to seek assistance for mapping from a university or other post-secondary school (as a student project, perhaps) or from non-profit organizations with GIS abilities.

FIGURE 2. City of Kingston's mapped illustration of housing age



Source: City of Kingston, *Kingston Home Energy Retrofit Program Rationale and Design Study (2020)*

Develop home archetypes (optional)

Home archetypes are developed using data modelling (often using detailed data from EnerGuide evaluations) to create categories of your community's housing stock that are based on characteristics such as:

- age of construction
- size
- primary heating fuel type (electricity, natural gas, fuel oil, propane, etc.)
- total energy consumption and energy costs
- building envelope and mechanical efficiency performance or efficiency ratings

Although it usually requires some specialized consultant expertise, home archetyping can tell you which upgrades will yield the greatest improvements in efficiency, emissions and costs. Archetypes can also be mapped to pinpoint the market segments that a home energy upgrade program could target to have the greatest impact. Many Canadian municipalities have used home archetypes in their program planning processes to better understand the opportunity for home energy upgrades. See **Appendix B** for sample home archetypes in Capital Region District, British Columbia.

Incorporating home archetypes into your program planning process can also help with identifying which groups of housing can benefit the *most* from energy upgrades, in terms of cost savings. This makes it a powerful technique for addressing energy poverty because it can help target households that experience the highest energy cost burden. We'll discuss energy cost burden more in Step 3.

STEP 2 CHECKLIST: EXAMINE LOCAL HOUSING STOCK

If you have successfully completed Step 2 you should have the following information:

- The **number of homes within your community**, ideally by major housing type, (e.g., single-family home or low-rise residential building three stories or under[9])
- **Total residential energy consumption**, ideally broken down by major housing type and/or by primary heating energy source (e.g., natural gas, electricity, fuel oil, propane)
- **Total residential GHG emissions** within your community from a municipal GHG inventory or average energy consumption per home and breakdown of energy consumption by energy source for your province/territory using NRCan's Comprehensive Energy Use Database

9 As required for establishing EnerGuide ratings for homes through a home energy evaluation or "audit."

STEP 3:

Understand residents' perspectives

To develop a successful home energy upgrade program, it's essential to understand who your potential program users (the owners of the residential buildings in your program area) are and to learn about their needs.[10] This step will help you do that, and it will also help you to identify potential opportunities for and barriers to participation in a home energy upgrade program in your community.

Your local municipal council will find information gathered directly from possible program users valuable. Councils want to ensure their constituents have had input into any proposed local energy upgrade program.

10 If planning a program within FCM's CEF scope, this refers to single-family homeowners and includes owners of low-rise residential buildings that are rented out to residents. If planning an upgrade program outside of this scope, for example to reach people renting units in multi-residential buildings, the target audience would be the *owners and/or managers* of those mid-rise and high-rise rental buildings.

You can also use data you collect here to verify the data you collected in Step 2, such as the primary energy sources residents use to heat their homes. You'll need this data to estimate the potential impact of your program in Step 4, so it's important that it be as rich as possible.

Table 6 summarizes this step. We'll be looking at these actions and outcomes in more detail in the rest of this section.

TABLE 6. Summary: Understanding residents' perspectives

Steps	Benefits
Gather residents' perspectives on home energy improvements: Survey residents on their viewpoints on home energy upgrades. What are the barriers and incentives to their participation in a home energy upgrade program?	• May help further define a target market for your program • Insight into barriers and opportunities that could be addressed to improve program participation • Can be another way of collecting/ confirming localized data on primary heating energy source from Step 2
Complete a review of home energy affordability (*optional*): Identify the percentage of households within the community with high, very high and extreme energy cost burdens	Information on households with high energy cost burdens in your community could be important for designing an appropriate program

Gather residents' perspectives on home energy improvements

If resources and/or capacity are available, conduct an anonymous online survey of the residents your local energy upgrade program would target to gather the following useful data:

- primary energy sources and equipment used for space and water heating in their homes, and the age/efficiency of that equipment[11]
- their past knowledge and experience with other energy upgrade programs offered by different levels of government or by utility providers
- barriers they face when it comes to making home energy improvements
- things that would motivate them to make home energy improvements
- home energy upgrades/renovations they've made in the past or are planning to make in the future, and how they paid/would pay for them
- under what circumstances they would consider accessing financing from a new local program

There may already be recent consumer surveys or research for your community and/or relevant ones from the provincial/territorial/national level. Here are a few examples:

- **Example of a national survey by the Consumers Council of Canada**
- **Example of a provincial survey by Transition Énergétique Québec**
- **Example of utility-led consumer survey by Fortis B.C.**
- **Example of municipal-led survey by City of Kingston**
- **Example of a resident and stakeholder engagement report by the City of Saskatoon**

These types of surveys can usually be developed in-house with municipal communications staff or by collaborating with a local partner such as a non-profit organization or a post-secondary school student and/or instructor. You can promote the survey in municipal spaces (e.g., curbside signs, ads on transit vehicles/shelters/benches, websites and social media blasts) often for free.

If your municipality does not have the capacity to conduct a survey, you can use existing research from other sources to understand some typical behaviours around program participation. See the survey examples in the call-out box on this page.

11 This could help to locally verify data collected during Step 2 if national or provincial/territorial data sets were utilized.

Complete a review of home energy affordability (optional)

Household energy cost burden is the proportion of household income spent on heating and electricity. Residents who are spending disproportionately more of their household income on energy costs than the national median are experiencing energy poverty.[12]

If one of your program goals is to improve housing affordability through implementing home energy conservation and efficiency improvements, you won't want to skip this step. And you may still want to complete it even if reducing household energy costs is not an explicit focus of your program. Your local council is likely to want to know more about an issue that a program *could* contribute to improving at the community level.

The Energy Poverty and Equity Explorer is an online mapping tool developed by Canadian Urban Sustainability Practitioners (CUSP). This tool compiles relevant Statistics Canada Census data such as:

- median home energy expenditure
- housing needing major repairs
- percentage of housing built before 1991
- percentage of single-detached dwellings versus mid- and high-rise buildings
- percentage of resident-owned versus rented households

Data from the Energy Poverty and Equity Explorer tool is readily available for download from CUSP's website. You can use the tool to identify varying levels of household energy burden in your community. Figure 3, made with the CUSP tool, captures a view of a Census tract near Winnipeg experiencing a high home energy cost burden. The figure illustrates the proportion of households and the varying degrees of household energy cost burden they are experiencing along with median home energy expenditure.

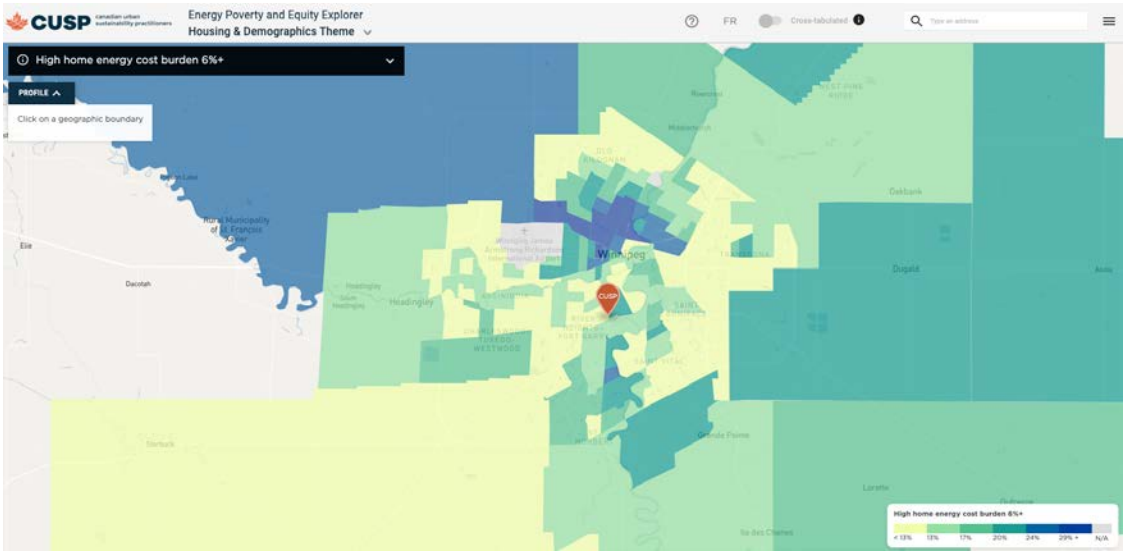
Understanding energy poverty in your community is just one aspect of planning a program with an equity lens. Although this guide does not go into detail about how to address equity in your program design, we encourage you to consider doing some additional research to understand socioeconomic and systemic barriers to program participation, and to ensure that the viewpoints and needs of marginalized or underrepresented groups are heard. The Energy Poverty and Equity Explorer tool includes additional demographic and housing data that can help with your analysis, such as:

- Proportion of renter or owner households
- Housing condition in terms of need for major repairs
- Homeowner affordability (i.e., % of income spent on shelter costs)
- Recent immigrant households as well as those speaking neither English nor French
- Proportion of visible minority and Indigenous households

12 As defined by the CUSP initiative, energy cost burden is calculated as the percentage of total after-tax household income that is spent on home heating and electricity compared to the national median percentage (3%). An energy cost burden of 6% is considered "high"; 10% is "very high"; anything 15% or more is "extreme."

For additional resources about integrating equity into financing programs, consult CEF's resource library.[13]

FIGURE 3. Household energy cost burden in a census tract in Winnipeg



STEP 3 CHECKLIST: UNDERSTAND RESIDENTS' PERSPECTIVES

If you have successfully completed Step 3 you should have the following information:

- Demographic data and results from local surveys (and possibly a home energy affordability review) that can help you identify/refine who the target market of your program is
- Potential barriers and opportunities for consideration in estimating program uptake levels

13 Another resource you may find useful is the guidebook, *Integrating equity, diversity and inclusion into municipal climate action*, developed by ICLEI Canada and FCM's Partners for Climate Protection program.

STEP 4:
Put it all together

You've assessed the home energy upgrade program marketplace, examined local housing characteristics and sought the perspectives of the residents in your community who could be your program's users. In this final step, you'll take the information you gathered in Steps 1–3 and use it to clarify your program's target market and estimate the potential uptake and impact of your program.

As you get started on this, keep in mind that it can be easy to become overly ambitious when estimating your program's uptake and impact. Try to be aware of any limiting factors—like how many homes can be physically retrofitted, contractor availability, administrative capacity, etc., so that you can set realistic expectations.

Identify your home energy upgrade program's target market

The information you gathered in Steps 1–3 can be used now to pinpoint your program's target market. This target market are residents of homes with specific housing/energy characteristics that would be served by your program.

You may find it helpful to further refine this target market into segments like the examples shown in Table 7. Programs can have multiple target market segments, and there will likely be some overlap between them.

TABLE 7. Possible target market segments

Market segment	Information source/step
Homeowners planning renovations	Research on other programs, consumer studies, resident surveys (Steps 1,3)
Homes that are likely to have a low building envelope standard (i.e., most homes built before 1991)	Review of type/age of housing stock (Step 2)
Homes using fuel oil or propane as their primary heating sources (i.e., homes with high energy costs and high GHG emissions)	Data on residential energy use (Step 2,3)
Homes with above-average energy use and/or GHG emissions per square metre (can be sub-categorized into homes that would realize the highest cost-savings potential)	EnerGuide data, other detailed energy consumption data, and/or modelled home archetypes (Step 2)
Residents who want to lower the carbon footprint of their homes	Resident surveys or other engagement activities (Step 3)
Homes/areas with high energy cost burdens	Home energy affordability review (Step 3)

You will likely establish a much more precise target market later, in the program design stage. But you still need some understanding of who your target market segments are now to estimate program uptake in the next step.

An important point to note is that the more you narrow down your program's target market, the smaller the number of homes/homeowners who are eligible to participate will be. This isn't necessarily a bad thing. For example, a program that focuses on fuel-switching to reduce GHG emissions may only reach a small portion of all the homes in a community that were built before 1991, but it is likely that a large portion of participating homes will be those heated by more expensive, higher-emitting fuels like oil and propane. This is good news for program impact (more on this concept in the final step).

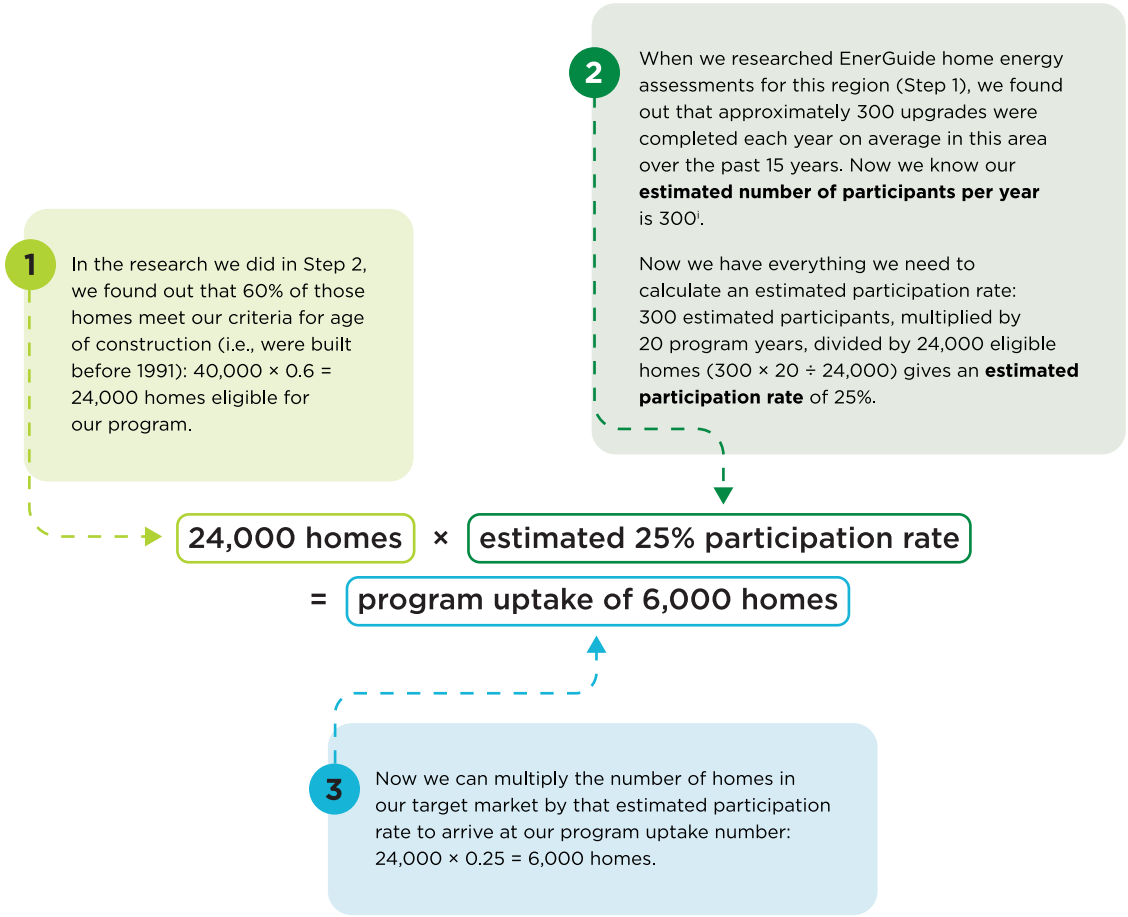
Estimate program uptake

This step simply involves calculating the estimated number of homes you think would potentially implement home energy upgrades through participating in a local program. The information you compiled in steps 1–3 will help you calculate program uptake.

Let's walk through the equation with an example:

Say we want to develop a 20-year program that focuses on low-rise residential homes built before 1991 in a community with 40,000 low-rise residential buildings.

FIGURE 4: Equation for estimating program uptake



i Using the historic rate of home energy upgrades is helpful for estimating program uptake, but this method does have some limitations. These projections should be refined further during the detailed design of a program.

You can further examine these considerations and refine program uptake estimates as more detailed information is collected and analyzed during the program design stage and as local decisions are made on the program's focus and features. But the numbers you have now will be good enough for the next step, where you calculate your program's potential impact.

Calculate program impact

In this step you'll make a preliminary estimate of your program's environmental impact: the overall or average percentage of improved energy efficiency that will be achieved by participating homes, and the impact of this on greenhouse gas emissions. There is also a simple equation later in this section for calculating your program's job creation impact.

FORMULA FOR CALCULATING POTENTIAL PROGRAM IMPACT:

baseline × % rate of improvement = impact

We'll be going over everything you need to do this equation in this section. You'll use some of the values you just calculated in the previous step and some from the data you gathered in Steps 1–2 of this guide. If your municipality has completed a community GHG emissions inventory, you can use the residential sector energy and emissions data from that to calculate your program's impact. However, the guidance in this section applies whether your municipality already has a community GHG inventory or not. We'll walk you through how to do the program impact calculation with and without it.

Key resource:

Guidebook on quantifying greenhouse gas reductions at the project level

Step-by-step guidance from ICLEI Canada and FCM's Partners for Climate Protection on estimating GHG reductions from local mitigation projects, including the basics of formulating calculations for home upgrade programs. Page 4 of the guidebook explains how to convert activity data (e.g., kilowatt-hours of electricity usage) to GHG emissions.

CHECKLIST: DATA YOU WILL NEED TO USE THIS FORMULA

- Estimated number of homes participating in your program (from your estimation of program uptake in the previous step)
- Average energy consumption per household in your region, expressed in gigajoules/GJ (from data on residential energy use you compiled in Step 2)
- Conversion tables to convert each fuel/energy source from GJ to original energy units and appropriate emission factors for each energy source to estimate GHGs (see Appendix A)
- Average percentage of household energy consumption by each source (Step 2) converted from GJ to original energy units (electricity in kilowatt hours; natural gas in cubic metres; fuel oil and propane in litres)[14]
- Estimated rate of improvement: the average reduction in household GHG emissions that would result from your program's upgrades, expressed as a percentage (based on your research on other programs in Step 1). Later in the sample equation you'll see we've used a 30% rate of improvement.[15]

Method

Find the baseline

1. First, calculate baseline energy consumption:

Estimated # of participating homes	×	average energy consumption per household (GJ)	=	Baseline energy consumption (GJ) before upgrade program

2. Now take that baseline and break it down into totals for each energy source (conversion tables for original energy units can be found in **Appendix A**):

Baseline energy consumption (GJ)	×	average % of total household energy consumption by each source in GJ converted to original energy units *(electricity: kWh; natural gas: m^3; fuel oil or propane: L)*	=	Quantity of each fuel/energy type consumed before upgrade program

14 Wood is not included in GHG calculations in this guide because it's largely recognized as a carbon-neutral fuel. But it's important to note that homes primarily using wood for heating can implement energy upgrades to save on costs and to improve indoor and outdoor air quality.

15 We chose 30% for our example because several home energy upgrade programs in Ontario and Quebec have achieved an average 30% reduction in GHG emissions and energy consumption. However, your research in Step 1 will be relevant to your jurisdiction and may lead you to a different rate of improvement to use in your calculation. For one thing, household consumption of fuels and electricity and the carbon intensity of electricity generation vary significantly across Canada. For another, your rate of improvement will also be tied to the type of upgrades targeted by your program and how comprehensive the upgrades are.

3. Now use that information to calculate baseline GHG emissions for each type of energy or fuel used (emissions factors for each fuel/energy type can be found in **Appendix A**):

Quantity of each fuel/ energy type consumed before upgrade program	×	its corresponding emission factor	=	Amount of GHG emissions for each fuel/energy type (tonnes CO_2e)

4. Finally, add all those GHG values (tCO_2e) together:

GHG value for electricity	+	GHG value for natural gas	+	GHG value for fuel oil	+	GHG value for propane	=	Baseline total GHG emissions before home energy upgrade program (tCO_2e)

Multiply baseline by rate of improvement to calculate program impact

Now you have everything you need to estimate the total impact of your home energy upgrade program.

5. Simply plug in your baseline from the previous calculations and multiply it by your estimated average rate of improvement (to see how many tonnes of GHG emissions your program will save:

Baseline total GHG emissions before home energy upgrade program	×	average rate of improvement (%)	=	Estimated program impact in GHG emissions (tCO_2e)

Sample calculation for a census metropolitan area in New Brunswick

Equation[16]	Data
1. Baseline energy consumption of participating homes before program: 6,000 homes × 110 GJ = **660,000** GJ baseline energy consumption	• Potential # of homes to be upgraded = total number of single-family homes built 1991 or before × estimated program uptake rate: 24,000 homes × 25% = 6,000 homes potentially participating (from your program uptake estimate) • NRCan database average energy consumption per household = 110 GJ
2. Quantity of each fuel/energy (excluding wood) used before upgrade program = 660,000 GJ × % average energy consumption per home, converted to original units: a. **Electricity:** 660,000 × .59 = 389,400 GJ × 277.8 (kWh/GJ) = 108,175,320 kWh b. **Natural gas:** 660,000 × .02 = 13,200 GJ × 26.8 (m^3/GJ) = 353,760 m^3 c. **Heating oil:** 660,000 × .19 = 125,400 GJ × 26.1 (L/GJ) = 3,272,940 L d. **Propane:** 660,000 × .01 = 6,600 GJ × 39.1 (L/GJ) = 258,060 L	Average % of household energy consumption by energy/fuel source (from NRCan database) and conversion tables to put them into original energy units (see **Appendix A**): • Electricity: 59% • Natural gas: 2% • Heating oil: 19% • Propane: 1% • Wood: 19%
3. Values for each energy source above × emissions factors to convert them into tonnes CO_2e a. **Electricity:** 108,175,320 kWh × 0.000270 (T/kWh) = 29,207 tCO_2e b. **Natural gas:** 353,760 m^3 × 0.0018933 (T/m^3) = 670 tCO_2e c. **Heating oil:** 3,272,940 litres × 0.002766738 (T/L) = 9,055 tCO_2e d. **Propane:** 258,060 × 0.001547859 (T/L) = 399 tCO_2e	Corresponding GHG emission factors for each energy/fuel source (see **Appendix A**)

16 All numbers have been rounded.

Equation[17]	Data
4. Emissions for each energy source above added together for baseline **total** GHG emissions before home energy upgrade program = 39,331 tCO_2e	Totals arrived at in previous step
5. Baseline total emissions multiplied by 30% estimated average rate of improvement to arrive at program impact: 39,331 tCO_2e × 0.3 = 11,799 tCO_2e GHGs reduced	% estimated average rate of improvement from upgrades (from research in Step 1): 30%

If your municipality already has a community-scale GHG emissions inventory

You can use this simpler approach using existing GHG figures from your municipal inventory as follows:

- Take the amount of residential-sector GHGs (expressed in tCO_2e) from your community GHG inventory and divide it by the total number of dwellings in the community (ideally by major housing type, such as single-family homes—see Step 1) to derive an average GHG value per dwelling

  Example:
  260,000 tCO_2e
  ÷ 40,000 single-family homes
  = 6.5 tCO_2e per dwelling

- Take that average GHG value per dwelling and multiply it by the estimated number of homes participating in your program (from your program uptake estimate) to get your baseline total GHG emissions

  Example:
  6.5 tCO_2e × 6,000 homes
  = 39,000 tCO_2e

- Now multiply that baseline by the average rate of improvement to arrive at your program's estimated impact (estimated number of GHGs reduced)

  Example:
  39,000 tCO_2e × 0.3 (30% average rate of improvement)
  = 11,700 tCO_2e

17 All numbers have been rounded.

Calculating job creation impact

Local home energy upgrade programs have economic impacts. The increased demand for the products and services involved in completing home energy upgrades (e.g., contractors, home energy evaluators) results in local job creation. Your local council is likely to be very interested in estimates of local economic activity/job creation that could be generated by a local home energy upgrade program, so you may want to generate a rough estimate at this stage.

Job creation can be calculated per dollar value of upgrade investment. A recent study found that 16 to 30 new jobs were created for every million invested in energy efficiency.[18] Once you have an idea of the average investment per household, you can use this 16–30/$1M job multiplier to estimate job creation impact in your local economy.

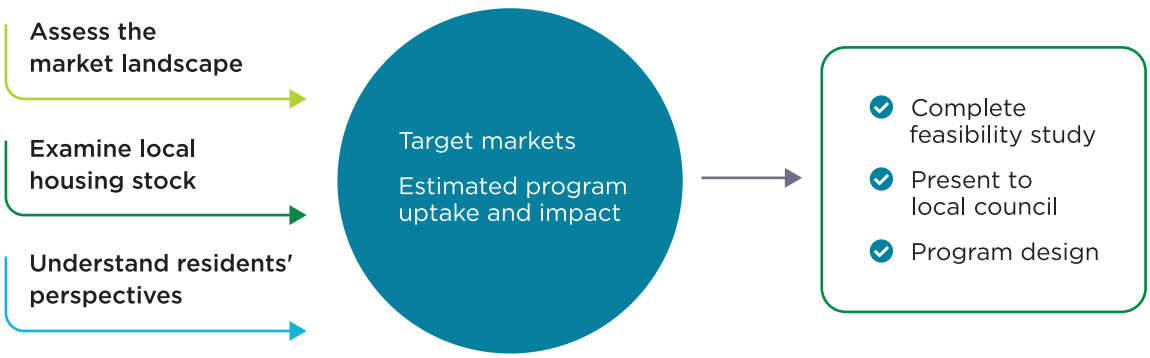
For example, if the average home energy upgrade will cost a total of $25,000 per home (including all materials, equipment and labour) and you aim to reach 1,000 homes with your program over the next five years, the total investment will be $25 million ($25,000 × 1,000 homes). Using the job multiplier formula above, we can now calculate that means 400 to 750 jobs could be created in your community by a new home energy upgrade program ($25M/$1M = 25; 25 × 16 = 400 jobs; 25 × 30 = 750 jobs).

18 See "Bridge to the Future: Final Report from the Task Force for a Resilient Recovery" (September 2020)

NEXT STEPS

We hope that you have found this guide helpful for assessing the potential and developing ideas for a home energy upgrade program in your community. The work you did in Steps 1–4 should put you in a good position to create a business case that can be shared with your municipal council and local partners to build support for a local program.

FIGURE 5. Next steps



When you're ready to take the next steps, FCM's Community Efficiency Financing initiative offers program planners working through this process grants for feasibility studies and program design studies.

Here are some other useful program planning resources for when that time comes:

- Clean Air Partnership's Accelerating Home Energy Efficiency Retrofits Through Local Improvement Charge Programs: A Toolkit for Municipalities
- FCM's Community Efficiency Financing Application Guide
- How to plan a home upgrade financing program (FCM CEF fact sheet)
- What does a successful home upgrade financing program look like? (FCM CEF fact sheet)

APPENDIX A:

Energy conversion tables and emission factors

To determine GHG emissions from home energy use, you'll need to multiply activity data by the emissions factor for the fuel source in question. Emissions factors reflect the mix of fuel types used in local energy production and are different for natural gas and other fossil fuels versus electrical utilities.

TABLE 8: Energy conversion

Energy source: Type	Energy source: Unit	/GJ
electricity	Kilowatt hours	277.78 kWh per GJ
natural gas	cubic metres	26.8 m^3 per GJ
propane	litres	39.07 L per GJ
heating oil	litres	26.1 L per GJ

Source: Canada Energy Regulator, Energy conversion tables

TABLE 9: GHG intensity of electricity by province/territory (2019)

Province/Territory	Electricity consumption emission factor (tCO_2e/kWh)
Alberta	.000670
British Columbia	.0000197
Manitoba	.0000013
New Brunswick	.000270
Newfoundland	.000028
Northwest Territories	.000200
Nova Scotia	.000760
Nunavut	.000890
Ontario	.000030
Prince Edward Island	.000270
Quebec	.0000015
Saskatchewan	.000710
Yukon	.000113

Source: Canada's National Inventory Report (NIR) 1990–2019: Greenhouse Gas Sources and Sinks in Canada — 2021 Edition, Part 3, Annex 13.[19]

TABLE 10: Heating fuel emission factors

Energy source	tCO_2e/unit of consumption
Natural gas	0.001899 tCO_2e/m^3
Light fuel oil	0.002767 tCO_2e/L
Propane	0.0015479 tCO_2e/L

Source: https://unfccc.int/documents/271493 – Canada. 2021 National Inventory Report (NIR) | UNFCCC 1990-2019: Greenhouse Gas Sources and sinks in Canada - 2021 Edition, Part 2, Annex 6.

19 Efforts should be made to use the most recent emissions factors available. Environment Canada releases its national GHG emissions inventory annually but there is a two-year time lag (i.e., the 2021 inventory's emissions factors are from 2019). Look for the most recent release to find the most up-to-date emissions factors.

APPENDIX B:

Home archetypes in capital regional district, British Columbia

1. Single-Story Electric	
% of Homes in the Region	23%
Housing Type	Single Story Detached
Heating Type(s)	Electric Heating, with some wood or propane
Primarily Built In	1950s–1970s
Median Gross Floor Area	193 m^2
GHG Intensity per home	1.42 tCO_2e/yr.
Common Retrofit Measures	• Windows • Ceilings

2. Mid-Century Oil	
% of Homes in the Region	7%
Housing Type	Single Story Detached
Heating Type(s)	Oil Heating, with some wood or propane
Primarily Built In	1950s–1960s
Median Gross Floor Area	192 m^2
GHG Intensity per home	8.51 tCO_2e/yr.
Common Retrofit Measures	• Foundation • Windows • Heat Pumps • Fuel Switch

3. Interwar Oil	
% of Homes in the Region	4%
Housing Type	Two-Story Detached
Heating Type(s)	Oil Heating
Primarily Built In	1920s–1940s
Median Gross Floor Area	240 m^2
GHG Intensity per home	11.64 tCO_2e/yr.
Common Retrofit Measures	• Ceiling • Windows • Heat Pumps • Fuel Switch

4. Two-Story Electric	
% of Homes in the Region	3%
Housing Type	Two-Story Detached
Heating Type(s)	Electric Heating
Primarily Built In	1970s–1980s
Median Gross Floor Area	248 m^2
GHG Intensity per home	1.69 tCO_2e/yr.
Common Retrofit Measures	• Windows • Heat Pumps

5. Row Homes	
% of Homes in the Region	6%
Housing Type	Two-Story Row House
Heating Type(s)	Predominantly Electric Heating (77%)
Primarily Built In	1970s–1980s
Median Gross Floor Area	143 m^2
GHG Intensity per home	2.26 tCO_2e/yr.
Common Retrofit Measures	• Windows • Ceilings

6. Mid-Century Gas Homes	
% of Homes in the Region	20%
Housing Type	Predominately Single-Story Detached
Heating Type(s)	Gas Heating
Primarily Built In	1940s–1970s
Median Gross Floor Area	Single-Story: 195 m2 Two-Story: 262 m2
GHG Intensity per home	Single-Story: 6.67 tCO2e/yr. Two-Story: 9.09 tCO2e/yr.
Common Retrofit Measures	• Ceiling • Windows • Furnace • Water Heater

7. Newer Homes	
% of Homes in the Region	29%
Housing Type	Mix of One and Two Story Detached
Heating Type(s)	Predominantly Electric Heating (80%) Gas Fireplaces Common
Primarily Built In	Since 1990
Median Gross Floor Area	267 m^2
GHG Intensity per home	2.40 tCO2e/yr.
Common Retrofit Measures	• Heat Pumps

8. Older Homes	
% of Homes in the Region	9%
Housing Type	Predominantly Two Story Detached
Heating Type(s)	Mix of Gas and Oil
Primarily Built In	Before 1920
Median Gross Floor Area	241 m^2
GHG Intensity per home	10.65 tCO2e/yr.
Common Retrofit Measures	• Ceiling • Walls • Foundation • Windows • Fuel Switch

Source: *CRD Residential Energy Retrofit Program Business Case Phase 2 Memo* (2021), prepared by the Integral Group and Windfall Ecology Centre for the Capital Regional District