APPENDIX A

CRD Residential Energy Retrofit Program

Business Case Phase 2 Memo – FINAL

September 2021

Prepared by

Integral Group
Suite 180 - 200 Granville Street
Vancouver, BC V6C 1S4

Windfall Ecology Centre
93a Industrial Pkwy S, Aurora, ON L4G 3V5

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Background

Reducing emissions in the buildings sector presents a significant challenge. While new construction standards are continuously improving in energy efficiency (with an emissions target potentially forthcoming), the existing stock of the capital region's homes will need to be retrofitted to reduce energy consumption and shift to renewable, low emissions sources of energy. When combined with the region's existing affordability challenges, retrofits pose a complex issue.

To help address these challenges and support the achievement of the Capital Regional District's (CRD) and local municipal climate change goals, the CRD and local government partners, are exploring the development of a *Regional Residential Energy Retrofit Program* capable of spurring deep emissions retrofit actions by home and building owners across the region. While several programs at the federal, provincial, and regional level have been put in place to support homeowners in retrofitting their homes, they have only begun to address the many barriers that homeowners face, from a lack of awareness of options, to a lack of trust in or access to measures, affordability challenges, and the sheer complexity of the task, among others.

A regionally-coordinated program that builds on these programs and specifically seeks to remove these barriers and provide homeowners with the support they need to make the switch to lower carbon home energy systems will be crucial to meeting the CRD's emissions reduction targets. Such a program would also highlight the many benefits to homeowners that electrification can bring, including:

- **Improved air quality**, by improving filtration and ventilation, regulating moisture, strengthening barriers to outdoor pollutants, and reducing sources of indoor air pollutants that can exacerbate pre-existing conditions.
- **Increased equity and affordability**, by helping homeowners identify and implement measures to reduce their energy consumption, especially when coupled with other incentives that reduce retrofit costs.
- **Improved resilience**, by supporting homeowners install heat pump systems that provide cooling as well as heating, safeguarding against increases in summer temperatures and the incidence of heat waves that will come with climate change. Supporting the addition of enhanced air filtration will also help protect household health against increasing wildfire smoke events.
- **Increased local economic growth**, by increasing the number of higher income/lower barrier jobs in the retrofit industry.

A Regional Home Energy Retrofit Program

To help homeowners identify and implement retrofit measures best-suited for their home, a subsidized "One Stop Shop" model is recommended for the capital region based on its ability to:

- Build on and integrate existing program infrastructure, including the CRD's current Bring It Home 4 Climate (BIH4C) program and the Province's Energy Coach Service, by providing homeowners with much-needed support in choosing the right option for them
- Provide homeowners with enhanced retrofit coordinator support tailored according to their needs, and focused on supporting the decarbonization of existing homes
- Better identify and target local market opportunities and help establish local contractor delivery networks, and
- Monitor performance through post retrofit follow-up to ensure homeowner satisfaction

A new CRD program could leverage the intake process through the Energy Coach program, while placing a concerted focus on fuel switching for emissions reductions as in BIH4C to ensure the benefits of home electrification are reaped. The proposed program design assumes that a moderate level of support could be provided by a Retrofit Coordinator per household to add to existing services, specifically helping alleviate the challenges of navigating the retrofit process once initial support has been provided via the Energy Coach service. Specific services that are assumed will be provided by a Retrofit Coordinator are outlined in the table below. These services build on the information and resources provided by the Federal government and the EnerGuide auditor, while addressing key gaps that prevent residents from translating the EnerGuide recommendations into specific actions and real-world GHG savings.

Step	Tasks
Screen	• Conduct (virtual) home energy check-up/screening
Review and Plan	• Review EnerGuide Renovation Upgrade Report • Assist client with upgrade choices • Consider DIY options and provide contractor selection advice and standardized quotation forms • Direct client to qualified contractor directory
Compare & Select	• Help homeowner scope work, compare contractor bids, ensure rebate eligibility, and provide troubleshooting throughout the process.
Finance	• Help identifying and selecting financing and incentives
Document	• Help getting documentation and assist with submitting rebate applications
Evaluate	• Quality Assurance checks post-retrofit (done in aggregate or spot-check) • Measurement & Verification

An initial focus on Part 9 (i.e., single family homes, duplexes and townhomes) is recommended for the CRD, as this sector represents the most significant opportunity and a potential savings of up to 15% of the capital region's total emissions over current levels. The upper end of this range can be captured by ensuring that most retrofits involve electrification and that the benefits of all electric homes listed above are captured. Some key considerations for the development of a Part 9 focused program are noted below:

- Oil heated-homes constructed before 1940 have the highest GHG emissions and remain a good target for retrofits, though there are fewer of these homes remaining. Oil-heated homes are also high adopters of fuel switching projects and often select heat pumps.
- Pre-1990 gas heated homes are high adopters of insulation upgrades, though they tend to retain or upgrade gas equipment rather than considering fuel switching. Newer homes (i.e., after 1990) are particularly high adopters of heat pumps.
- The rapid increase over the last decade of homes in the capital region adding natural gas furnaces indicates a continued risk of homes fuel switching towards natural gas. Every home that replaces electric resistance heating with a heat pump is one fewer home adding natural gas. As such, homes with electric resistance heating should remain a target area for the program, to forestall increases in natural gas use that could otherwise eliminate the net savings.
- The Province of BC is releasing an income qualified program specifically targeting low-income households and the unique barriers they face in upgrading their homes, the CRD should focus on other demographics in initial stages of the program and seek to strategically fill gaps as these income-qualified programs become established in the market.
- Targeting program outreach materials to the following markets will help to increase uptake in formative program years and build overall market capacity and demand:
    - Demographics and neighbourhoods that may be well equipped to make improvements, including higher income neighborhoods (e.g., Oak Bay and the Uplands), senior populations, and households in need of renewal, can improve program uptake and the overall impact on energy and carbon savings.
    - Newly purchased homes represent an opportunity for upgrades, as many new homeowners often take on renovations early on.
    - Moderate-income communities where natural gas is less prominent, and electric resistance and oil heating are more common, also presents a valuable GHG reduction opportunity alongside a potential reduction in energy poverty.
- Emphasizing the non-financial benefits of retrofits (e.g., increased thermal comfort and cooling, better indoor air quality, and lower carbon footprint), in communication and outreach can help attract homeowners to the program.

A Business Case for the CRD

Total estimated program costs for a Part 9 focused home retrofit program are outlined in the table below:

Program Year	Y1	Y2	Y3	Y4	Y5
Calendar Year	**2022**	**2023**	**2024**	**2025**	**2026**
Budget	**$602,500**	**$602,500**	**$602,500**	**$602,500**	**$602,500**
CRD Staff (0.5 FTE)	$52,500	$53,500	$54,500	$55,500	$56,500
Program Overhead	$240,000	$188,220	$190,484	$192,794	$195,150
Homeowner Support	$310,000	$360,780	$357,516	$354,206	$350,850
Estimated Program FTEs (excluding CRD staff)	3	5	5	5	4
% Program Overhead (excluding CRD staff)	40%	31%	32%	32%	32%
Homes Going Through Program/Year	885	1030	1021	1012	1002
% annual penetration	0.9%	1.0%	1.0%	1.0%	1.0%
Homes/Year with leveraged resources	92	107	106	105	104
% annual penetration with leveraged resources	0.1%	0.1%	0.1%	0.1%	0.1%
Additional tCO_2e abated each year*	1781	2072	2054	2036	2016

Key insights from the cost analysis include the following:

- A CRD-run program that integrates into existing program offerings and provide homeowners with coordinator support not currently offered by existing CleanBC Energy Coach services is estimated to require an average of 7 hours of support or $350 per household. Such levels of support will vary considerably as those engaging in deeper retrofits or with more complex homes may require more, while others will require less.
- Program overhead is estimated at approximately $290,000 in the first year, decreasing to $240,000 in subsequent years as the program gets off the ground and promotional materials are developed.
- Program resources that can be leveraged in a CRD-led program include existing federal and provincial rebates and incentives for pre- and post-retrofit audits, electrical service upgrade top-ups and rebates. In the event that these resources are reduced or eliminated, the CRD will need to reassess the nature and/or level of support for homeowners to reap the best value.
- A fixed budget of $602,500 per year for the first five years is estimated to support the completion of home retrofits in 1% of the homes in the capital region per year, representing a standard but substantial uptake rate. While carbon savings will vary based on the nature of the upgrade, it is estimated that this could yield between 1.18 tCO_2e and 2.43 tCO_2e of emissions savings per home, or a total of over 2000 tCO_2e additional carbon savings across

the capital region each year. This translates into a cumulative29,443 tCO_2e avoided over five years.

- Program costs supporting a 1% uptake rate can be met by applying to the Federation of Canadian Municipalities' *Community Efficiency Financing* (CEF) funding stream. However, an uptake rate of 3% of homes per year is necessary to achieve a full building stock improvement by 2050. The scale of such a program would require significant support at provincial and federal levels, including additional incentives and rebates for electrification equipment and supporting efficiency measures.

Moving Beyond Single-Family Homes

While the GHG savings available in Part 3 multifamily buildings represent only 18% of the GHG savings potential as is available in the Part 9 housing stock, a significant proportion of the building sector in some CRD communities is made up of multi-unit residential buildings. As such, both strata owned and rental, and will require dedicated programming to meet municipal and provincial emission reduction ambitions. With respect to strata, a project currently being led by Metro Vancouver and a group of other local governments is exploring the potential expansion of Metro Vancouver's *Strata Energy Advisor Program* across the province. In its current form, the program is intended to provide strata buildings with a program specifically designed to address their unique barriers. If adopted at the provincial level, such a program would support strata owners and their property managers understand and undertake energy efficiency and emissions reduction upgrades, and fill the gap of retrofit support currently available to strata owners. However, even if the Strata Energy Advisor program is not expanded provincially, it would provide a strong framework on which to expand the CRD's program to strata housing in a later or concurrent phase.

The analysis of the multifamily rental housing stock listed in the BC Assessment data indicates that there are 30 purpose-built rental buildings over 100,000ft^2, accounting for 20% of the rental floor area in the region but only 2.5% of the 1,187 buildings. The overall age of the rental stock is older than the strata stock as well; 15 of the 30 largest rental MURB buildings were built before 1977, with the median year built for the sector overall at 1969. Targeted outreach to the owners and property managers for these buildings could have a significant impact on community emissions across the region, and would benefit a greater proportion of lower-income households or those living in or at risk of energy poverty.

1. INTRODUCTION

1.1. Background

The Capital Regional District (CRD) has set a target of reducing its greenhouse gas (GHG) emissions community-wide by 61% (over a 2007 baseline) by 2038, and working towards regional carbon neutrality by 2030. To meet this goal, emissions reductions will need to be achieved across several sectors, including the building sector, which accounts for over 30% of the capital region's emissions.

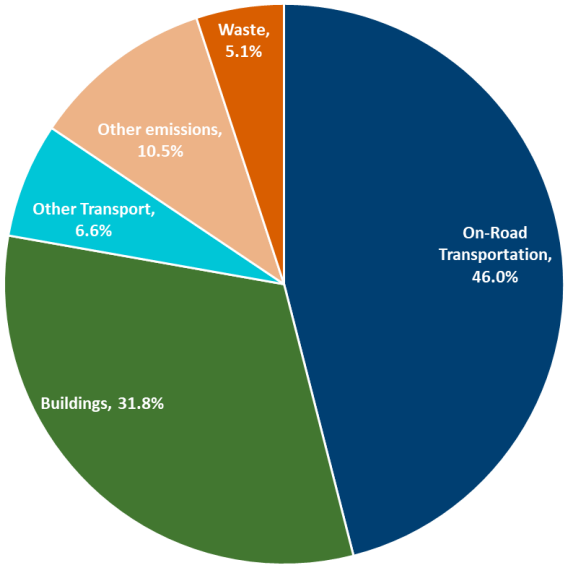


Figure 1: CRD GHG inventory by sector, 2018

Reducing emissions in the buildings sector presents a significant challenge. While new construction standards are continuously improving in energy efficiency (with an emissions target potentially forthcoming), the existing stock of capital region's homes will need to be retrofitted to reduce energy consumption and shift to lower carbon sources of energy. When combined with the region's existing affordability challenges, retrofits pose a complex issue. Indeed, the CRD's *Transition 2050* initiative identified seven key challenges to deep emissions retrofits[1]:

- **Scale of the challenge.** Retrofit uptake has been low across the Province, meaning a rapid increase in the rate, scale and depth of home retrofits will be required for both the CRD and the Province of BC to meet their 2030 GHG reduction targets.
- **Economic barriers.** Changes in utility costs, high upfront costs, overall affordability, and contractual restrictions with some rental properties all constrain retrofit uptake.
- **Awareness and acceptance.** Homeowners lack awareness and understanding of retrofit opportunities, rebates, technologies, and the overall benefits of retrofits.

[1] City Green Solutions & Home Performance Stakeholder Council. *Residential Retrofit Market Acceleration Strategy.*

- **Consumer trust, access, and industry capacity**. There is limited access to high efficiency products, as well as challenges finding qualified contractors.
- **Rental housing and demographic challenges**. Economic barriers are present in low-medium income (LMI) households, while rental properties are faced with a split incentive problem.
- **Complexity**. The overall complexity of the retrofit process and additional barriers associated with hazardous material; for example, asbestos and disposal costs limit homeowners' ability and willingness to engage in retrofits.
- **Psychological barriers.** Physiological barriers to the adoption of residential retrofits include distrust towards experts and authorities, as well as a perceived risk of changing from one system to another.

Coupled with the fact that approximately 15% of the capital region's population is characterized as living in or being at risk of energy poverty, any effort to increase the rate and depth of retrofits must take care to also ensure that the cost of living can be improved or at least maintained. Energy poverty is often defined as households who struggle to meet their home energy needs and spend more than 6% of their after-tax income on their energy needs.[2] Similar concerns also exist around the issue of "renovictions", in which tenants may be evicted to allow for renovations to be made to a unit, often resulting in higher rent units.

1.2. Project Purpose & Approach

To help address these challenges and support the achievement of the CRD's climate change goals, this project is tasked with developing a detailed business case for a successful *Regional Residential Energy Retrofit Program* capable of spurring deep emissions retrofit actions by home and building owners across the region. While several programs at the federal, provincial, and regional level have been put in place to support homeowners in retrofitting their homes, they have only begun to address the barriers noted above. A regionally-coordinated program that builds on these programs and specifically seeks to remove these barriers and provide homeowners with the support they need to make the switch to lower carbon home energy systems will be crucial to meeting the CRD's emissions reduction targets. Such a program would also highlight the many benefits to homeowners that electrification can bring, from improved air quality and resilience, to lower home energy costs and increased local economic activity.

Given the emissions reduction opportunity that this sector faces, this memo has developed a draft program design and business case focused on Part 9 homes (i.e., single-family, duplex and townhouse). The data presented here is based on the following steps and sources of information and analysis:

- A review of available data sources to assess the scale of the retrofit market in the capital region
- A review of existing and planned program offerings in the residential retrofit market in BC and Canada

[2] CUSP. 2019. *Energy Poverty in Canada: a CUSP Backgrounder*

- A scan of best practices in residential retrofit programs to determine potential models
- A workshop and follow-up meetings with an Advisory Committee to review proposed program approaches and costs, representing leaders and key stakeholders in the retrofit market
- Discussions with CRD staff and Steering Committee members, representing staff from member jurisdictions

The information and insights derived from these steps were used to draft a high-level set of assumptions around potential program design, which were then costed based on consultant team, Advisory Committee and CRD and municipal staff experience to inform a business case prior to full program design. Recommendations for Part 3 (i.e., multi-unit residential buildings) are also provided, given the importance of taking advantage of the equity and emissions reduction opportunities in this sector as well.

2. EMISSIONS REDUCTION POTENTIAL IN THE CAPITAL REGION

To assess the potential of a residential retrofit program to help meet the CRD's emissions reduction targets, it is necessary to first identify the region's current residential building stock and its key characteristics. The scale of the retrofit market in the region was assessed by taking the following steps for both Part 9 and Part 3 residential buildings[3]:

1. **Energy Savings Potential:**
    a. *Part 9*: An assessment of available EnerGuide data to show the average pre- and post-retrofit energy use intensities (EUI) and greenhouse gas intensities (GHGI)
    b. *Part 3*: A review of energy savings estimates from the Strata Energy Advisor program and an analysis of the GHG potential for multi-unit residential buildings (MURB) fuel-switching
2. **Building Stock:** An analysis of BC Assessment data to identify the number of homes and floor area across the capital region, grouped by decade built, jurisdiction, and housing type.
3. **Fuel Type Estimates:**
    a. *Part 9*: An exploration of a Victoria Real Estate Board survey of >10,000 homes to estimate primary heating fuel for single family homes.
    b. *Part 3*: A review of the BC Assessment data, coupled with an application of assumptions from previous studies
4. **Region-wide Estimates:** An application of EnerGuide pre-retrofit, post-retrofit, and post-fuel-switch-retrofit[4] EUIs and GHGIs assigned across homes (based on number and floor area) by jurisdiction and building age, to estimate total current emissions and total emissions savings potential across the region

[3] The B.C. Building Code has two main categories of buildings, Part 9 (simple buildings) and Part 3 (complex buildings). Part 9 buildings are generally three stories or less, and under 600 square meters. Some examples include houses and duplexes, small apartment buildings, and small commercial buildings. Part 3 buildings are generally over three stories and more than 600 square meters. Some examples include shopping malls, office buildings, condos, apartment buildings, schools, theaters, and care facilities.

[4] A fuel switch retrofit refers to a replacement of a more GHG emissions-intensive heating system (i.e., one that uses oil or natural gas) with one that is lower in emissions intensity (i.e., electricity)

Each of these steps is discussed in further detail in the sections below.

2.1. Single-Family/Part 9 Savings Potential

EnerGuide for Houses is a program created by Natural Resources Canada (NRCan) that provides homeowners with independent expert advice concerning energy efficiency in their homes. Through the work of Registered Energy Advisors (REAs), homes are evaluated across Canada both before and after energy efficient retrofit projects. By collecting key measurements such as fuel type, floor area and insulation levels, REAs use a home modelling software to derive metrics including GHG emissions, EUI, and EnerGuide ratings, all of which are used to advise the homeowner on making energy efficient improvements to their home. Data from all EnerGuide evaluations are then collected by NRCan, creating a database of houses and home retrofit projects ideal for benchmarking existing homes and estimating emission reduction potential.

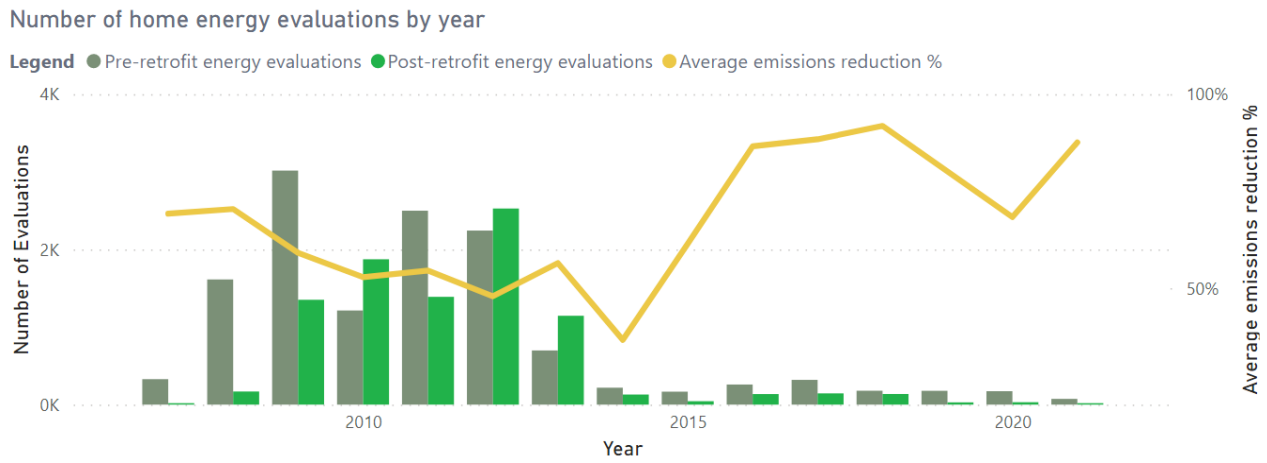


Figure 2: Reviewed EnerGuide data set and average emissions reductions.

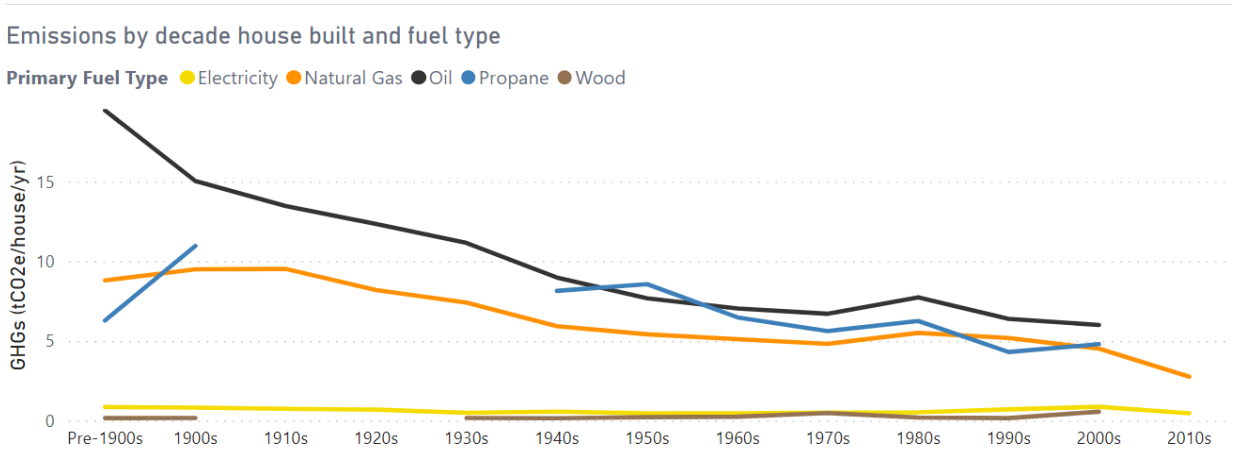


Figure 3: Pre-retrofit emissions by decade and heating fuel type (Note: gaps indicate where no data was gathered on homes of that vintage using that fuel)

For this project, 13,177 pre-retrofit evaluations and 9,117 post-retrofit evaluations within the capital region were analyzed, spanning from 2007 to early 2021 (see Figure 2). Below are some key findings:

- An average retrofit project within the region reduces GHG emissions by 38.45%. When segmented, fuel switching projects save an average of 70.53 of emissions, whereas non-fuel switching projects save 10.58%.
- Fuel switching occurs in 26% of recorded retrofit projects, with 63% switching to electricity and 37% switching to natural gas. 92% of fuel switches see a shift away from oil, with 5% shifting away from natural gas. The high occurrence of fuel switching away from oil reflects the high cost of oil heat, as well as the *Oil-to-Heat-Pump* program that operated in the region from 2015 to 2018.
- Average household GHG emissions vary heavily based on the heating fuel source used. Oil-using homes are the highest emitters with an average of 9.92 tCO2e/year, followed by natural gas at 8.05 tCO2e/year and propane at 7.70 tCO2e/yr. Electric heated homes are considerably lower at 1.52 tCO2e/year. Figure 3 shows the pre-retrofit evaluation GHGs per home by decade.
- The largest quantity of GHG emissions reduced through retrofitting is in 1910 homes, with an average household reduction of 3.32 tCO2e/yr. The average reduction continues to decline with decreasing house age, with homes built in the 2000s only saving an average of 0.52 tCO2e/yr.
- While the high number of EnerGuide evaluations in the sample reflects in part the availability of federal ecoEnergy incentives during the earlier half of the sample period, these 9,117 completed retrofits still represent *less than 10%* of the homes in the capital region.
- Among single family homes, floor area, year of construction and primary pre-retrofit heating fuel are key indicators of GHG savings. These findings drove the structure of the remainder of this analysis.

2.2. Multifamily/Part 3 Savings Potential

Given the absence of EnerGuide data to draw on for Part 3 multi-family buildings, the energy savings potential for the Part 3 building stock was estimated by using findings from Metro Vancouver's *Strata Energy Advisor* program, in addition to a set of studies of retrofit opportunities in MURB properties on Vancouver Island and the Lower Mainland.[5] The *Strata Energy Advisor* pilot program report from 2016 grouped MURB retrofits into several key retrofit tiers.[6] However, this analysis did not examine a change of heating fuel or technology; buildings using natural gas heat were assumed to still be using natural gas heat, and buildings using electric resistance were not assumed to switch to heat pumps. As such, a Tier 4 retrofit opportunity was developed by drawing on an analysis of the heat pump opportunities to estimate the savings opportunity from a fuel switch.[7] The resultant tiers are as follows:

0. *Retrocommissioning / Tune-up only*
1. *Normal Renewal:* code minimum equipment replacement without increased insulation, or air sealing

[5] Metro Vancouver, Strata Energy Advisor. http://www.strataenergyadvisor.ca/Pages/default.aspx
[6] RDH, Strata Energy Advisor Program Recommendations, 2016
[7] Integral Group, Heat Pump Applications in Residential Buildings, 2016

2. *Energy Retrofit:* R5 Wall Insulation, R10 Roof Insulation, Condensing Boiler/furnace
3. *Comprehensive Retrofit*: R10 Wall Insulation / R20 roof insulation, air sealing, U-0.2 windows,93%+ efficient furnace or boilers
4. *Heat Pump Retrofit*: Distributed air source heat pump or 4-pipe air-to-water heat pump with COP of 3.0, and a central air to water heat pump for domestic hot water, along with similar insulation upgrades as Tier 3.

Average emissions savings estimates for MURB retrofits for each of these tiers are shown in Figure 4.

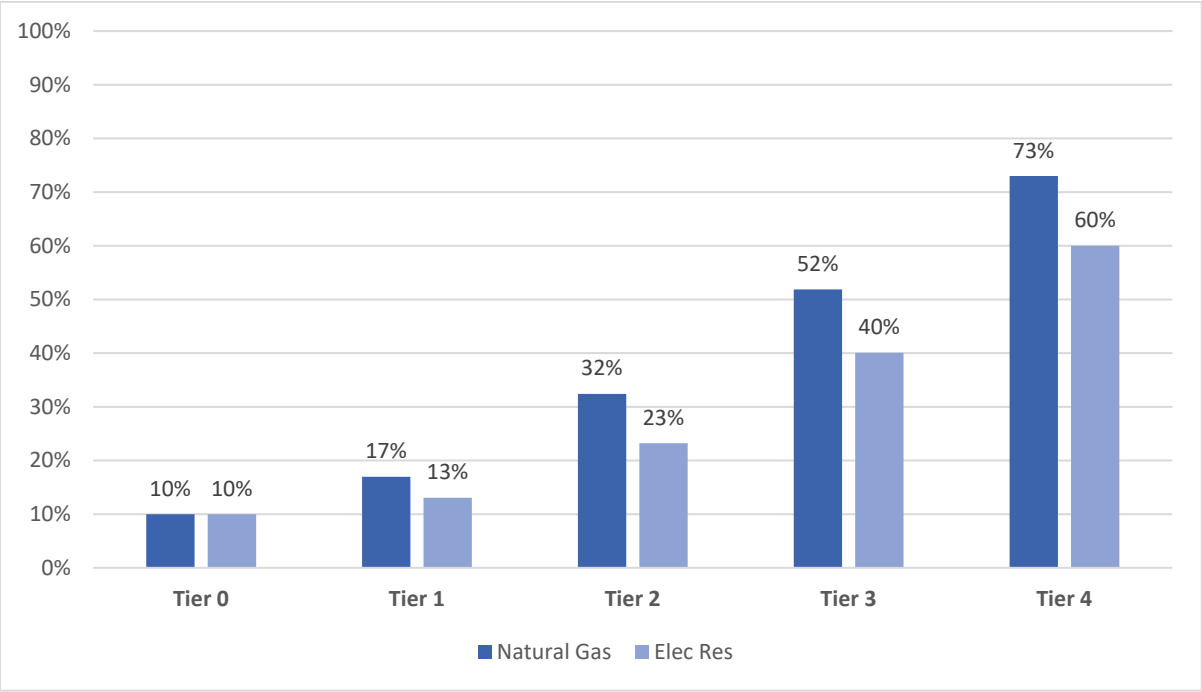


Figure 4: Potential GHG savings in MURB retrofits, British Columbia Climate Zone 4C

2.3. Housing Stock Analysis

A review of the BC Assessment housing data for the region was conducted to identify the floor area of homes by decade and jurisdiction (see Figures 5 and 6 for single family homes, and Figures 7 and 8 for Part 3 Multifamily buildings). This analysis revealed that most homes in the capital region are smaller, single-family homes, and 63% of all residential dwellings and 68% of all residential floor area is represented by Part 9 buildings. These 101,535 homes in the dataset comprise single-family detached homes, townhouses, strata townhouses, duplexes, triplexes, and fourplexes.[8]

The remaining residential floor area is represented by strata multifamily buildings and purpose-built rental multifamily buildings. Stratified condominium buildings (strata) represent 63% of the Part 3 floor area and 20% of the overall residential floor area, while purpose-built rental represents 37% of the Part 3 buildings and 12% of overall residential floor area. The bulk of the Part 3 stock is found in the City of Victoria, home to 49% of all multifamily units, and 61% of the purpose-built rental

[8] As BC Assessment does not account specifically for First Nations homes, they are not represented in this analysis

multifamily units in the Capital Region. Esquimalt, Langford, Saanich, and Sidney are home to 86% of the total multifamily housing stock in the Capital region.[9] *A summary breakdown of all home types across the capital region is shown in Table 1*.

Table 1: Breakdown of home type across the capital region

Typology	Units/ Homes	Buildings	Gross Floor Area (ft^2)	% of Units/Homes	% Buildings	% GFA
Single Family Houses (including suites)	110,034	92,085	133,454,861	56.9%	90.7%	63.9%
Duplex, Triplex, and Fourplex	12,786	6,074	8,523,298	6.6%	6.0%	4.1%
Strata MURB	40,674	2,200	41,954,968	21.1%	2.2%	20.1%
Rental MURB	29,730	1,187	24,772,510	15.4%	1.2%	11.9%
Total Residential	193,224	101,546	208,705,637	100.0%	100.0%	100.0%

[9] Purpose-built rental multifamily floor area and unit counts are both partial estimates. As 75% of the multifamily rental buildings in the BC Assessment dataset have no listed floor area, floor area was estimated based on the number of units. Conversely, as 40% of the buildings with a listed gross floor area had no unit counts, unit counts for those properties were estimated based on the floor area. Both sets of estimates used the ENERGY STAR assumption of 1.2 units per 1,000 ft^2. An additional 272 multifamily properties had neither floor area nor unit counts; these buildings were excluded from the sample entirely.

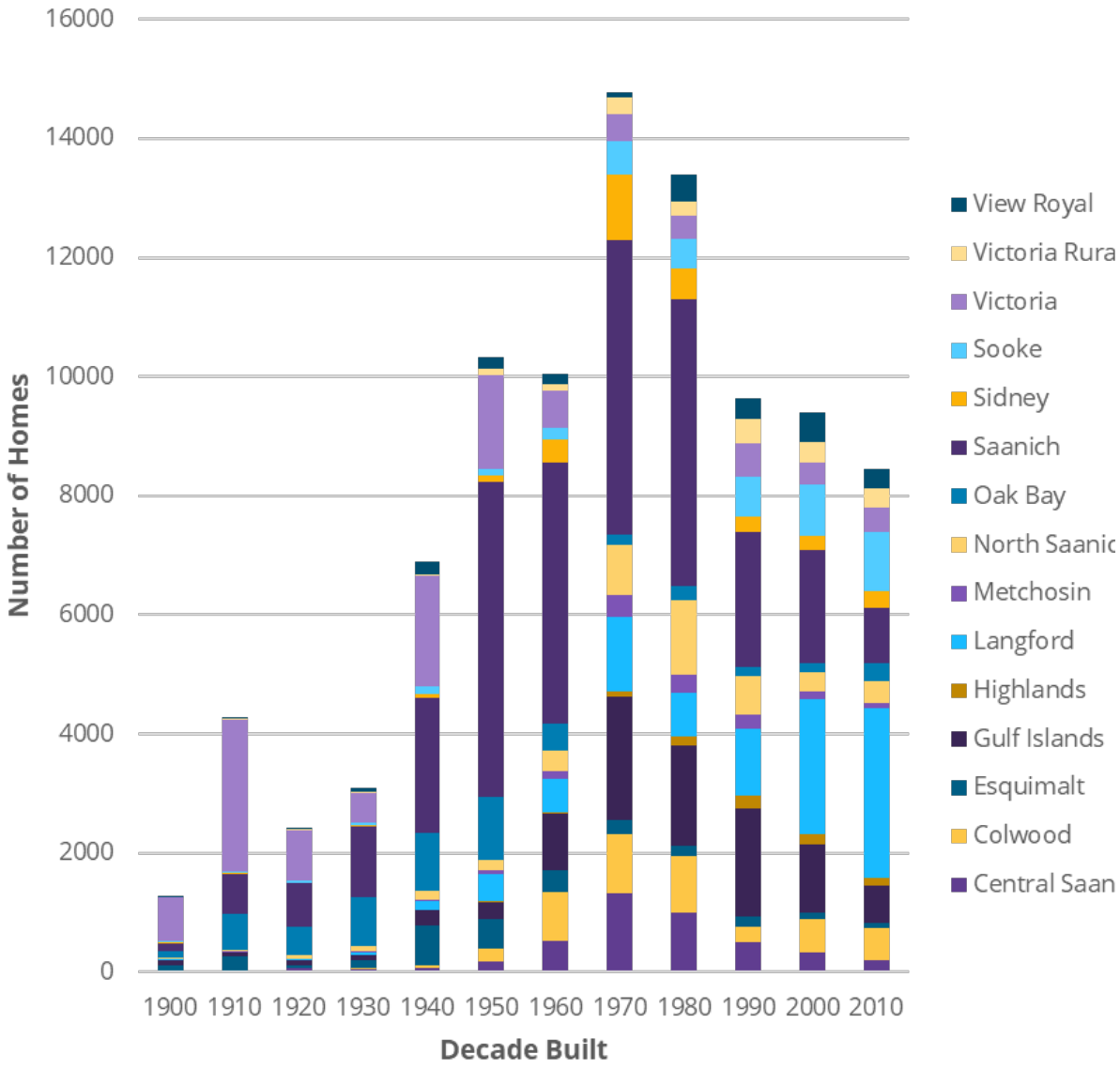


Figure 5: Number of homes in the capital region by decade built and jurisdiction (Victoria Rural here refers to the unincorporated Juan de Fuca Electoral Area)

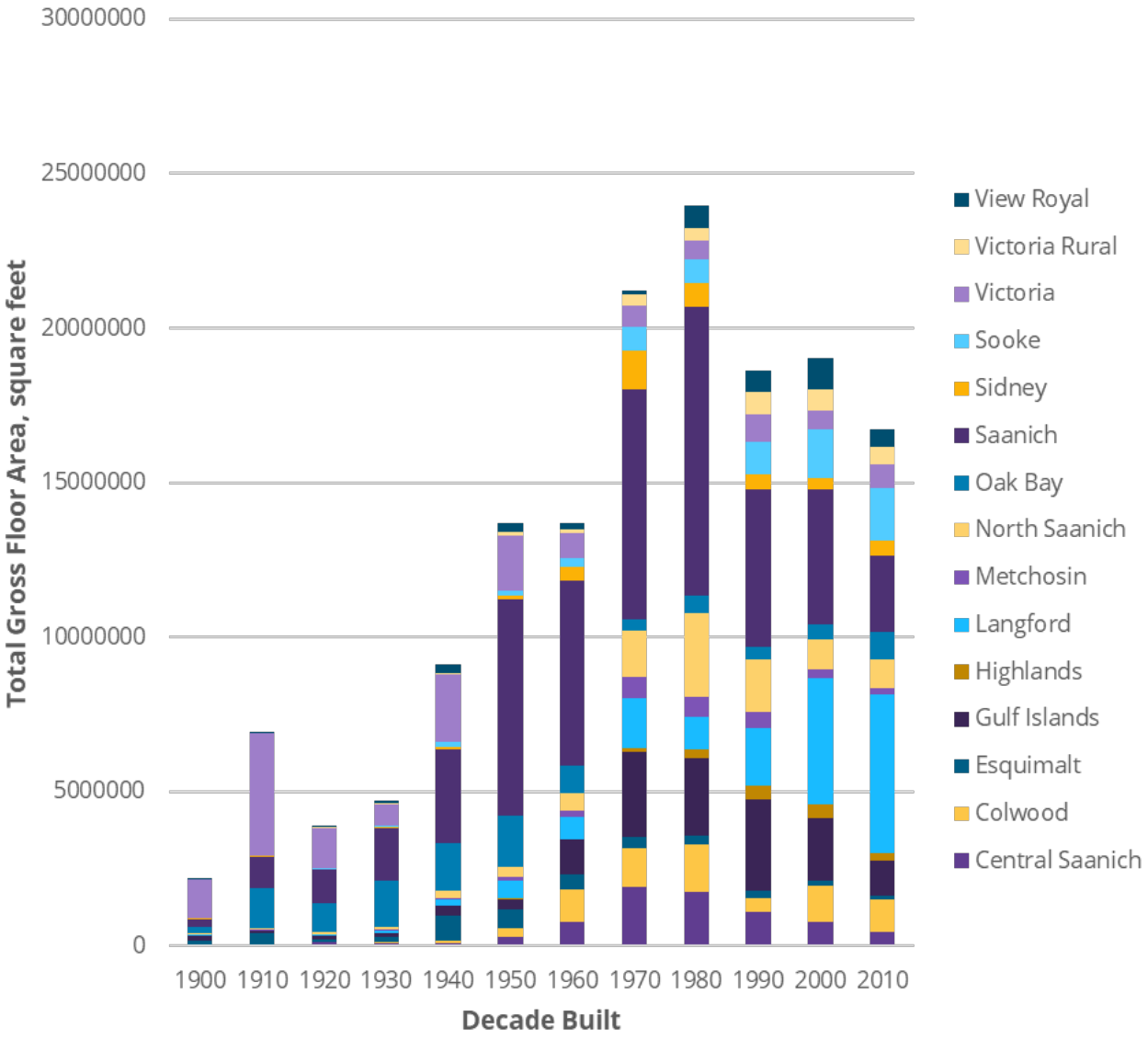


Figure 6: Total floor area of homes in the capital region by decade and jurisdiction (Note: Victoria Rural here refers to the unincorporated Juan de Fuca Electoral Area)

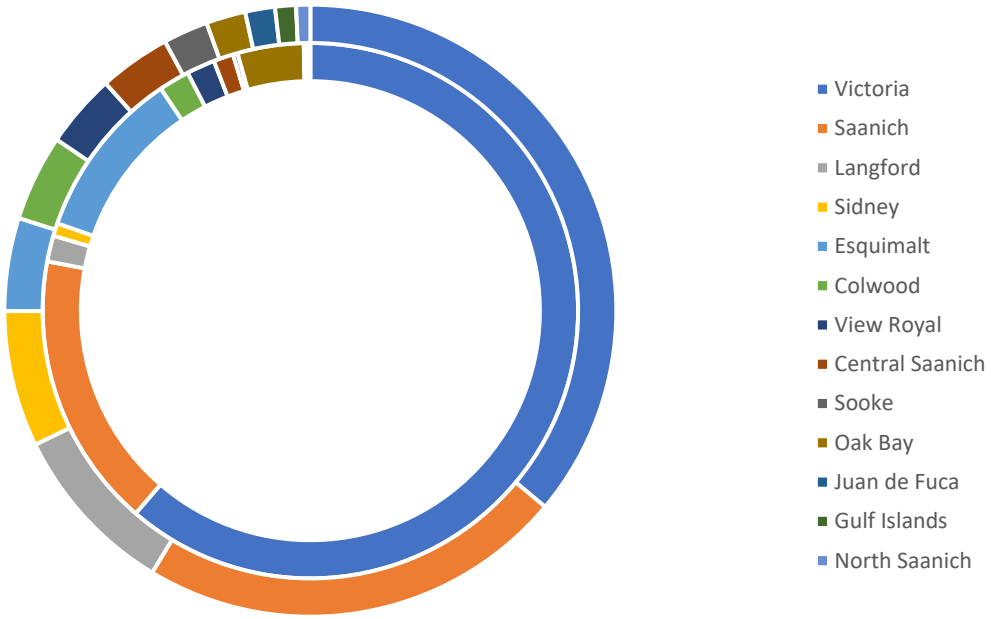


Figure 7: Breakdown of strata-owned MURB (outer ring) and purpose-built rental MURB (inner ring) floor area by jurisdiction

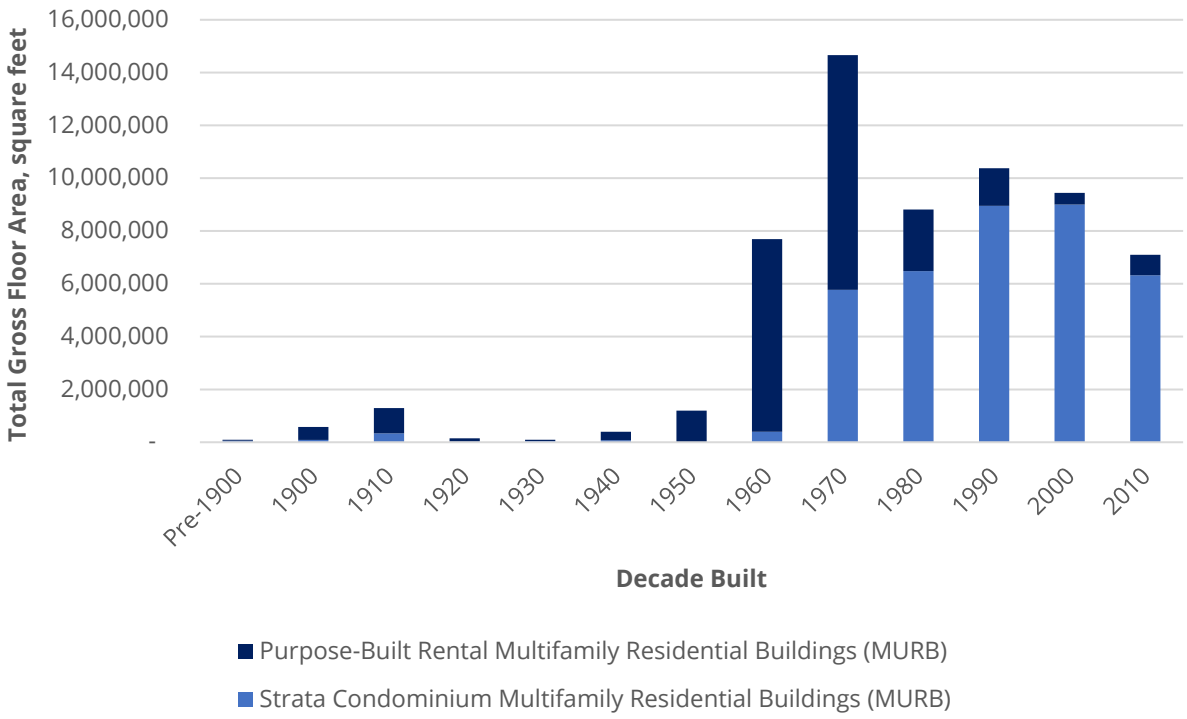


Figure 8: Distribution of Strata and Purpose-Built Rental MURB floor area by decade built in the capital region.

Survey data of 10,000 homes in the capital region was also used to assess heating fuel type distribution. This data shows that natural gas use is also increasing across the capital region, as the rate of gas hookups has gone up five-fold over the last decade (see Table 2and Figure 9). This is an issue of particular concern for a residential retrofit program, as natural gas represents an emissions-intense source of energy.

Table 2: Primary heating fuel breakdown among single family homes in each jurisdiction (Note: some rows do not add up to 100% due to rounding)

Jurisdiction	Electric	Gas	Oil	Propane	Wood
Colwood	39%	42%	6%	3%	9%
Central Saanich	42%	36%	5%	6%	12%
Esquimalt	41%	35%	10%	2%	11%
Gulf Islands	38%	1%	2%	12%	46%
Highlands	44%	24%	2%	11%	19%
Langford	58%	33%	3%	2%	4%
Metchosin	27%	12%	17%	11%	33%
North Saanich	58%	16%	5%	12%	9%
Sidney	42%	46%	3%	2%	7%
Oak Bay	34%	46%	12%	1%	7%
Saanich	42%	34%	12%	3%	10%
Sooke	45%	28%	2%	10%	16%
Victoria	42%	41%	8%	2%	7%
View Royal	46%	44%	2%	3%	4%

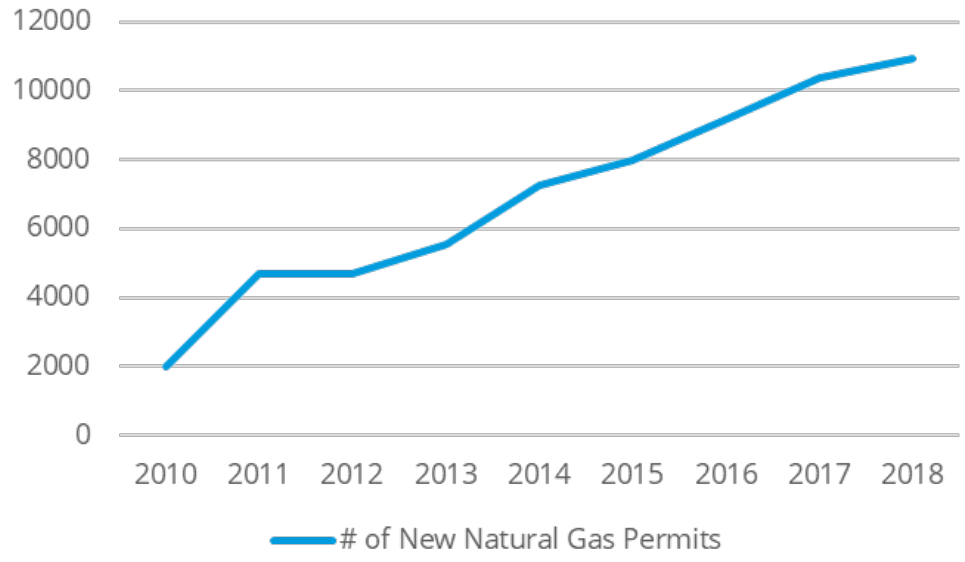


Figure 9: New natural gas connections in the capital region, 2010-2018

2.4. Emissions Reduction Potential Across the Capital Region

Part 9

To model the potential emissions savings from a residential retrofit program, a number of steps were taken. First, home age and the heating fuel survey results were used to assign an assumed heating fuel to each home in region's BC Assessment dataset. Each home was then assigned a pre- and post-retrofit energy use and emissions profile, based on the home's size, age, and assumed heating type, which resulted in 890 possible combinations of heating fuel type, decade built, and jurisdiction. Using EnerGuide data, a pre- and post-retrofit energy use intensity (EUI) and greenhouse gas emissions intensity (GHGI) was calculated for each of the combinations of decade built and primary pre-retrofit heating fuel. Average post-retrofit EUI and GHGI values were also calculated for homes that switched from any heating fuel to electricity. These two sets of EnerGuide-derived EUI and GHGI values were then mapped to homes in the region.

This process allowed for an estimate the pre-retrofit emissions for all homes in the capital region, by jurisdiction, and estimate hypothetical post-retrofit emissions if all homes were to be retrofitted. Estimated pre-retrofit emissions cannot be directly compared to the CRD GHG inventory, due to inconsistencies in the assignment of energy use to sectors of the building stock and the specific emission factors. However, calculated emissions roughly align with the current CRD inventory for residential emissions, which validates the overall approach. Post-retrofit estimates were calculated for two scenarios. Under the "standard" scenario, all homes receive retrofits that achieve the average savings for homes of their age and heating type (with 25% switching to lower emissions heating fuels, in line with historical rates). Under the second scenario, all homes are assumed to switch to high-efficiency electric heating (i.e., heat pump); see Table 3.[10]

Table 3: Potential GHG savings, assuming all Part 9 homes in the capital region are retrofitted

Single Family Scenario	Total GHG (tCO_2e)	Savings Estimate (tCO_2e) vs Calculated Baseline	Average GHG Savings per home	% GHG Savings in Single Family Sector	*Savings as % of CRD 2018 Emissions*
Baseline Calculated Emissions	375,918				
Scenario 1: Post-retrofit with standard approach	248,932	126,986	1.35	**34%**	*7%*
Scenario 2: Post-retrofit with electric heat pump fuel switch	131,498	244,420	2.60	**65%**	*15%*

The variation across jurisdictions as shown in Figure 9 and Figure 10 below is due to the differences in the age of homes, the predominant heating fuels, and the number of homes. Most jurisdictions

[10] As these calculations use the latest 2021 BC Hydro emissions factor of 40.1 tCO_2e/GWh, the comparison with the CRD's 2018 emissions inventory (see Figure 1) is not exact, but gives a general sense of the scale of the potential impact.

will see emissions reductions in the single-family sector of between 30% and 40% in the standard retrofit scenario, and 55% and 70% in the electrification fuel switch scenario. Langford and Sooke are outliers due to the age of their housing stock; new homes see lower emissions savings, and in both jurisdictions, the majority of homes were built in the last 30 years. The unincorporated areas of Juan de Fuca and the Gulf Islands also have lower savings, as a higher proportion of the existing homes in those areas already use a biomass fuel and so see lower emissions savings from retrofits.

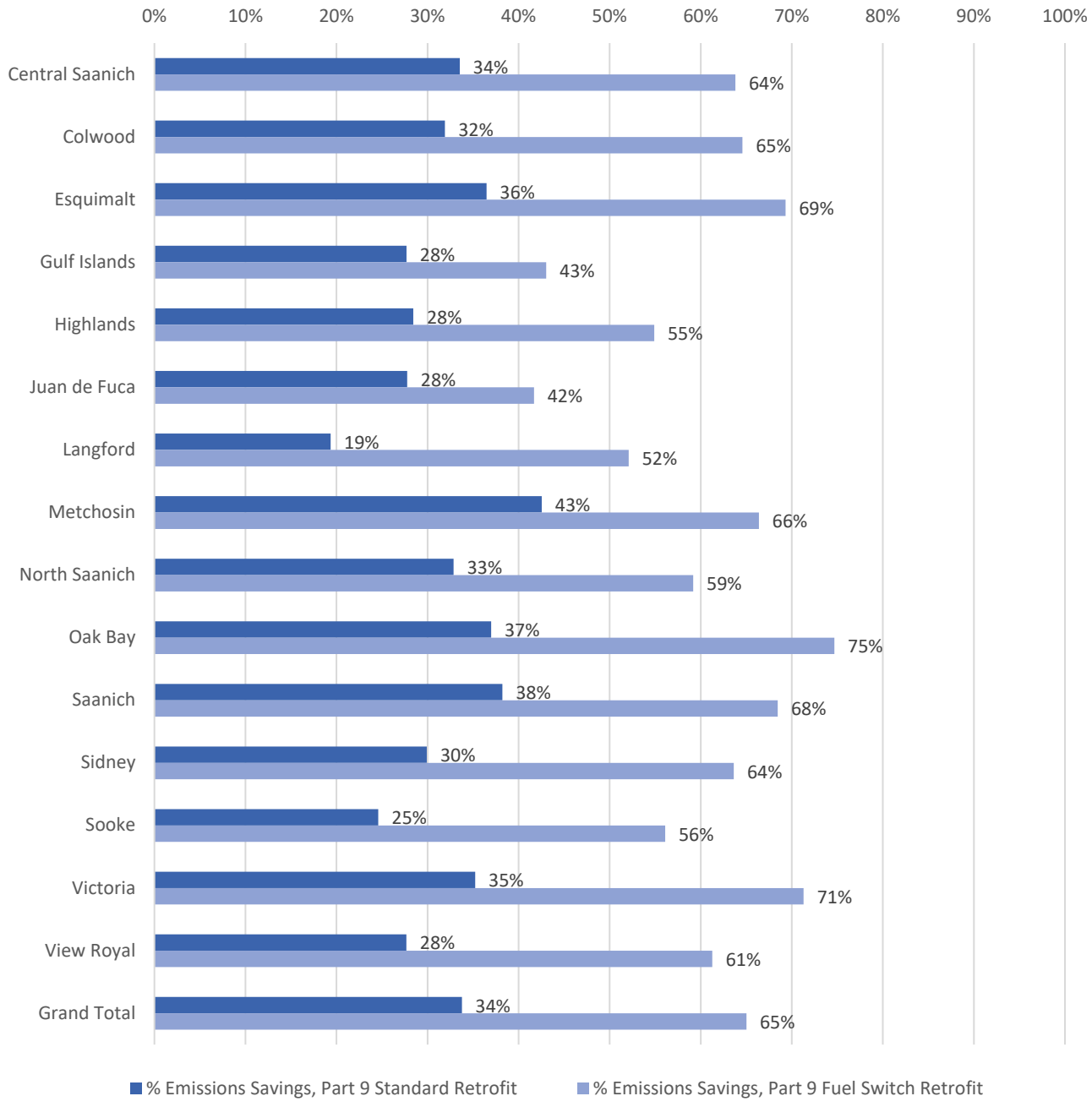


Figure 10: GHG savings potential in Part 9 homes by jurisdiction, percentage

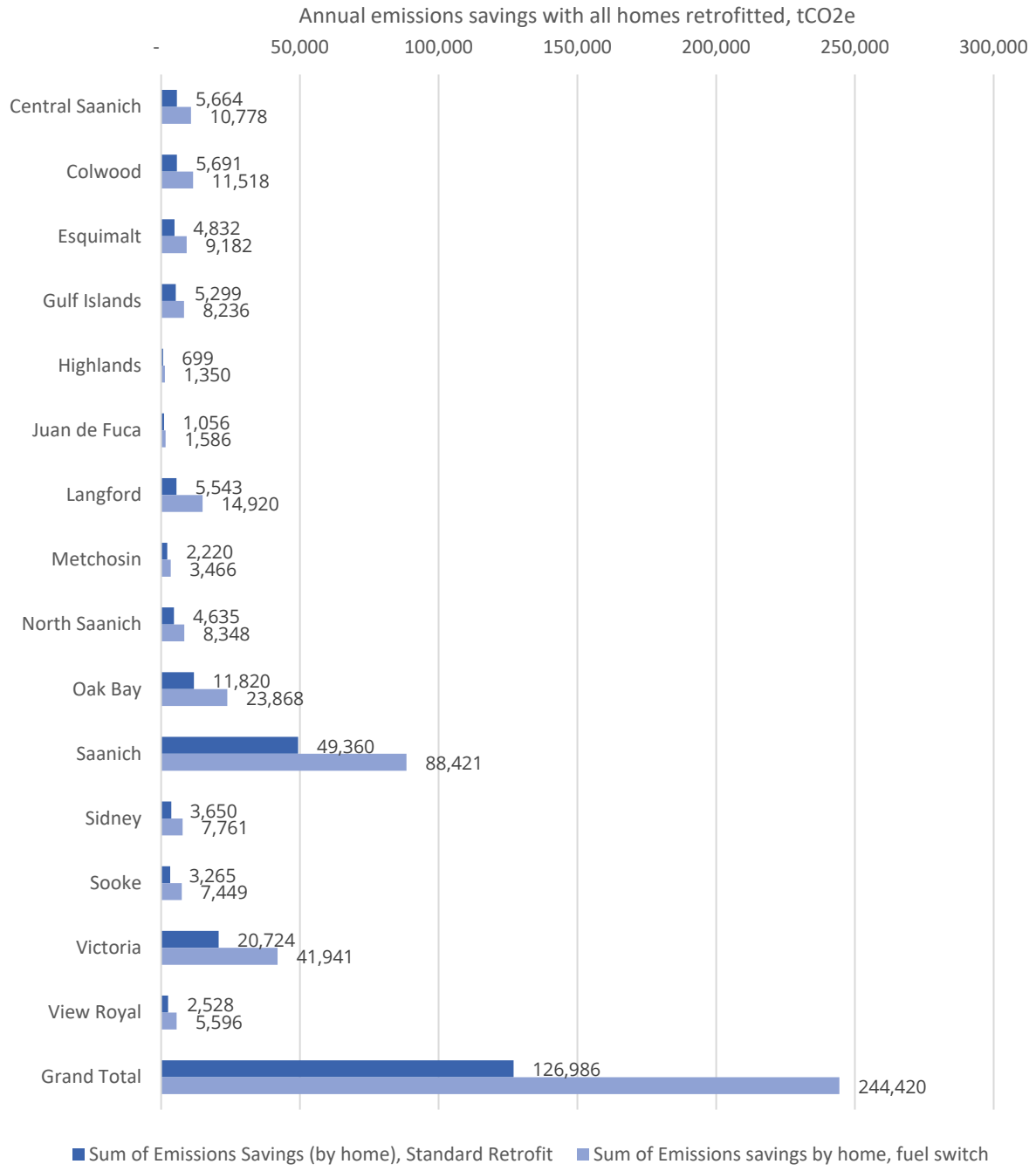


Figure 11: Emissions savings potential in Part 9 homes by jurisdiction, annual avoided tco_2e

Part 3

To model the potential emissions savings from a program targeting Part 3 strata and purpose-built rental homes, data from the Climate Action Secretariat and NRCAN's *Comprehensive Energy Use Database* (CEUD) was used to estimate the division of the multifamily housing stock in the capital region. These estimates were created using five scenarios of space heating energy source and domestic hot water energy source (see Figure 12), each of which have different associated baseline EUIs and GHGIs. Due to lack of localized survey data on heating fuels or achieved emissions reductions for Part 3 MURB in the capital region, Part 3 GHG estimates are higher level than Part 9 estimates described above.

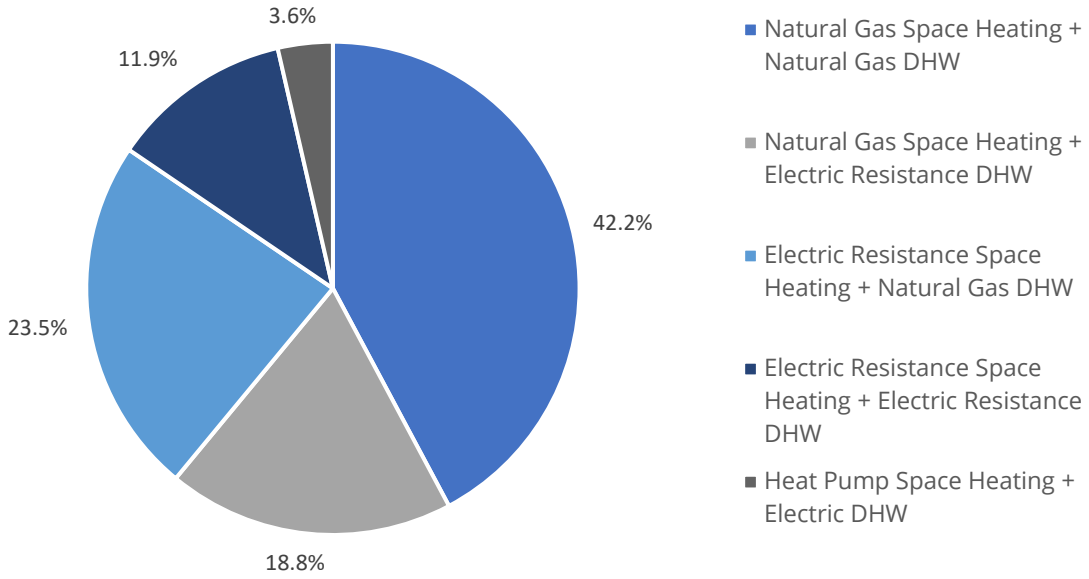


Figure 12: MURB heating sources in British Columbia Climate Zone 4A

EUI, total energy use, and total GHG emissions were then calculated for the estimated MURB floor area for each heating configuration and jurisdiction. GHG savings for the five tiers of MURB retrofits (which also differ by heating configuration) were then calculated and totaled, as shown in Table 4.

Of these five tiers, the Tier 2 "Standard Retrofit" is the closest MURB approximation of the EnerGuide "standard retrofit" shown above, while the Tier 4 fuel switch retrofit is a heat pump-based fuel switch and electrification retrofit. Overall, the potential savings represent approximately one quarter of the estimated savings from the single-family home sector, but remain significant. Savings are broken out between rental and strata buildings; however, as there is insufficient data on the differences in heating types between rental and strata-owned MURB, this is based solely on floor area. As heating sources may vary between strata and rental buildings; the relative savings may also be different. Figure 13 shows the distribution of savings by jurisdiction, which primarily reflects the distribution of MURB floor area across the capital region.

Table 4: Estimated potential energy and GHG savings for Part 3 residential buildings

Scenario	Total GHG Estimates for Part 3 MURB (tCO2e)	Savings Estimate (tCO_2e) for Part 3 MURB	Savings Estimate (tCO_2e) for Strata MURB	Savings Estimate (tCO_2e) for Rental MURB	% GHG Savings in Multifamily Sector	*Savings as % of CRD 2018 Emissions*[11]
Baseline Calculated Emissions	103,740					
Tier 0: Retrocomissioning	93,366	10,374	6,523	3,851	**10%**	*0.6%*
Tier 1: Basic Renewal	87,325	16,415	10,321	6,094	**16%**	*1.0%*
Tier 2: Standard Retrofit	72,888	30,852	19,398	11,454	**30%**	*1.8%*
Tier 3: "Comprehensive" Retrofit	53,505	50,235	31,585	18,650	**48%**	*3.0%*
Tier 4: Fuel Switch Retrofit	32,360	71,380	44,880	26,500	**69%**	*4.2%*

[11] Calculated emissions use the latest 2021 GHGI figures for BC Hydro, which diverges from the assumptions used in the 2018 CRD GHG Inventory, Therefore, the comparison of estimated savings to the region-wide inventory is provided to give a sense of relative scale but does not represent an apples-to-apples comparison.

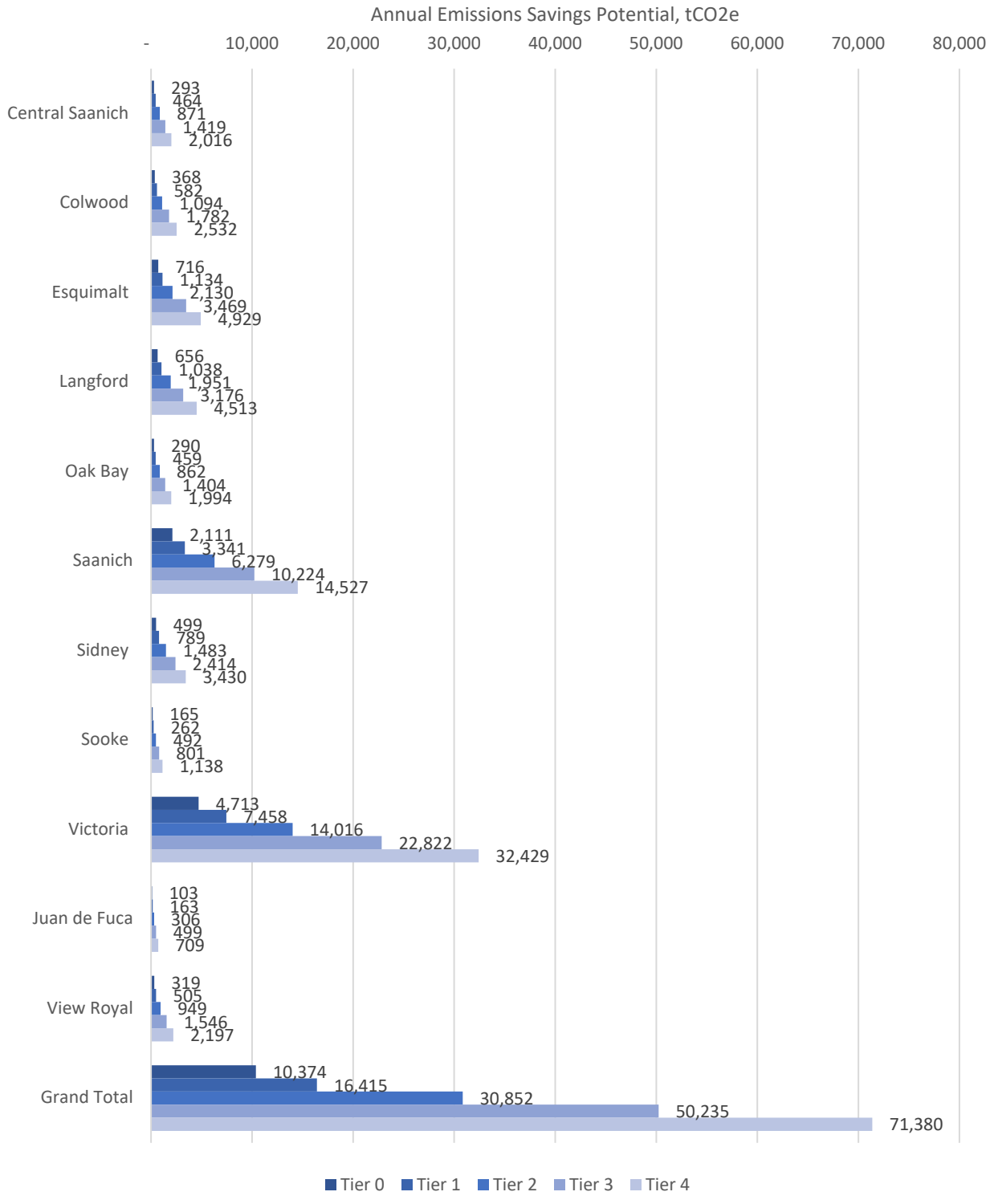


Figure 13: Emissions savings potential at varying Retrofit Tiers in Part 3 MURB by jurisdiction, annual avoided tCO_2e (Note: jurisdictions accounting for less than 1% of total potential emissions savings are not shown).

2.5. Key Takeaways

The analysis above reveals a number of key points of relevance to a potential energy retrofit program in the capital region:

- Overall, there is a large untapped potential for energy retrofits to help reduce emissions from existing homes in the capital region and support the achievement of the CRD's climate targets. Retrofitting every home in the region could achieve a 7% to 15% reduction in region wide GHG emissions relative to current levels, a significant contribution to its goal of reducing emissions by 61% by 2038. The upper end of this range can be captured by ensuring that most retrofits involve electrification (i.e., a switch to a heat pump).
- Part 9 homes represent the most significant opportunity for emissions reductions, while Part 3 residential dwellings make up a much smaller proportion of total homes in the region.
- There is significant emissions reduction potential from fuel switching from high emitting heating sources such as oil, natural gas, and propane towards electric heating.
- Older construction homes and homes using fuel oil are best to target for a residential retrofit program, as they have the highest average GHG emissions and the highest emission reduction potential. However, given the increasing growth of natural gas, retrofitting homes from natural gas to electricity will also be an important program focus.

Targeting homes that are 15 to 25 years old and using natural gas or another fossil fuel are a potential program target, as they will be coming up on their first heating system replacement and will have sufficient insulation to make a switch to a heat pump more cost-effective (in general, residential heating systems have a lifespan of 15 years, though many are used beyond that lifespan).

3. THE EXISTING PROGRAM LANDSCAPE

Prior to developing its own program, it is important for the CRD to explore the existing program landscape to ensure complementarity and avoid duplication or potentially confusing the market. Several programs are already on offer in the Canadian and BC context that have begun to address some of the barriers associated with deep emissions retrofits in the residential sector. However, many still remain, leaving a need and an opportunity for the CRD to go further in supporting homeowners in completing retrofit projects. The success of a residential retrofit program for the CRD will be contingent on its ability to leverage and fit into this existing program landscape, and fill any remaining gaps, while staying within its legal authority and an acceptable budget. The key programs that are either currently offered or have been signalled as forthcoming are summarized briefly below.

3.1. Utility Programs

Part 9

The province's two main utilities, FortisBC and BC Hydro, offer a number of incentives and rebates that support homeowners in reducing the costs of home energy upgrades. Rebates ranging from $100 to $2000 are currently offered for the following upgrades:

- Electrical heating systems to heat pumps
- Furnace upgrades
- Water heater upgrades to high efficiency natural gas heaters
- Window and door upgrades
- Insulation upgrades
- Secondary space heating
- Appliances

Many capital region municipalities also offer top-ups for specific rebate programs, ranging from $350 to $2000. However, it should be noted that a number of these top-ups are currently fully subscribed and are therefore no longer available (e.g., District of Central Saanich, District of North Saanich, Township of Esquimalt, CRD).

Part 3

Utility incentives are also available for improving the performance of multi-unit residential buildings (Part 3). Rebates range from $1,000 - $45,000, and are currently offered for:

- Natural gas furnace and boiler upgrades
- Water heater upgrades to high-efficiency natural gas heaters
- HVAC controls
- Window and door upgrades
- Insulation upgrades
- Secondary space heating
- Lighting upgrades
- Appliances

While many incentives exist for broad upgrade measures that improve the overall efficiency of both Part 9 and Part 3 homes, those that encourage natural gas upgrades are currently incentivizing more emission-intensive choices, making it more challenging for homeowners to make lower-carbon choices.

3.2. CleanBC Better Homes and Buildings

Part 9

CleanBC Better Homes is an online platform funded by the Province of BC and the Government of Canada. The platform provides online resources and support for homeowners and businesses interested in reducing energy use and greenhouse gas emissions from new and existing buildings. CleanBC sponsors a number of rebates, ranging from $100-$3000. This includes the CleanBC Heat Pump *Group Purchase Rebate* (GPR). The GPR rewards groups of homeowners who join together and complete a fuel switch upgrade to an electric air source heat pump. The larger the group, the higher the rebate, ranging from $200 per participant (2-4 homes) to $500 per participant (20-30 homes).

Another notable aspect of the program is the offer of free energy coaching services, provided by trained energy efficiency specialists via email or phone. This service is available at all stages of an energy improvement project. Energy coaches provide information and advice on energy efficiency upgrades and rebates, with translated services are also available in Cantonese, Mandarin, Punjabi and Farsi. It should be noted, however, that this service is "fuel neutral", in that upgrades and rebates for fossil fuel equipment (e.g., natural gas boilers) are available and may be recommended. In addition to the energy coaching service, the following are also available via the Better Homes program:

- Educational materials on types of energy efficiency upgrades available and the interaction of upgrades with the 'House As a System' approach
- Details of the EnerGuide Home Evaluation process, benefits and eligibility
- Energy advisor search tool filtered by upgrade type and area
- Information on the CleanBC Better Homes and Home Renovation Rebate Program
- User-friendly rebate search tool
- Explanation of program requirements and sample contractor invoices
- Help finding a suitable contractor through the Program Registered Contractors list. The database allows the homeowner to filter contractors by location and type of upgrade
- Online application tool to help homeowners and businesses apply for rebates

The Province of BC is also currently considering an income-qualified home retrofit program intended to provide high-value incentives to low- and moderate-income households for a range of space heating, building envelope, ventilation and health and safety measures. While qualification criteria are currently under development, the projected value of retrofits are expected to cover up to 80-90% of costs for low-income households, and 70-80% of costs for moderate-income households. The program is expected to launch in late summer or early fall 2021, and will offer support services tied to the receipt of specific rebates, providing significant cost reduction opportunities for homeowners across the board. The focus of this program on either energy efficiency and/or emissions reductions (and therefore on fuel switching) is currently unknown.

Part 3

CleanBC provides three custom programs focused on electrification of larger residential and commercial buildings. The *Custom*, *Custom-Lite*, and *Commercial Express* programs allocate incentives based on carbon savings, and the CleanBC Small Building Energy Coach program provides support for smaller buildings in accessing these incentives.

- ***The Custom Program*** supports up to 50% of an energy study's cost, up to a maximum of $20,000. based on a rate of $40/tCO2e of lifetime greenhouse gas savings, BC Hydro will support up to $200,000 per customer. For heat pump rooftop units, the Program offers a rate of $60/tCO2e.
- ***The Custom Lite Program*** provides $60/tCO2e of lifetime GHG savings for heat pump rooftop units up to a maximum of $72,000 and $40/tCO2e of lifetime GHG savings for all other qualifying measures up to maximum $48,000 incentive per customer.
- ***The Commercial Express Program*** offers capital incentives up to a maximum of $100,000 per project. Incentives are based on various factors specific to your building, including building: type, age, location, square footage, hours of operation, and the type of equipment being considered.
- ***The CleanBC Small Building Energy Coach*** program currently offers free energy coaching services to assist building owners and operators reduce GHGs through fuel-switching and other electrification measures and take advantage of CleanBC's *Commercial Express* and *Custom Lite* programs.

3.3. Natural Resources Canada

Part 9

The Canadian federal government committed to supporting home and building retrofits in the Pan-Canadian Framework on Clean Growth and Climate Change, which outlined the following commitments:

- Developing a model code for existing buildings by 2022 to be adopted by the provinces and territories
- Requiring benchmarking and labelling of building energy use
- Setting new standards for heating equipment and other key technologies to the highest level of efficiency that is economically and technically achievable, and
- Supporting the continuation and expansion of provincial and territorial efforts to retrofit existing buildings

Since then, the federal government has committed to supporting homeowners in retrofitting their homes via an allocation of $2.6 billion to Natural Resources Canada to supply:

- Canada Greener Homes Grant
    - Up to $5,000 per home in energy efficiency grants
    - $1 million for free EnerGuide assessments ($600 per home)
- Up to $40,000 in interest-free loans, and
- $10 million for EnerGuide Energy Advisor training

Part 3

The Federal Government has committed to investing $2 billion in low-interest financing for energy efficient buildings through the Canada Infrastructure Bank (CIB) Building Retrofit Initiative. The initiative provides funding for large projects with a minimum requirement of $25 million. Two types of project applicants are eligible:

1. Building owners may apply for financing to retrofit one or more of their buildings
2. Third-party retrofit aggregators, including:
    - Existing Energy Service Companies (ESCO) that form a dedicated Special Purpose Vehicle (SPV) to originate and develop retrofit projects
    - Super ESCO models that are SPVs functioning as an intermediary between building owners and multiple ESCO providers
    - New entrants to the energy services market that are working on buildings or investing in retrofit projects
    - Commercial PACE (C-PACE) program administrators

3.4. Bring It Home for the Climate

The *Bring It Home 4 the Climate* program (BIH4C) program is designed to support and engage homeowners in the capital region by addressing barriers to retrofit uptake. The program forms a component of the Transition 2050 *Residential Retrofit Acceleration project* developed by the CRD and City Green Solutions.

To encourage progress towards deep energy and emission retrofits, the program subsidizes EnerGuide energy assessments and provides free materials for shallow retrofits. BIH4C focuses on building community champions and rewarding those who participate to raise awareness and motivate others in the community to explore energy efficiency upgrades. The program includes the offering of a free Virtual Home Energy Check Up (VHEC), which involves an online survey followed by a video call with an energy expert to explore next steps. The BIH4C administrative team is also available to support participants in registering for a subsidized Pre-Upgrade EnerGuide Home Evaluation. A unique element of the program is the seasoned EnerGuide evaluators who operate as program "Energy Experts" available to support homeowners on a wide range of topics related to the retrofit process including accessing rebates. Advice is additionally geared towards supporting low-carbon retrofits, in light of the program's focus on climate change and emissions reductions The BIH4C program is funded to the end of 2021.

3.5. SEA Change – Strata Energy Advisor Program

The *Strata Energy Advisor* pilot program was launched in May 2018 in Metro Vancouver to address the unique barriers strata councils face in retrofitting common space. The program provided strata councils, property managers and strata members free assessments and advice on measures to reduce energy and carbon. Through the initial pilot, 38 buildings completed retrofits resulting in 2,265 tonnes of GHG reductions. Metro Vancouver and UBC are currently exploring opportunities to expand the program provincially.

3.6. Federation of Canadian Municipalities (FCM)

The Federation of Canadian Municipalities (FCM) supports local governments in implementing sustainability practices through the Green Municipal Fund. This program provides funding streams, resources and training to help municipalities deliver their sustainability initiatives. CRD's Residential Energy Retrofit Program Business Case study is supported by FCM's *Community Efficiency Financing*

(CEF) funding stream, as part of a larger program design study in partnership with the City of Victoria and District of Saanich.

The CRD's previous feasibility work in this area identified third-party lending as the preferred financing model to integrate into a residential energy retrofit program. However, the scope and design of the program will remain flexible given the changing financing landscape in the province and country. The CEF funding stream has also made capital funding available to implement municipal retrofit programs. The CRD will have the opportunity to apply to the CEF capital funding stream to support the cost of the programing suggested below.

4. PROPOSED PROGRAM DESIGN

4.1. A Proposed Program Model for the CRD

While the programs noted above have begun to address some of the barriers to deep emissions retrofits in the residential sector, many still remain. Among those that are most under the purview and interest of the CRD are awareness and complexity barriers that limit homeowners' interest in completing retrofits, both as a result of limited understanding and valuation of retrofits, as well as the inconvenience they pose. Moreover, many of the programs offered at federal, provincial and utility scales have shifted considerably over time, changing their offerings, eligibility criteria, application processes, and even branding. As such, there is still considerable value in a consistently offered, CRD-led program that better supports homeowners in understanding and navigating the home retrofit process, especially in a way that meets the CRD's emissions reduction targets.

Overall, an appropriate model for a CRD-led retrofit program is one that will best support and achieve energy and emissions reductions in CRD's residential sector, while leveraging/planning for the support at federal and provincial levels noted in the section above. However, there are several additional program details to consider, including notably the model of program support that the CRD can offer. A review of precedent programs in other jurisdictions (see Appendix A) reveals several potential models, ownership types, and revenue sources.

Among these, **One Stop Shops (OSS)** have been widely adopted and are worth more exploration. OSS are integrated home retrofit services that are designed to eliminate well known barriers to energy efficiency renovations. They provide a turnkey service to homeowners, simplify communications and knowledge sharing, and at their best place a trained independent third-party energy advisor at the side of the homeowner to support the complex decisions clients must make regarding interrelated retrofit measure installation, evaluation of quotes, and contractor selection.

In Europe, OSS retrofit facilitation programs are considered a best practice and have expanded beyond low-income programs and are available in many jurisdictions to all homeowners regardless of family income. For example, almost 4 million homes had been retrofitted under the German OSS *Effizienzhaus* program by 2019. The first such service in Canada was designed and piloted by Windfall Ecology Centre with several indigenous communities beginning in 2006. Today, OSS are a common approach to delivering turnkey home weatherisation programs to low-income families in North America.

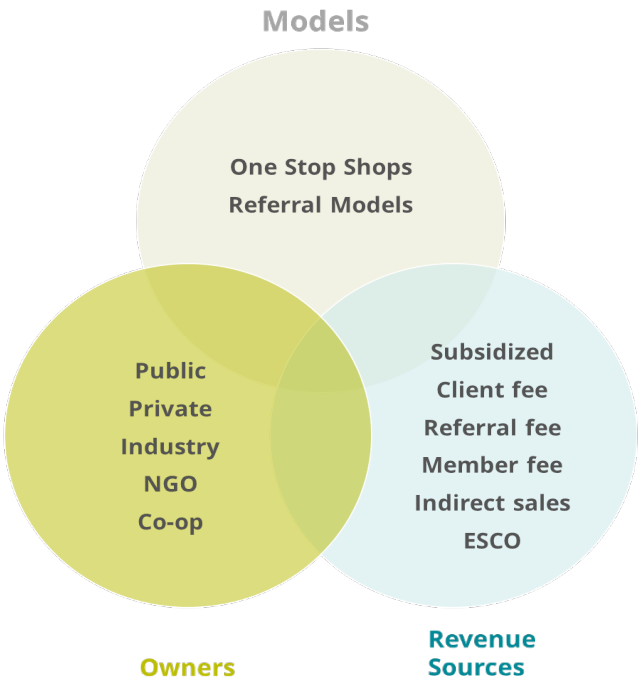


Figure 14: Different program models, ownership types and revenue sources contemplated for this study

Ontario's Winterproofing program is an example of a ratepayer funded OSS that provides free insulation and draft proofing upgrades to income qualified homeowners and renters. The entire upgrade process including pre and post audit, contractor selection, and project management is performed by third party service organizations.

4.2. Proposed Program Design

Based on existing program review, consultant team experience, and feedback from key stakeholders, a subsidized OSS model is recommended for the CRD based on its ability to:

- Build on existing program infrastructure, including current BIH4C program offerings, to simplify the retrofit process for homeowners
- Provide homeowners with enhanced retrofit coordinator support tailored according to their needs, and focused on supporting the decarbonization of existing homes at relatively low cost (when compared to more intensive support programs))
- Avoid the potential risk and liability issues associated with a direct program ownership model
- Better identify and target local market opportunities and help establish local contractor delivery networks, and
- Monitor performance through post retrofit follow-up.

Given the ongoing nature of the existing Energy Coach and BIH4C offerings, it is recommended that the CRD build on the success of these programs to provide additional wrap-around services for homeowners. While the current energy coach program is well-suited to those who are just getting started with a retrofit project, homeowners often need additional support once they are part way

through the process and have been provided baseline information about their building and retrofit options. A new CRD program could leverage the intake process through the Energy Coach program, while placing a concerted focus on fuel switching for emissions reductions as in BIH4C to ensure the benefits of home electrification are reaped.

The proposed program design for the CRD therefore assumes that a moderate level of support could be provided by a Retrofit Coordinator per household to add to existing services, specifically helping alleviate the challenges of navigating the retrofit process once initial support has been provided via the Energy Coach service. Specific services that are assumed will be provided by a Retrofit Coordinator are outlined in Table 5.

As the end goal of this program is not only to increase the number of home retrofits, but to increase the depth of those retrofits (i.e., achieve greater levels of energy efficiency) and promote fuel switching, extending the full level of support to all retrofits may not be appropriate. As a starting point, it is assumed that any customer will be able to access the initial steps of initial screening, and reviewing pre-upgrade EnerGuide audit results—but that fossil fuel-based equipment retrofits should be excluded from further program assistance.

Table 5: Proposed responsibilities of the Retrofit Coordinator

Step	Tasks
Screen	• Conduct (virtual) home energy check-up/screening
Review and Plan	• Review EnerGuide Renovation Upgrade Report • Assist client with upgrade choices • Consider DIY options and provide contractor selection advice and standardized quotation forms • Direct client to qualified contractor directory
Compare & Select	• Help homeowner scope work, compare contractor bids, ensure rebate eligibility, and provide troubleshooting throughout the process.
Finance	• Help identifying and selecting financing and incentives
Document	• Help getting documentation and assist with submitting rebate applications
Evaluate	• Quality Assurance checks post-retrofit (done in aggregate or spot-check) • Measurement & Verification

Given that the GHG savings potential in the Part 9 single-family sector in the capital region is five to six times that of the Part 3 sector, it is both recommended and assumed that an initial program will focus on targeting this sector. Providing a strong level of support for Part 9 homeowners will ensure that the CRD can move more swiftly and efficiently towards meeting its emissions reduction targets, while assisting the largest proportion of residents in the capital region with program support. Further reflections on a future expansion to Part 3 residential buildings are presented at the conclusion of this report.

4.3. Targeting Program Markets

Understanding specific home archetypes is essential to clarifying the market potential of a residential energy retrofit program and developing targeted marketing opportunities, but will also be necessary later on to help support the development of unique retrofit pathways, costing models, and to inform detailed program design. Once a program is up and running, Retrofit Coordinators and/or program application forms can query homeowners to quickly identify their home archetype, narrowing the potential retrofit pathway options available to the homeowner and thereby simplifying the homeowner support process.

To better inform the business case and future program design considerations, statistical cluster analysis techniques were therefore used to further break down the capital region's Part 9 housing sector into specific archetypes. Part 9 housing archetypes were derived from 13,177 pre-retrofit EnerGuide evaluation files, spanning from 2007 to present. Differences in floor area, year of house construction, number of storeys, primary fuel type, and house type were investigated to develop the individual clusters.

To compare differences between these six variables, a Gower distance metric was applied to create a matrix of partial dissimilarities across individuals ranging from 0 to 1, where 0 is most similar and 1 is most dissimilar. Gower distance was used over the K-means method, as it allows for clustering with a mix of numeric and qualitative variables. The optimal number of clusters was determined by running an analysis on groups ranging from 2-10 clusters. Silhouette coefficients ranging from –1 to 1 were then determined for each grouping, where groups nearest 1 show the highest degree of separation between clusters. From this analysis, an initial grouping of seven clusters was chosen, as the silhouette coefficient did not substantially increase with further increasing clusters.

Once the number of clusters was selected, the Gower distance matrix was run through a Partitioning Around Medoids (PAM) algorithm to partition the housing data into seven distinct clusters. The PAM algorithm was chosen over K-means because although it is more computationally intensive, it is more robust and less susceptible to outliers.

Following feedback from the client and Advisory Committee, homes built since 1990 and homes built before 1920 were split out into their own groups, creating nine archetypes in total. These post-process adjustments were needed as newer homes were underrepresented in the source data but represent almost a third of all homes in the capital region, while the oldest homes represent a particularly significant savings opportunity. Upon finding that two-story gas-fired homes built in the interwar period made up only 2% of homes in the capital region and had similar retrofit measures newer single-story gas homes, clusters 6 and 7 were combined into a single archetype.

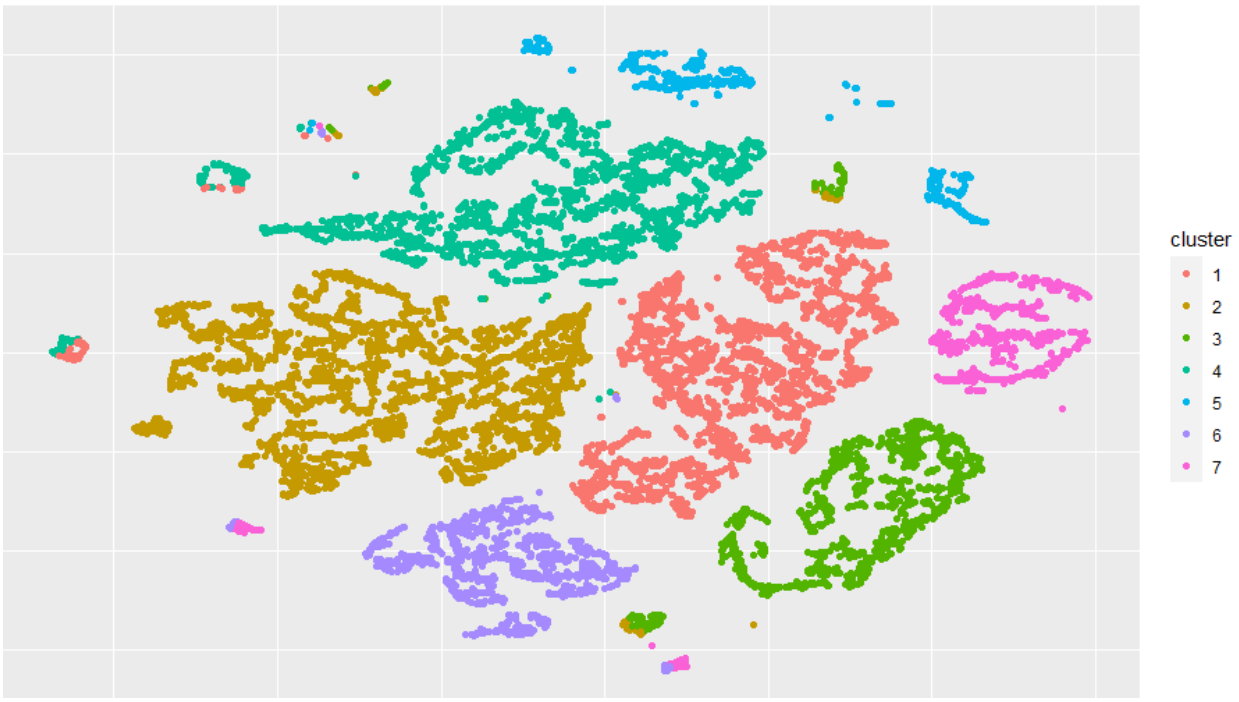


Figure 15: Initial seven clusters

Table 6 lists the defining attributes of each archetype, including common retrofit measures based on which retrofit elements showed up the most frequently in EnerGuide audits of homes in that archetype. Table 7 provides the percentage of EnerGuide audits for each archetype that included that measure, with the most common elements in bold.

Table 6 lists the defining attributes of each archetype, including common retrofit measures based on which retrofit elements showed up the most frequently in EnerGuide audits of homes in that archetype. Table 7 provides the percentage of EnerGuide audits for each archetype that included that measure, with the most common elements in bold.

Table 6: Archetype characteristics

1	***Archetype Name***	**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	***Archetype Name***	**Mid-Century Oil**
	Housing Type	Single Story Detached
	% of Homes in the Region	7%
	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	***Archetype Name***	**Interwar Oil**
	Housing Type	Two-Story Detached
	% of Homes in the Region	4%
	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	***Archetype Name***	**Two-Story Electric**
	Housing Type	Two-Story Detached
	% of Homes in the Region	3%
	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	***Archetype Name***	**Row Homes**
	Housing Type	Two-Story Row House
	% of Homes in the Region	6%
	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	***Archetype Name***	**Mid-Century Gas Homes**
	Housing Type	Predominately Single-Story Detached
	% of Homes in the Region	20%
	Heating Type(s)	Gas Heating
	Primarily Built In	1940s – 1970s
	Median Gross Floor Area	Single-Story: 195 m^2 Two-Story: 262 m^2
	GHG Intensity per home	Single-Story: 6.67 tCO_2e/yr. Two-Story: 9.09 tCO_2e/yr.
	Common Retrofit Measures	• Ceiling • Windows • Furnace • Water Heater
7	***Archetype Name***	**Newer Homes**
	Housing Type	Mix of One and Two Story Detached
	% of Homes in the Region	29%
	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 tCO_2e/yr.
	Common Retrofit Measures	• Heat Pumps
8	***Archetype Name***	**Older Homes**
	Housing Type	Predominantly Two Story Detached
	% of Homes in the Region	9%
	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 tCO_2e/yr.
	Common Retrofit Measures	• Ceiling • Walls • Foundation • Windows • Fuel Switch

Table 7: Percent of homes in each archetype that undertook a given measure, as identified in the EnerGuide data

#	Name	Ceiling Insulation	Wall Insulation	Foundation Insulation	Windows	Fuel Switch	Furnace	Water Heater	Heat Pump
1	**Single-Story Electric**	41%	16%	19%	**52%**	2%	0%	5%	35%
2	**Mid-Century Oil**	35%	17%	**26%**	43%	**58%**	8%	7%	**48%**
3	**Interwar Oil**	35%	**24%**	22%	38%	**58%**	9%	8%	**47%**
4	**Two-Story Electric**	30%	12%	17%	**54%**	2%	0%	6%	37%
5	**Row Homes**	**48%**	19%	12%	48%	10%	2%	3%	15%
6	**Mid-Century Gas**	**45%**	**28%**	**28%**	**53%**	6%	**22%**	**15%**	14%
7	**Newer Homes**	16%	2%	9%	19%	7%	6%	12%	**60%**
8	**Older Homes**	**45%**	**44%**	31%	**40%**	32%	15%	12%	25%

4.4. Exploring Potential Homeowner Markets

In addition to specific home archetypes, program design must also consider the different needs and opportunities associated with different homeowner markets. Of particular importance is the potential impact of fuel switching on the cost of energy to the consumer, especially given the difference in costs between electricity and natural gas in BC. The impact of energy costs can be expressed as a measure of a region's energy poverty, defined as a condition in which a household is required to spend more than 6% (i.e., twice the national median of 3%) of after-tax income on energy. In the capital region, 14% of households have been found to experience an energy cost burden of 6% of greater. This is especially true in Juan De Fuca, Metchosin, and Sooke, where over 20% of households have high energy cost burdens (see Figure 16).[12] This issue is not unique to the capital region – nationwide, 17% of households in Canada's Census Metropolitan Areas (CMAs) experience high energy cost burden.[13] However, it is nevertheless an important consideration when designing energy and emissions reduction programs.

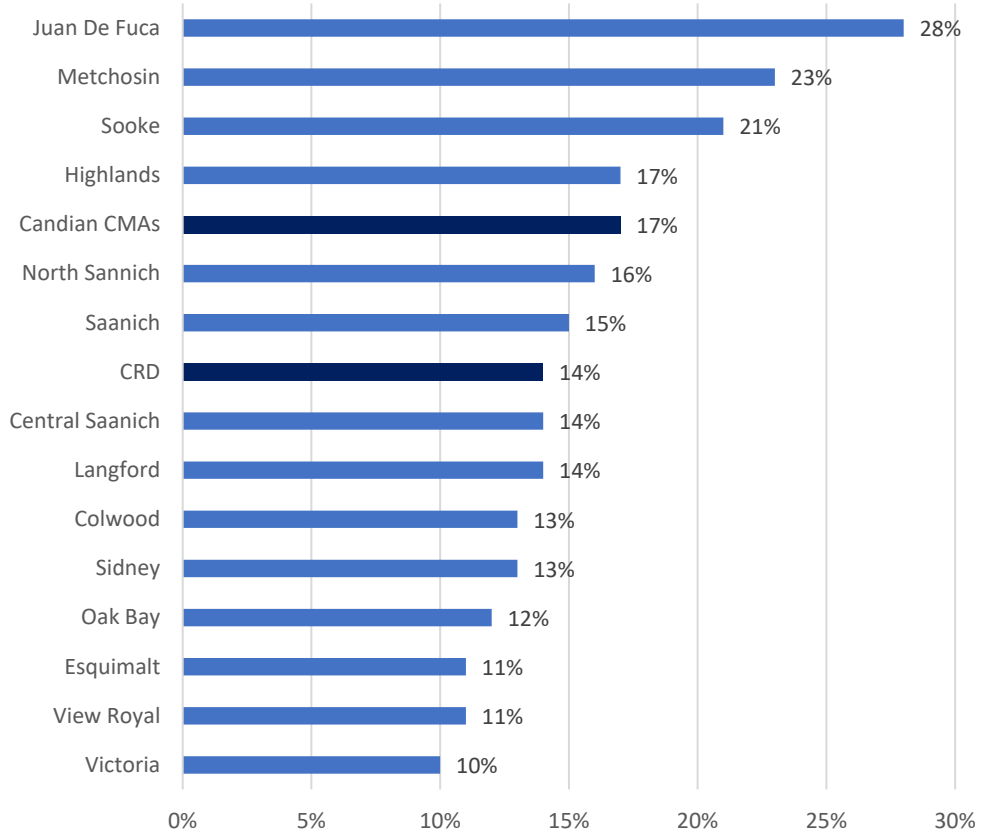
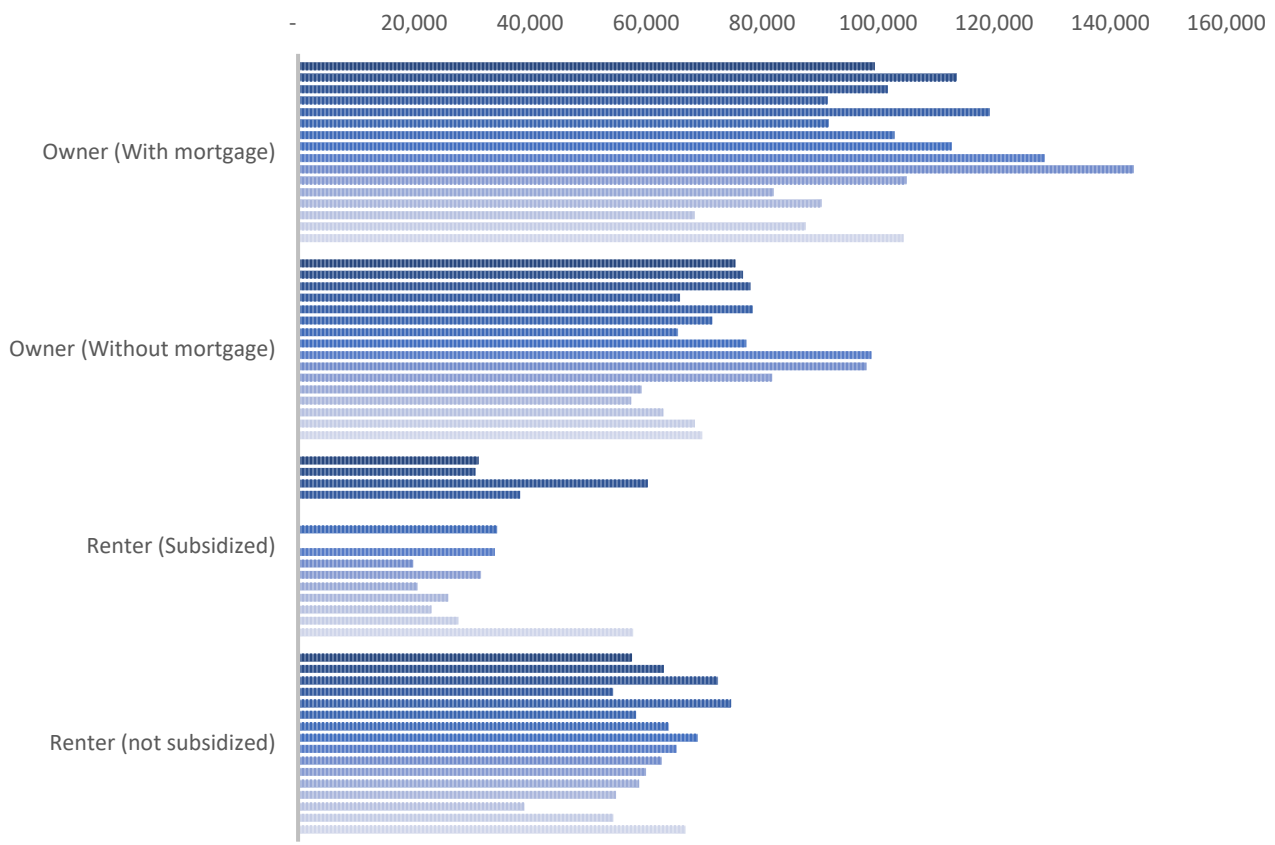


Figure 16: Energy poverty across the capital region (data source did not include Gulf Islands)

[12] M. McNaughton (2020). "Energy Poverty Community Profile: District of Saanich." University of British Columbia. https://sustain.ubc.ca/about/resources/energy-poverty-community-profile-district-saanich

[13] Canadian Urban Sustainability Practitioners (2019). "Energy Poverty Across Canada: A CUSP Backgrounder." https://www.energypoverty.ca/backgrounder.pdf



	Renter (not subsidized)	Renter (Subsidized)	Owner (Without mortgage)	Owner (With mortgage)
CRD	57,546	31,131	75,376	99,389
Central Saanich	63,026	30,590	76,665	113,436
Colwood	72,354	60,292	77,960	101,603
Esquimalt	54,286	38,291	65,800	91,227
Highlands	74,650	-	78,393	119,204
Juan de Fuca	58,202	-	71,331	91,347
Langford	63,822	34,327	65,420	102,684
Metchosin	68,890	-	77,244	112,592
North Saanich	65,231	33,913	98,776	128,590
Oak Bay	62,685	19,938	97,910	143,923
Saanich	59,962	31,551	81,628	104,800
Sidney	58,729	20,664	59,140	81,857
Sooke	54,775	25,928	57,398	90,122
Gulf Islands	39,004	23,006	62,863	68,260
Victoria	54,303	27,622	68,324	87,381
View Royal	66,754	57,752	69,629	104,297

Figure 17: Median income by municipality and tenure type

Other key demographic criteria to explore in program design include the distribution of incomes across the region, as well as the proportion of renters vs. owners and overall homeowner age. With respect to the former, this analysis shows a high proportion of fixed-income homeowners in the region, many of whom are without a mortgage (see Figure 17).

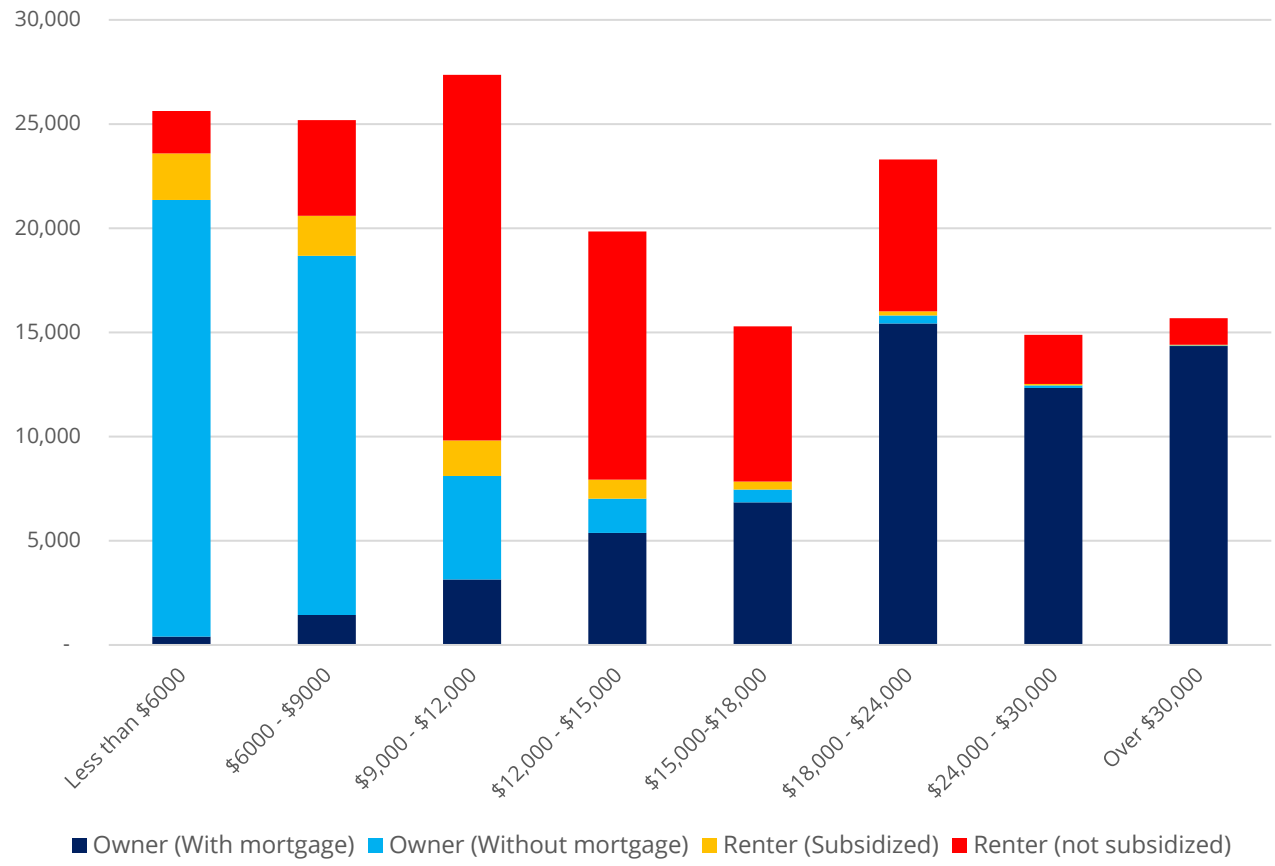


Figure 18: Number of households by annual shelter cost and tenure type

As shown in Figure 18, renters are uncommon in a number of capital region jurisdictions, but make up over 30% of households in the urban areas of Victoria, Esquimalt, Colwood, Saanich, and Langford. Figure 17 also shows that there are significant senior household populations (>30%) across several municipalities/electoral areas: North Saanich, Sidney, Central Saanich, Oak Bay, Metchosin, Juan de Fuca, and the Gulf Islands. As might be expected given the high percentage of seniors, less than half of homeowners still have a mortgage in most of these communities; conversely, there are a low percentage of seniors in Victoria, Esquimalt, Colwood, Saanich, Langford, Highlands and View Royal. These communities also have more renters, and fewer homeowners without a mortgage. Such information is important to consider in program and business case development, as rental housing expenses tend to be less than homeowner expenses (though some renters are burdened with very high annual housing costs as well).

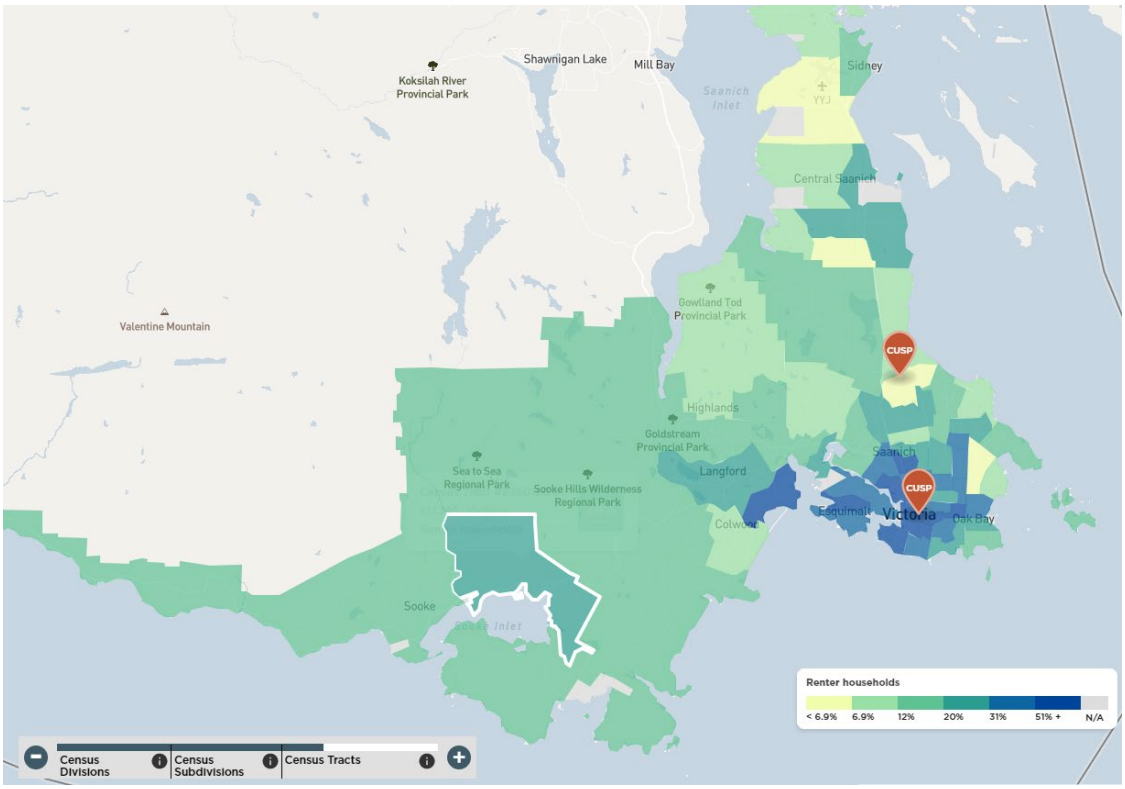


Figure 19: Percent of renters across the capital region census areas (www.energypoverty.ca)

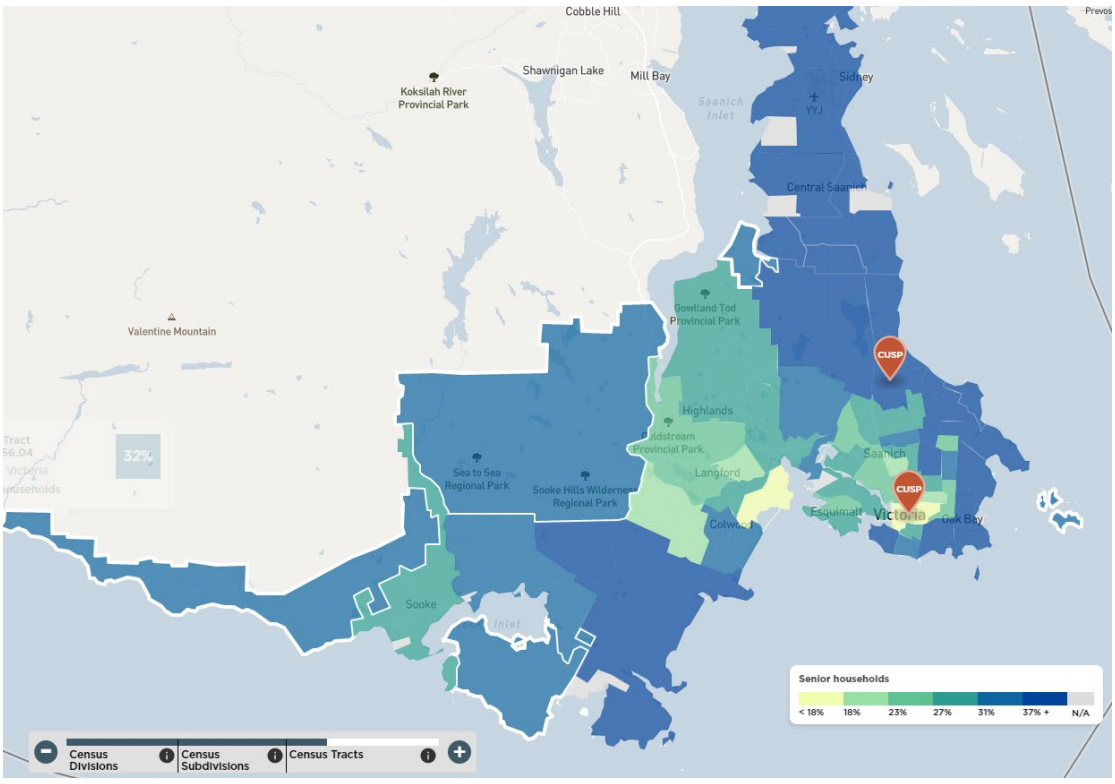


Figure 20: Percent of seniors across the capital region census areas (www.energypoverty.ca)

4.5. Key Takeaways

Drawing on this additional analysis, several key opportunities and challenges emerge:

Home Archetypes

- Interwar oil and older homes have the highest GHG emissions and remain a good target for retrofits, though there are fewer of these homes remaining. Oil-heated homes are also high adopters of fuel switching projects, generally towards heat pumps.
- Pre-1990 gas heated homes are high adopters of insulation upgrades, though they tend to retain or upgrade gas equipment rather than considering fuel switching.
- Newer homes are particularly high adopters of heat pumps.
- While 42% of homes in the capital region are already primarily heated by electricity, the rapid increase over the last decade of homes adding new natural gas connections indicates a continued risk of fuel switching towards natural gas. EnerGuide data shows low rates of gas heated homes fuel switching or adding a heat pump—switching customers off natural gas will be a significant challenge, once they are locked in. Every home that replaces electric resistance heating with a heat pump is one fewer home adding natural gas. Therefore, homes with electric resistance heating should remain a target area for the program, to forestall increases in natural gas use that could otherwise eliminate the net savings.

Homeowner Markets

- As the BetterHomes BC's *Energy Coach* program already provides some OSS services, the CRD should focus on providing additional services that address additional retrofit barriers and support homeowners in making low-carbon retrofits as easy as possible. Aligning any new program with existing offerings will be key to simplifying the experience for homeowners.
- The *Canada Greener Homes Grant* (p.19) will likely increase the demand for home energy advisors, increasing the need for OSS programs that can support homeowners in executing the recommendations in their EnerGuide assessment.
- Any new program must help to avoid and even alleviate energy poverty in the capital region. The relatively high levels of energy burden in the region make it particularly urgent to ensure that energy costs remain low, including through the recommendation of complementary envelope upgrades to reduce energy demand. While natural gas is often seen as a low-cost alternative to electrically heated homes, the costs of energy can vary greatly depending on the condition of the home. Preparing homeowners for the increasing federal carbon tax, as well as BC Hydro's upcoming amendments to rate structures, will help to futureproof upgrades to political and economic factors that are increasingly favouring electrification.
- Fuel switching using heat pumps is still in early adoption phase and may increase utility costs, particularly in large or leaky homes. To avoid exacerbating energy poverty, complementary envelope upgrades should be supported, and an early focus placed on middle and upper-income homeowners to support market development before being rolled out more broadly. Existing programs also already target low-income households and the

unique barriers they face in upgrading their homes; as such, the CRD should focus on other demographics in initial stages of the program and seek to strategically fill gaps as these income-qualified programs become established in the market.

- Targeting the program outreach to larger demographics and neighbourhoods that may be well equipped to make improvements, including higher income neighborhoods (e.g., Oak Bay and the Uplands), senior populations, and households in need of renewal, can improve program uptake and the overall impact on energy and carbon savings. Targeting outreach to more moderate-income communities where natural gas is less prominent and electric resistance and oil heating are more common may also present a valuable GHG reduction opportunity, alongside a potential reduction in energy poverty.
- Emphasizing the non-financial benefits of retrofits (e.g., increased thermal comfort and cooling, better indoor air quality, and lower carbon footprint), in communication and outreach can help attract homeowners.
- Developing a broad set of value propositions that can be tailored to individuals based on their unique needs can increase participant interest and ensure their needs are being met.

4.6. Additional Program Benefits

In addition to GHG reductions, home retrofits create a range of social, environmental and economic benefits. Retrofitting existing buildings can increase safety and health for residents, improve social inequities, and stimulate economic growth and jobs. Designing programs using social, environmental and economic lenses can help optimize these co-benefits, and leverage complementary programs focused in these areas.

Improved health outcomes for residents. Energy inefficient and poorly performing homes can be often overlooked sources of poor occupant health. Poor indoor air quality as a result of poor ventilation can cause headaches, fatigue, coughing, sneezing, sinus congestion, shortness of breath, dizziness, nausea, and irritation of the skin, eyes, nose or throat.[14] It can also trigger or exacerbate allergy and asthma symptoms, as well as increase susceptibility to viruses such as COVID-19 by compromising the immune system.[15] These poor health outcomes disproportionately impact vulnerable groups, including those with pre-existing medical conditions, pregnant women, seniors, and children. With respect to the type of system used, natural gas appliances pose both a risk of fire (due to its flammability) as well as natural gas poisoning via gas leakages. While leakages from gas boilers are less common, natural gas use in cooking equipment are now linked with significant air pollutant levels inside the home.[16,17] Fortunately, significant improvements in air quality can be achieved by increasing filtration and ventilation, regulating indoor moisture, remediating mould, strengthening barriers to indoor and outdoor pollutants, and shifting to less polluting energy

[14] British Columbia. "Indoor Air Quality" (accessed on Aug 10, 2021). https://www.healthlinkbc.ca/healthlinkbc-files/indoor-air-quality
[15] Health Link BC. "Wildfires and Your Health" (accessed on Aug 20, 2021) https://www.healthlinkbc.ca/health-feature/wildfires
[16] Hu, Tianchao, Singer, Brett C., and Logue, Jennifer M. Wed (2012), "Compilation of Published PM2.5 Emission Rates for Cooking, Candles and Incense for Use in Modeling of Exposures in Residences." Lawrence Berkeley National Lab. https://www.osti.gov/servlets/purl/1172959.
[17] Brady Anne Seals and Andee Krasner, (2020), "Health Effects from Gas Stove Pollution," Rocky Mountain Institute. https://rmi.org/insight/gas-stoves-pollution-health/

systems. These changes also have benefits for local governments and health authorities - an analysis of the Toronto building stock found that retrofitting all residential buildings with forced-air HVAC systems and tighter building envelopes could save the province USD2.3 - 3.8 billion a year in healthcare costs due to reduced exposure to particulate matter. [18]

Increased resilience to climate stresses and shocks. Several measures that improve energy efficiency and reduce emissions can also improve resilience, including adding mechanical cooling through electric heat pumps to protect against overheating, improving envelope performance to increase the home's safety in the case of blackouts, and adding mechanical ventilation and filtration to protect residents from wildfire smoke.

Of recent and noteworthy mention is the record-breaking heat, wildfires and drought seen in summer 2021, with heat alone causing 570 premature deaths across the Province during the "heat dome" event in June and July.[19] Seniors and those living with pre-existing health conditions are particularly vulnerable to death or severe illness from sustained high temperatures.[20] The risks inherent in these increasing temperatures have led to increasing pressure for all levels of government to create long-term solutions addressing extreme indoor temperatures. Indeed, the City of Vancouver passed a motion in the aftermath of the heatwave, acknowledging that "*it is time we make maintaining high indoor air quality and energy efficient air conditioning part of our standard expectations of housing just as we do toilets, bathtubs, and heat*." BC Hydro data shows that air conditioning use in BC households has more than tripled to 34% since 2001, and residents are adding an average of $200 to their total summer bills by using A/C inefficiently. [21] The portable A/C units are the most popular and also the least efficient –they use ten times more energy than a central air conditioning system or a heat pump and use twice as much energy as a window unit.

The increased demand for cooling strengthens the business case for heat pumps, and can be leveraged to market electric heat pumps over traditional A/C units. Electric heat pumps can meet dual climate and resilience objectives by providing low-carbon efficient cooling and heating. As such, proactively targeting those looking to purchase A\C units and vulnerable populations can address public health needs and reduce the number of households locking into inefficient cooling systems.

Increased equity and affordability. As noted above, approximately 15% of the CRD's population is characterized as living or at risk of energy poverty, defined as households who struggle to meet their home energy needs and spend more than 6% of their after-tax income on their energy needs.[22] A

[18] Zuraimi, M.S. and Tan, Z (2015), "Impact of residential building regulations on reducing indoor exposures to outdoor $PM_{2.5}$ in Toronto," *Building and Environment*.
[19] Province of British Columbia, Chief Coroner's Statement on Public Safety During High Temperatures (July 30, 2021). https://archive.news.gov.bc.ca/
[20] Smith, K.R., A.Woodward, D. Campbell-Lendrum, D.D. Chadee, Y. Honda, Q. Liu, J.M. Olwoch, B. Revich, and R. Sauerborn, 2014: Human health: impacts, adaptation, and co-benefits. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 709-754.
[21] BC Hydro. "Not-so well-conditioned: How inefficient A/C use is leaving British Columbia out of pocked in the cold" https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/news-and-features/bch-ac-report-aug-2020.pdf
[22] CUSP. 2019. *Energy Poverty in Canada: a CUSP Backgrounder*

retrofit program can help to reduce energy bills and thus energy poverty by recommending retrofit measures that have short payback periods and that can quickly reduce household energy costs. These cost saving measures can be prioritized and paired with incentives for lower-income residents to help reduce overall retrofit costs as well. Energy savings over the long term can also be realized by supporting fuel shifts to electricity where feasible, as the increasing federal carbon tax and upcoming changes to BC Hydro's rate structure that will support electrification will make natural gas the less cost-effective choice.

Create jobs and economic growth. Retrofits drive economic growth and jobs in design, construction, trades, and manufacturing. Governments can support climate action and economic recovery by investing in green industries. Retrofits create a high number of jobs per dollar invested – 9.5 direct and indirect jobs per $1 million invested, compared with 3.6, 2.8 and 5.3 jobs per $1 million invested for the oil and gas sector, electricity generation, and plastic product manufacturing respectively.[23, 24] These jobs are located in communities where people live. Energy efficiency jobs present an attractive mix of higher pay and lower barriers to entry –meaning that workers in the energy efficiency sector have less formal education than the national average, but their income is higher than the national average.[25]

5. ESTIMATED PROGRAM COSTS

Based on the analysis and key takeaways presented above, a business case can be developed based on a set of high-level assumptions around program design and their associated costs. In terms of program design, the following assumptions have been made:

- The program will initially focus on Part 9 homes, with a potential expansion to Part 3 in the future (i.e., Part 3 is not addressed in this business case), and
- The program will leverage existing program architecture at provincial and regional scales to ensure best use of resources.

Specifically, the estimated program costs presented below assume the availability of the following supports and infrastructure to help support the home retrofit process:

- Free pre/post EnerGuide assessments subsidized by the federal government, supplemented as needed by the CleanBC program (i.e., where federal subsidies cover only a portion of the cost of assessments)
- A variety of product rebates, including existing provincial and utility rebates, as well as up to $5,000 in federal rebates
- Additional product rebates for low- and moderate-income households to be offered by the provincial government
- Up to $40,000 in federally funded interest-free loans

[23] Madi Kennedy and Tom-Pierre Frappé-Sénéclauze (2021), "Canada's renovation wave: A plan for jobs and climate." The Pembina Institute. https://www.pembina.org/reports/canadas-renovation-wave.pdf

[24] Statistics Canada, "Input-output multipliers" https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610059401&pickMembers%5B0%5D=2.3&pickMembers%5B1%5D=4.6&cubeTimeFrame.startYear=2013&cubeTimeFrame.endYear=2017&referencePeriods=20130101%2C20170101

[25] Kennedy, and Frappé-Sénéclauze. "Canada's renovation wave: A plan for jobs and climate.".

- Existing CRD program resources and architecture (e.g., web platforms, outreach materials) that can be supplemented/adapted

In the sections below, cost estimates are broken down into to major categories:

1) *Program overhead*, which represent costs associated with overall program design, marketing, staffing, and administration
2) *Homeowner support*, which provides cost estimates for retrofit support service per home.

These costs are then combined to provide an overall estimate of program costs for the first five years of a regional retrofit program.

5.1. Estimated Costs: Program Overhead

Table 8 below lists one-time and annual overhead costs assumed as a part of the program, including marketing and awareness raising, recruitment, training, staffing (including both CRD and other program staff), and other program materials. It is worth noting that while significant investment in marketing and recruitment would likely yield higher program uptake rates, a more moderate level of investment in these items has been assumed to maintain a more modest program budget. Overall, a greater investment in targeted marketing efforts that identify high-potential demographics (e.g., new millennial homeowners, higher-income, climate-conscious households) and homes (e.g., with near-term heating system replacement needs) is likely to yield improved uptake and is recommended for the first phase of program deployment. Such a targeted approach would also reduce outreach costs, which could be further supplemented by marketing and recruitment support from CRD municipalities, contractors, and community-based organizations (CBO).

Table 8: Estimated costs: program overhead

Program Component	Description	Y1 Costs	Annual Costs, Y2+
Initial marketing & awareness raising	**Targeted marketing by home and demographic** • Development of a fulsome marketing and outreach plan • Segregation of different demographics/home age/needs based on available data • Identification of specific home/owner profiles/archetypes with associated messaging	$25,000	$5,000
	Marketing and educational materials* • Brand development • Website update • Program flyers • Info/fact sheets • Short video production • Testimonials** • Social and newspaper media content • Lawn signs	$30,000	$15,000

Program Component	Description	Y1 Costs	Annual Costs, Y2+
	• Translation into other languages (e.g., French, Cantonese, Mandarin, Punjabi, Farsi)	$3,500	$1,000
Recruitment	**Program outreach** • Paid social and other media • Community events • Targeted door-to-door outreach	$20,000	$15,000
	• Mail blast/bill inserts	$13,000	$13,000
	Contractor outreach/training • Webinar/contractor breakfast • Fact sheet • Homeowner script • Ongoing outreach/relationship building (in concert with HPSC) • Encourage collaboration between contractors to provide coordinated experience and single point of contact for homeowners	$15,000	$8,000
	Community Based Organization (CBO) outreach • Webinar/lunch • Fact sheet • Homeowner script • Ongoing outreach/relationship building	$5,000	$8,000
Training	**Retrofit Coordinator** • Training on CRD program only, including available rebates and financing options	$10,000	$10,000
Staffing* **	CRD staff – Program Coordinator (0.5 FTE)	$52,500	$53,500
	Program manager (1 FTE)	$75,000	$75,000
	Direct supervision	$20,000	$20,000
	Program administration	$16,000	$16,000
Other Materials	**Program Materials** • Development of contractor form, including consultation with contractors	$7,500	$0
Totals	**CRD Staff**	**$52,500**	**$53,500**
	Program Overhead	**$240,000**	**$186,000**
	Total Overhead	**$292,500**	**$239,500**

** Assumes existing materials can be adapted*

*** Testimonials are already being funded under a different program outside the CRD, but can be adapted for CRD program use*

**** Staffing costs do not include Retrofit Coordinator time, as this is captured in homeowner support costs (see Section 5.2)*

5.2. Estimated Costs: Homeowner Support

Table 9 below shows the estimated costs for upgrade support per home. Hourly rates for support are estimated at a blended rate of $50/hour to account for the levels of training/support that are likely required for successful program deployment. Note that a section indicated leveraged resources has been included to demonstrate where current rebates already help reduce the costs associated with home energy retrofits. While there is no indication that such rebates will be discontinued in the near future, the CRD could need to find additional funding or amend the program to address any such gaps in the future.

Table 9: Estimated costs: homeowner support

Step	Tasks	Hours/ Home	Cost/ Home
Screen	• Conduct (virtual) home energy check-up/screening	0.5	$25.00
Review and Plan	• Review EnerGuide Renovation Upgrade Report • Assist client with upgrade choices • Consider DIY options and provide contractor selection advice and standardized quotation forms • Direct client to CleanBC qualified contractor directory	2	$100.00
Compare and Select	• Help homeowner scope work, compare contractor bids, and ensure rebate eligibility	2	$100.00
Finance	• Help identifying and selecting financing and incentives	0.25	$12.50
Document	• Help getting documentation and assist with submitting rebate applications	1.25	$62.50
Evaluate	• Quality Assurance checks post-retrofit (done in aggregate or spot-check) • Measurement & Verification	1	$50.00
TOTAL		**7**	**$350.00**
Leveraged Resources	• Pre/post-audit costs (likely unnecessary due to anticipated Federal programs)	N/A	$500
	• Top-ups for electrical service upgrades / heavy-ups	N/A	$1500
	• Rebate top-ups	N/A	$350 - $1000
TOTAL with Leveraged Resources		**7**	**$2,700 - $3,350**

Table 10 shows total program costs for a fixed budget and approximately 1% uptake, which is fairly standard for an effective, traditional efficiency program. The number of homes retrofitted increase in Year 2, once higher start-up costs are expended in Year 1, and then decrease slightly in Years 3-5 as staff costs increase by 2% per year while the budget stays fixed.

Table 10: Total Program Costs, assuming a fixed budget over five years

Program Year	Y1	Y2	Y3	Y4	Y5
Calendar Year	**2022**	**2023**	**2024**	**2025**	**2026**
Budget	**$602,500**	**$602,500**	**$602,500**	**$602,500**	**$602,500**
CRD Staff (0.5 FTE)	$52,500	$53,500	$54,500	$55,500	$56,500
Program Overhead	$240,000	$188,220	$190,484	$192,794	$195,150
Homeowner Support	$310,000	$360,780	$357,516	$354,206	$350,850
Estimated Program FTEs (excluding CRD staff)	3	5	5	5	4
% Program Overhead (excluding CRD staff)	40%	31%	32%	32%	32%
Homes Going Through Program/Year	885	1030	1021	1012	1002
% annual penetration	0.9%	1.0%	1.0%	1.0%	1.0%
Homes/Year with leveraged resources	92	107	106	105	104
% annual penetration with leveraged resources	0.1%	0.1%	0.1%	0.1%	0.1%
Additional tCO_2e abated each year*	1781	2072	2054	2036	2016

** Carbon abatement assumes savings of 2 tCO2e per home, which represents a mid-point case between the average GHG savings per home for a standard retrofit of 1.35 tCO2e, and the GHG savings of fuel switching retrofits of 2.6 tCO2e per home; see Section 2.1 for more details on these estimates.*

While retrofitting 1% of homes per year is substantial, a higher uptake rate of 3% of homes per year is necessary to achieve a full building stock improvement by 2050. Table 11 shows the costs, program reach, and carbon savings under a higher uptake scenario to demonstrate the scale of the costs and effort that would be required to meet this target. However, it should be noted that to achieve such a high level of program penetration, multiple funding provincial, federal, and utility streams and efforts will be required, making CRD's program one of a larger set of complementary program offerings. In both scenarios, it is assumed that this will be met by a mix of federal incentives, utility incentives, and top-ups from other levels of government.

Table 11: Program budget implications of higher (3%) program uptake

Uptake Scenario	High Uptake
% Annual Penetration	3%
Homes Per Year	**3046**
Total Budget Needed	**$1,305,600**
CRD Staff Support	$53,500
Program Overhead	$186,000
Homeowner Support	$1,066,100
Program FTEs	11
Total budget including leveraged resources	*$10,204,100*
tCO2e abated per year	6129

5.3. Key Takeaways

The cost analysis presented above yields several key pieces of information that are necessary to consider as the CRD moves into the next phase of program design:

- A CRD-run program that integrates into existing program offerings and provide homeowners with coordinator support not currently offered by existing CleanBC Energy Coach services is estimated to require an average of 7 hours of support or $350 per household. Such levels of support will vary considerably as those engaging in deeper retrofits or with more complex homes may require more, while others will require less.
- Program overhead is estimated at approximately $290,000 in the first year, decreasing to $240,000 in subsequent years as the program gets off the ground and promotional materials are developed.
- Program resources that can be leveraged in a CRD-led program include existing federal and provincial rebates and incentives for pre- and post-retrofit audits, electrical service upgrade top-ups and rebates. In the event that these resources are reduced or eliminated, the CRD will need to reassess the nature and/or level of support for homeowners to reap the best value.
- A fixed budget of $602,500 per year for the first five years is estimated to support the completion of home retrofits in 1% of the homes in the capital region per year, representing a standard but substantial uptake rate. While carbon savings will vary based on the nature of the upgrade, it is estimated that this could yield between 1.18 tCO_2e and 2.43 tCO_2e of emissions savings per home, or a total of over 2000 tCO_2e additional carbon savings across the capital region each year. This translates into a cumulative 29,443 tCO_2e avoided over five years.
- Program costs supporting a 1% uptake rate can be met by applying to the Federation of Canadian Municipalities' *Community Efficiency Financing* (CEF) funding stream. However, an uptake rate of 3% of homes per year is necessary to achieve a full building stock improvement by 2050. The scale of such a program would require significant support at provincial and federal levels, including additional incentives and rebates for electrification equipment and supporting efficiency measures.

5.4. Key Barriers and Issues to Resolve

The program and business case described above has been designed to provide homeowners with a significant addition of support to identify and complete deep emissions retrofits, while avoiding duplicating existing and forthcoming programs at federal and provincial scales. However, a number of additional issues remain in need of resolution for the CRD to successfully implement such a program. While some of these issues lie outside of the CRD's direct control, there are nevertheless opportunities to work with other organizations and jurisdictions to support them. Some key issues identified in this preliminary phase of work include:

- **The bespoke nature of many retrofits.** There is a wide variance in the actual conditions in an individual home and the upgrades required in a deep energy efficiency and/or fuel switching retrofit, especially when health issues are considered. This in turn creates a wide variation in costs, much of which is not accounted for in typical energy efficiency incentives. For example, asbestos materials found in many older homes require remediation prior to renovation, which adds costs not covered by rebate or incentive programs.
- **Conflicting messaging of multiple programs.** Both homeowners and contractors can become easily confused and fatigued by the array of programs on offer by different actors, which is only set to increase over the next few months and years. While additional support for retrofits is sorely needed, the CRD will need to work closely with provincial and federal authorities to ensure clear and coordinated messaging. In particular, it will be important to coordinate with the existing provincial Energy Coach program, as this is a strong potential entry point into a CRD-led program.
- **Managing liability.** Feedback from key stakeholders indicates that ensuring objectivity and impartiality with respect to contractor selection is important to maintain to avoid potential conflicts of interest or litigation. This can be accomplished by referring to existing qualified contractor lists where relevant. Homeowner support in understanding contractor quotes would need to be approached carefully by adhering to the risk management practices outlined below.
- **Low contractor interest in retrofit programs.** Stakeholder input indicates that regional contractors are already currently over capacity, making it difficult for them to become familiar with and promote new programs. The CRD will need to work with contractors directly, as well as industry organizations, to ensure a sufficient value proposition is developed that piques the interest of the contractor community in promoting and supporting the program. This is especially important given the multiple federal, provincial and other programs on offer or planned for the near future.
- **Insufficient availability of qualified contractors.** Where contractors are available and interested, there may be relatively few with the skills and training required to complete successful upgrades that meet both emissions reduction and customer satisfaction goals. Furthermore, the recent announcement of federal rebates for efficiency upgrades have made for long wait times to contract with an Energy Advisor. The CRD can partner with organizations such as the Home Performance Stakeholder Council to continue to increase interest in additional contractor training and thus the available pool of qualified contractors capable of meeting program targets.
- **Little authority over quality assurance.** Neither energy advisors nor the CRD have the necessary authority to require contractors to follow up in the event of a dissatisfied program participant. While making use of qualified contractors lists can help reduce this risk, there remains a threat of poor performance, to the detriment of both meeting the CRD's targets and the reputation of the program.
- **Ongoing need for coordination.** The complexity of arranging and coordinating work is a key barrier to home retrofits. This additional service is a common element of best-in-class

retrofit programs from Europe; however, providing this service was estimated to require 6-15 hours of additional work, depending on the number of measures selected. Such a level of support was assumed to be beyond the scope and potential level of support for this program, and would greatly reduce the number of homes the program could reach under the assumed project budget. The CRD may wish to work with existing general contractors to encourage partnerships with program-offered retrofit coordinators to ensure better overall service delivery while maintaining low program costs.

- **Ongoing support for natural gas systems.** Several studies have shown the impact that significant rebates can have on the market adoption of certain products and technologies.[26,27] Ongoing programs at the provincial and utility scales that offer rebates for natural gas heating and domestic hot water systems make such products significantly more attractive than some electrification measures, especially given their already low up front capital costs. In order to make investments into fuel switch renovations more attractive, the CRD has an opportunity to advocate for higher levels of provincial and federal incentives that reduce the capital costs of electrification, in addition to a sufficiently compelling marketing campaign to promote their benefits.
- **Need for additional financial support for low-income homeowners.** While the proposed program reduces the financial and other burden associated with the retrofit process, it does not actually help pay for retrofits themselves. Low-income programs tend to cover a greater percentage of the cost of energy efficiency measures than other programs and in many cases will cover the full cost of selected measures. On average, market-rate multifamily programs cover one-third of the costs of efficiency measures, with the property owner covering the remaining portion. In the low-income space, on average, efficiency programs cover 90% of costs, and the customer covers 10% or less of the costs.[28] Low-income homeowners also need specific marketing and outreach, and programs targeted to their needs. As the CRD does not have the capital to finance low-income retrofits, low-income customer uptake will depend on other incentives available. This gap is expected to be filled by a forthcoming Province-led income-qualified retrofit program.
- **Rental housing.** Rental housing has not been effectively tackled by home retrofit programs, as the tenants typically pay all utilities but have no ability to engage in retrofits, while the landlords have little incentive to upgrade homes. The CRD program may wish to support single family rental dwellers using landlord education and other supportive programs, including guides to help renters engage in conversations with their landlord about retrofits.

[26] Fuller, Merrian C., Cathy Kunkel, Mark Zimring, Ian Hoffman, Katie Lindgren Soroye, and Charles Goldman (2010), "Driving Demand for Home Energy Improvements." Berkeley National Laboratory. https://escholarship.org/content/qt2010405t/qt2010405t.pdf

[27] Stephane de la Rue du Can, Amol Phadke, Greg Leventis, and Anand Gopal (2010), "A Global Review of Incentive Programs to Accelerate Energy-Efficient Appliances and Equipment," Lawrence Berkeley National Laboratory, https://www.osti.gov/servlets/purl/1165201

[28] Ian M. Hoffman, Charles A. Goldman, et al., "The Cost of Saving Electricity Through Energy Efficiency Programs Funded by Utility Customers: 2009–2015," Lawrence Berkeley National Laboratory (June 2018), https://emp.lbl.gov/publications/cost-saving-electricity-through

5.5. Managing Liability and Program Risk

Providing expert advice to homeowners regarding home energy retrofits is widely recognized as an effective support to retrofit uptake and is a best practice in much of the developed world. In Canada, home retrofit advisory services are already offered in BC and Ontario. Windfall Ecology Centre has provided home retrofit advice to homeowners since 2001 and delivered turn-key home retrofit services to low-income families in Ontario on behalf of Enbridge Gas since 2014. In BC, City Green has provided similar services via the Province of BC's *Energy Coach* program, and provided homeowners in the capital region with retrofit advice and support over 2020 and 2021 to considerable success. Retrofit advisory services are now under consideration by the Metro Vancouver Regional District, the City of Vancouver, and several other municipalities across Canada, and will increase in prevalence as existing building emissions reductions become increasingly important to reducing municipal and regional carbon emissions.

Managing potential liability and risk is an important aspect of the CRD business case and is one of the reasons an OSS model delivered by a third party has been recommended. Other risk management measures include advisor training, appropriate insurance coverage, and a simple liability waiver agreed to by program participants as part of the enrollment process. In all cases, advisors should be sure to provide advice and never make decisions on behalf of homeowners.

6. PART 3 MULTIFAMILY HOMES

As shown above, the GHG savings available in Part 3 multifamily buildings represent only 18% of the GHG savings potential as is available in the Part 9 housing stock. As such, it is recommended that the CRD focus its resources on single family, townhome, and duplex/triplex homes to ensure most efficient use of existing capital, ensure access to the service from homes across the region, and leverage ongoing work at the provincial scale (e.g., via the Energy Coach service).

However, a significant proportion of the building sector in some CRD communities is made up of multi-unit residential buildings, both strata owned and rental, and will require dedicated programming to meet municipal and provincial emission reduction ambitions. These building types require a different process than single-family homes—the audit process is different and more expensive (ASHRAE Level 2 or 3, instead of EnerGuide), and the retrofits are often more complex, especially if fuel switching is being considered. Low to moderate income earners are also more likely to be renters and occupy MURBs, and as such present a more acute equity challenge than single family dwellings in the capital region. There are also split incentives between the individual strata owner or tenant and the building management, where the actor footing the bill for a retrofit is not the same actor that receives the resultant benefits in the form of energy and cost savings. Strata-owned and purpose-built rental housing therefore require different forms of support to realize emission reductions. Because the affordability gap — i.e., the difference between the cost of a housing unit and the price a low-income resident can afford— is a central housing issue in the capital region, it also needs to be a core focus of any program focused on these buildings.

Nevertheless, the urgency for electrifying these buildings remains as great or greater than for Part 9 homes, as there are fewer opportunities to replace commercial-scale boilers and furnaces (due to their longer service lives). Moreover, demographic analyses tend to show that lower-income

households disproportionately inhabit multi-family buildings (particularly purpose-built rental) and are more likely to be affected by the health impacts associate with poorly performing buildings and/or those that are ill-equipped to manage the impacts of climate change.

Fortunately, there are some current and potential future programs that are seeking to address this space, including the *Building Benchmark BC* program, designed to support large building and portfolio owners understand, report and publicly disclose their buildings' performance. While not a retrofit support program, *Building Benchmark BC* provides owners and participating jurisdictions with the information necessary to begin to improve performance. Support offered to participating building owners in future years of the program will also receive basic information on potential retrofit opportunities.

As this is also a growing sector, it is worth noting that the BC Energy Step Code (which governs the construction of purpose-built rental in many municipalities in the capital region) will be the most direct way to influence the energy performance of new MURB. Potential changes to the BC Energy Step Code to include carbon regulations and resilience measures, such as high efficiency cooling, could make accelerated adoption of the BC Energy Step Code a high impact way to reduce future emissions from this sector.

Other opportunities for specific ownership types are noted in further detail below.

6.1. Strata Buildings

As noted above, a project currently being led by Metro Vancouver and a group of other local governments is also currently exploring the expansion of Metro Vancouver's *Strata Energy Advisor Program* across the province. In its current form, the program is intended to provide strata buildings with an OSS program designed to address their unique barriers. If adopted at the provincial level, such a program would support strata owners and their property managers understand and undertake energy efficiency and emissions reduction upgrades, and fill the gap of retrofit support currently available to strata owners. However, even if the Strata Energy Advisor program is not expanded provincially, it would provide a strong framework on which to expand the CRD's program to strata housing in a later or concurrent phase.

6.2. Multifamily Rental Buildings

Purpose-built rental buildings are a complex target for a CRD retrofit program, as the sort of guidance, support, and incentives needed for this ownership type differ dramatically from the single family or strata stock. However, an additional targeted outreach opportunity to this sector is likely of high value. The analysis of the multifamily rental housing stock listed in the BC Assessment data indicates that there are 30 purpose-built rental buildings over 100,000 ft^2, accounting for 20% of the rental floor area in the region but only 2.5% of the 1,187 buildings. The overall age of the rental stock is older than the strata stock as well; 15 of the 30 largest rental MURB buildings were built before 1977, with the median year built for the sector overall at 1969. Targeted outreach to the owners and property managers for these buildings could have a significant impact on community emissions across the region, and would benefit a greater proportion of lower-income households or those living in or at risk of energy poverty. As such, it is recommended that a targeted program for

purpose-built rental housing be developed in partnership with capital region municipalities. The City of Victoria's *Market Rental Revitalization Study* (MaRRS) could form a foundation for the CRD to build on, as it characterized the rental building stock in Victoria and explored means of ensuring tenant support and avoid renovictions while undergoing energy and seismic retrofits.

7. CONCLUSION

This report has presented the findings of a set of analysis and engagement intended to inform a business case for a residential energy retrofit program at the CRD. While specifics of program design are out of scope for this work, a broad set of assumptions have been made regarding program design that can be built upon in subsequent phases of program development. Following approval of the business case, program design should be more fully fleshed out using input from key stakeholders, including contractors working in the region. The CRD should also continue to monitor developments at the federal and provincial scales to ensure program developments at these scales can be leveraged for best program results.

APPENDIX A. ONE-STOP-SHOP (OSS) CASE STUDIES

A.1 KFW Effizienzhaus

KFW Effizienzhaus is the German national home retrofit program.

Attributes	Details
Location	Germany
Date Started & Impact	Operating over 10 years
Ownership Model	KFW state bank in partnership with German Energy Agency
Key Activities	KFW provides low interest loans and other incentives. The German Energy Agency licenses Energy Advisors, maintains the Effizienzhaus rating system and quality assurance protocols (similar to NRCan).
Key Resources	• Low interest loans up to 120,000 EUR (up to 35% forgivable) • Incentives for audit and retrofit facilitation costs (including contractor selection and coordination • State licensed independent Energy Advisors provide audit and retrofit facilitation services.
Homeowner Journey	1. Homeowner retains a licensed Energy Advisor. There are over 10,000 licensed Energy Advisors (included among them are trades people, architects, engineers, etc.). KFW supports the cost of the Energy Advisor 2. With assistance from the Energy Advisor apply for a retrofit loan from a local bank which manages loans on behalf of KFW (significant portions of KFW loans are forgiven based on performance achieved). 3. Enter into loan agreement and start retrofit work. 4. Submit confirmation and receive repayment grant. The Energy Advisor plays an important role in the remodeling process. Devises the remodeling plan with the homeowner, based on: • Building specifications, calculations, and experience • Current incentives and rules • The wishes and financial constraints of the homeowner • Reviews bids with the homeowner Directs the actual retrofit and all contractors. • Helps develop contractor RFPs • Helps collecting and comparing bids • Advises homeowner regarding contractor selection • Ensures quality and timeliness of contractors' work • Measures the results (e.g., blower door test) and issues the "Energy ID" • Fills out relevant (technical) forms for KfW and the loan application.

Attributes	Details
Marketing Channels	KFW is a highly recognised brand familiar to most Germans. Information websites are maintained by KFW, the German Energy Agency, and licensed Energy Advisors
Revenue	German government recovers costs through expanded economic activity. Estimated over 200,000 jobs created or protected per year.
Costs	Energy Advisor fees are paid by KFW on a sliding scale with a maximum of EUR 4000 per completed retrofit. Pre and post audits are separately subsidized (EUR 800)
Success & Risks	As of 2019 over 3 million retrofits completed

A.2 Oktave

Oktave is an integrated renovation service model in the French region of Alsace, which aims to increase the number of deep renovations. The model provides the building owner with a main point of contact that guides them throughout the renovation process.[29]

Attributes	Details
Location	Grand Est region, France
Date Started & Impact	Started in 2016 to provide homeowners with an independent renovation advice service specialising in deep energy retrofits. Completed 180 project in first 2 years.
Ownership Model	Regional government agency
Key Activities	Technical renovation advice tailored to the specific building. • Support with a financial plan, combining potential grants, tax rebates and low-interest loans • Project management assistance throughout the renovation process • Personalised "post-works care" for two years after completion of the renovation • A directory of qualified and experienced professionals trained by Oktave to guarantee long-term building performance
Key Resources	• Financial management (accounting, auditing, quality control, litigation) • Operational management (renovation advisors, loan advisors, relationship with contractors and companies)
Homeowner Journey	The retrofit journey follows four main steps: 1. Initial contact and on-site visit, from which the suggested measures are derived. The renovation plan is discussed and outlined based on the need and financial means of the homeowner. Following this, an Oktave contract is signed, stipulating the terms and cost. 2. The Oktave advisor collects offers from relevant building professionals and puts together the most appropriate renovation package. The homeowner agrees on a renovation and financial package suggested by the advisor.

[29] Turnkey Retrofit, 2020, *project n°839134*.

Attributes	Details
	3. The actual renovation works take place, during which the advisor supports the homeowner when needed. A blower-door test is used to control the general quality and performance of each renovation. 4. The final step is the "post-work care", in which the advisor stays in contact with the homeowner and ensures the technical and financial plans work as intended.
Marketing Channels	• Local renovation advice centres • Local network (installers, architects, tradespeople etc.) • Website and social media
Revenue	• Compensation of the technical support in the form of a service package billed to the customer. • Financial income generated through its credit intermediary activity (referrals).
Costs	• Labour cost (advisors, admin personnel etc.) • Information system cost (development, maintenance) • Communication cost
Success & Risks	The program was modestly successful in its first two years of operation and was projecting uptake of 1000+ retrofits per annum post 2020. Since it is operated by a local government agency it is exposed to litigation risk.

A.3 Izigloo

The Izigloo web platform is an intelligent online registry. It keeps track of the maintenance and management of single-family homes on behalf of subscribers. Based on an analysis of data from 70,000 completed renovation projects, it can provide a quick estimation of a homes upgrade potential, which often entices people to engage in a retrofit. The Izigloo renovation service allows homeowners to check their energy consumption online, get personalized advice on how to improve the performance of the home and provide links with qualified professionals to carry out the work.

Attributes	Details
Location	France
Date Started & Impact	The platform launched in 2015 but the company has been retrofitting homes since 2010. It recognised the need for a more structured support for renovation projects because customers, often, perceive them as complicated, expensive, and time-consuming. Few customers were willing to pay for additional services, hence the idea of industrialising the support through a digital platform. The main objective is to trigger renovation work and match customers with building professionals. Since launch the project has supported 40,000 home retrofits with an average project size of EUR 9000
Ownership Model	Privately owned
Key Activities	• Provides automated calculation and estimations of the required cost, energy savings, available subsidies relating to a potential renovation project

Attributes	Details
	• Offers energy renovation advice • Allocates the right building professionals to a project
Key Resources	• Online portal and extrapolation solution • Network of professionals
Homeowner Journey	1. The building owner finds their way to the Izigloo website. User receives an estimate of the total cost (based on decision trees, product list with prices, subsidies and eligibility criteria) 2. If the building owner is interested, an appointment is made with an advisor. The building owner indicates how soon he/she would like to get the work done. 3. The project is published on the portal as an open tender for the professionals to bid on. 4. Up to three professionals can "buy" the prospective project and deliver their proposal. 5. The building owner signs with the preferred professionals. 6. The renovation work is conducted. 7. 8. Follow-up feedback form is filled in by the building owner.
Marketing Channels	Izigloo reaches most customers through online marketing and guides them through the steps of the renovation journey.
Revenue	• Selling potential projects to professionals (i.e., leads) • Percentage of the project value when a project is carried out
Costs	EUR 8 million to develop
Success & Risks	Successful model with high development costs

A.4 SuperHomes

SuperHomes is an integrated renovation service that has been successful in increasing the number of deep energy renovations by providing technological and financial support for homeowners.

Attributes	Details
Location	Tipperary region, Ireland
Date Started & Impact	Started in 2015 and completed approximately 280 retrofits. Average primary energy saving is 71%
Ownership Model	Publicly owned by the Tipperary Energy Agency
Key Activities	• Home energy assessment/survey • Renovation project management • Grant/subsidy application • Post-installation check/evaluation
Key Resources	• Good project managers • Strong local network • Financial package
Homeowner Journey	1. The building owner expresses interest and makes an application on the SuperHomes website. 2. If the project is deemed feasible, a home energy audit is carried out. The assessment includes a blower door test.

Attributes	Details
	3. A suggested package of measures designed to achieve an EPC A-rating is proposed. Some measures are mandatory within the scheme. The complexity of a deep renovation is simplified and presented in a digestible way to the homeowner, while the recommendations are tailored to the specific building and the incentives of the homeowner. 4. SuperHomes provides costs to the homeowner from a pre-approved panel of contractors and sub-contractors. 5. If the homeowner wishes to proceed, TEA accesses subsidies on behalf of the client. 6. The project management and quality assurance of the various contractors and installers is by TEA. 7. A post-audit is carried at the end of the works by TEA.
Marketing Channels	• Local network (companies, association of building managers etc.) • Local renovation advice centres • Website
Revenue	Project management and professional fees which are included in the total cost of the works for the homeowner.
Costs	Labour cost (advisors, admin personnel etc.) • Communication/outreach costs
Success & Risks	Approximately 280 deep retrofits completed in first 3 years. Regional utility absorbs liability risks

A.5 BetterHome

BetterHome is an industry-driven one-stop-shop model. It has proven successful in increasing demand for deep energy renovations. The model reduces the burden on the building owner by streamlining the renovation process.

Attributes	Details
Location	Denmark
Date Started & Impact	Started by 4 retrofit sector suppliers in 2014 the collaboration has generated 1182 retrofit to 2019.
Ownership Model	BetterHome was created as an independent organisation. The overall objective is governed by the private suppliers through regular board meetings (Rockwool, Danfoss, Grundfos, and Velux)
Key Activities	• Renovation advice. The homeowner uses an online tool to enter details about their homes and energy consumption and receive a report and recommendations on renovation measures and offers from local suppliers. • Skilled professionals. Local craftspeople carry out the installation work. The craftspeople receive training and guidelines from BetterHome. • Financial package. The customer discusses the renovation project with his/her usual bank, and the bank can use the BetterHome tool

Attributes	Details
	to refer to the details. The associated banks trust the BetterHome quality and financial characteristics
Key Resources	• Project managers • Smart digital solution • Network of building professionals • Expertise in building components
Homeowner Journey	1. Homeowner uses the BetterHome online portal to get a first estimate for their building and indicates interest in learning more about their retrofit options. If both parties are interested in moving forward, they schedule a date for an on-site visit. 2. During the on-site visit an energy assessment is conducted, for which the installer has an online standardised survey to complete. The installer also discusses different renovation possibilities that they have and informs them about indoor environmental quality aspects and how to improve these. Based on the online survey, the installer can present energy and cost saving potential for different renovation alternatives. 3. If they find a solution that meets the expectations of the building owner, they sign a contract. While BetterHome assists in providing standardised contracts, the contract is between the installer and building owner. 4. Renovation is carried out. 5. Post-retrofit survey to make sure everything went as planned. Installers that receive substantial complaints are removed from the BetterHome network.
Marketing Channels	• Online portal • Network (suppliers, installers, local banks) • Social media
Revenue	Free to the homeowner and there are no payments between BetterHome and the contractors. The industry consortium relies on product sales to generate revenue.
Costs	• Labour cost (project managers, business model developers, admin personnel etc.) • Development and maintenance of the online portal/solution
Success & Risks	1182 retrofits in first 5 years. Product suppliers assume retrofit risks