

## Green Retrofit Economy Study

### TECHNICAL MEMO: DEMAND-SIDE ANALYSIS

(June 2022)

**Disclaimer**

The information, concepts and recommendations expressed in this document are based on information available at the time of the preparation of this document. Action or abstinence from acting based on the opinions and information contained in this document are the sole risk of the reader and Delphi shall have no liability for any damages or losses arising from use of the information and opinions in this document. All information is provided "as is" without any warranty or condition of any kind. The document may contain inaccuracies, omissions or typographical errors. This report contains research findings from interviews and secondary research as part of a broader suite of project activities to support the Green Retrofit Economy Study Research.

**Copyright © 2022 The Delphi Group**

All rights reserved. The use of any part of this document, whether it is reproduced, stored in a retrieval system, or transmitted in any form or means (including electronic, mechanical, photographic, photocopying or recording), without the prior written permission of The Delphi Group is an infringement of copyright law.

**Project Lead on behalf of The Delphi Group:**

Ben Clark  
bclark@delphi.ca

**DELPHI.ca | 434 Queen St | Ottawa ON | K1R 7V7 | T +1 613.562.2005 | E [info@delphi.ca](mailto:info@delphi.ca)**

## Contents

<b>1. Introduction .....</b>	<b>4</b>
<b>2. Summary of Demand for Retrofits .....</b>	<b>6</b>
<b>3. Research Findings on the Demand for Retrofits .....</b>	<b>16</b>
<b>4. Quantifying the Demand for the Retrofit Workforce .....</b>	<b>19</b>
<b>Appendix A: Provincial Retrofit Targets .....</b>	<b>32</b>
<b>Appendix B: Definitional Framework for Assessing Retrofit Demand .....</b>	<b>34</b>

## 1. Introduction

### Project Context

The goal of this project is to develop a fulsome picture of the workforce and equipment supply chain capacity gaps across Canada's retrofit economy. The scope of the research focuses on multi-measure energy efficiency retrofits. Retrofitting involves adding or fitting a component or feature that was not included in the initial phase of construction. Thus, retrofit measures are different from renovation, refurbishment, restoration, renewal, etc.

The research strives to equip governments and industry with insights into the workforce and supply chain opportunities and risks presented by scaling up the retrofit economy in Canada, with a particular focus on large (i.e., Part 3) buildings.

This Technical Memo describes the demand side of the retrofit equation and represents one piece of the capacity gap analysis. It represents an effort to build on existing research and build a definitional framework, which is described in further detail in **Section 2** below. Subsequent technical reports explore the supply side of the equation, while the overall research findings are compiled and summarized in the Final Summary Report.

**RETROFIT:** To retrofit literally implies providing something with a component or feature not fitted during manufacture or adding something that it did not have when first constructed. The term has been used in the built environment to describe substantial physical changes at building level and has often been used interchangeably with terms such as 'refurbishment', 'conversion' or 'refit'. But at an urban or city scale retrofit means something much larger and more comprehensive, more integrated; underpinned by sustainable financing and with a clearly defined set of goals and metrics. – from the *U.K Retrofit 2050 Project*

**DEEP CARBON RETROFIT:** A deep carbon retrofit is the process of improving and updating a building's systems with the primary goal of minimizing greenhouse gas emissions. It can include reducing building energy demand, replacing and/or electrifying heating and mechanical systems, and/or producing on-site renewable energy. – from CaGBC's *Decarbonizing Canada's Large Buildings Study*

**RETROFIT PATHWAY:** A set of common retrofit measures to achieve energy and/or GHG emissions reductions, grouped by building system and applicable to a group of buildings that share common features (e.g., building type, size, age, location). See *Table 2 below*.

### About the Research Process

After several months of scoping and alignment discussions among partners, the project team began work in October 2021, and the Canadian Green Retrofit Economy Study was officially launched publicly on November 17, 2021.

Research activities in this initial phase of the project included key informant interviews, engagements with data providers and stakeholder groups, profile at conferences and webinars, and secondary research to build on previous studies. A goal of the project was to advance the dialogue about retrofits through stakeholder engagement, and Table 1 below provides a summary of engagement activities.

**Table 1: Engagement Summary**

Activity	Description
<b>Project Announcement &amp; Report Releases</b>	Link to project announcement and landing page pushed to thousands of people through mailing lists and social media.
<b>Key Informant Interviews</b>	16 interviews with a range of industry, government, and non-profit stakeholders.
<b>ZEBx Deep Emission Retrofit Dialogue</b>	Presentation and dialogue with audience of >80 green building professionals.
<b>Technical Advisory Group</b>	February 2022 workshop with the CaGBC Technical Advisory Group on three components of the research: <ol style="list-style-type: none"> <li>1. Key occupations for retrofit measures</li> <li>2. Products, materials, and supply chain</li> <li>3. Retrofit economy growth scenarios and related assumptions</li> </ol>
<b>Products and Materials Workshop</b>	January 2022 industry stakeholder workshop to define and prioritize the technologies and products needed to support large building retrofits and gain a better understanding of the barriers and opportunities to adoption.
<b>CaGBC Building Lasting Change and Electro-Federation Canada Conferences</b>	Project profiled in keynote speech and workforce-specific sessions.

Key themes from the interviews and stakeholder engagement activities are described in **Section 3**. Further engagement activities to validate research findings and mobilize knowledge are planned through 2022.

The project team developed and tested a Scenario Analysis Tool to quantify the demand for the key occupations, services, and equipment necessary to scale up Canada's green retrofit economy. Initial scenarios have been run through the tool and work is ongoing to validate assumptions and data sources; **Section 4** provides a description of the approach and methodology for this Tool.

## 2. Summary of Demand for Retrofits

For Canada to achieve its 2030 and 2050 climate targets, the pace and depth of building retrofit activity needs to be dramatically increased, with emphasis on building system upgrades and deep carbon focused retrofit activity. To support increased upgrades and retrofit activity in Canada's large buildings, there will need to be increased industry capacity, expanded education and training, new policies and strengthened regulations, increased investment flow, as well as technology advances.

As part of the drive to ramp up retrofit activity in Canada, it will be crucial to strategically recruit and train the needed cohort of tradespeople, as well as related supportive professions. All associated building retrofit professionals will need to become more familiar with the key approaches and processes to maximize deep carbon retrofit results and meet the needs of an evolving industry.

In this section we describe the common building types that are considered in the research, generalized retrofit pathways, equipment and services, and the key occupations that will need to be involved. This framework provides the basis for our approach to analyzing the demand for retrofits and the logic of the Scenario Analysis Tool.



## Building Types

To support the identification of potential deep carbon retrofit pathways that could be employed as part of increased retrofit market activity, this study focused on specific building types which encompass a significant percentage of the building floor space in Canada. The building types considered included the following:

- High rise residential (~13 storey or 13,000m<sup>2</sup>)
- Mid rise residential (~4 storey or 6,000m<sup>2</sup>)
- Low-rise multi-unit residential (Part 3 buildings over 600 m<sup>2</sup>)
- Mid rise office (~13 storey or 21,000m<sup>2</sup>)
- Low rise office (~2 storey or 3,000 m<sup>2</sup>)
- Retail (e.g., malls and plazas)
- Logistics (e.g., warehouses and big box retail stores)
- Hospitality (mid-rise hotels)

Information on the generalized deep carbon retrofit pathways for these identified building types was mostly derived from CaGBC's Decarbonizing Canada's Large Buildings study, which included the development of select building baseline conditions, optimized deep carbon retrofit pathways to consider, as well as evaluating costing and financial considerations.<sup>1</sup> It is important to note however that while this study was able to derive generalizations on preferred retrofit pathways, the unique context of a building must be further considered, including the building's type, age, and location, and available workforce for deep carbon retrofits, to determine the extent which retrofit pathway can be applied.

## Retrofit Measures

For any building owner, manager, or professional that is striving to reduce building related emissions and improve energy efficiency, evaluating viable retrofit pathways and developing an optimized transition plan are fundamental activities that need to be undertaken in a holistic way. Irrespective of a building's size and type, a deep carbon retrofit – aiming to reduce energy consumption by more than 40% - requires a "building as a system" approach.

As identified in the Decarbonizing Canada's Large Buildings summary report released in December 2021, there are three main technical strategies that can serve as a starting point as part of zero carbon transition planning and retrofit project development for most large building types in Canada:

1. Reduce/replace fossil fuel use for space heating, mainly through electrification
2. Implement energy demand-reduction measures and
3. Incorporate and/or install on-site renewable energy systems.

As case-by-case assessments are done for buildings, further details on specific measures can be determined. **Error! Reference source not found.** below provides examples of the key measures that can be employed to help establish viable carbon reduction pathways for the selected building types in this study, grouped by the four main building systems: electrical, enclosure, mechanical, and renewables.

<sup>1</sup> See: <https://www.cagbc.org/CAGBC/Advocacy/decarbonizing.aspx>

**Table 2: Retrofit Pathway Summary**

Building system	Sub-building system	Examples of carbon reduction measures
<b>Electrical</b>	Lighting	LED retrofit, including full lighting system redesign.
	Plug loads (digitalization)	Optimized operations and building automation systems, reduced energy waste.
<b>Enclosure</b>	Windows/doors	Upgrade to triple glazed windows.
	Walls	Upgrade performance with exterior insulation and improved air barrier system.
	Roofs	Upgrade performance with installation of exterior insulation.
<b>Mechanical</b>	Space heating/cooling	Replace existing system with low ambient air to air or air to water heat pump system, supported by an electric resistance or HE condensing gas boiler if necessary (considering climate zones).
	Air distribution systems in offices	For archetypes with constant air volume multi-zone systems, convert to multi-zone variable air volume systems.
	Ventilation	Install energy recovery ventilators.
	Hot water heating	Replace gas systems with a dedicated air to water heat pump, supported by an electric resistance or condensing gas boiler for temperature top-up, or a wastewater heat recovery heat pump and storage tank.
<b>Renewable Energy System</b>		Maximize on-site renewable energy generation through solar PV or hot water system installation, as determined by available roof area, utility regulations, and annual electrical load (not to be exceeded).

Although there are differences in a building's operation and performance depending on its end use and the carbon intensity of its electricity, the technical solutions available today and professional skills required are somewhat common across the various building types. For some building types with different energy use profiles, such as higher domestic hot water loads (e.g., multi-unit residential and hotels) or higher energy demand and plug loads (e.g., retail grocery and malls), there may be significant differences in the priorities and sequences that retrofit measures take, but not necessarily major differences in the type of trades and/or professionals needed overall.

For buildings in regions that have more carbon-intensive electricity grids, there may need to be a greater emphasis on achieving emissions reductions through electrical demand reductions as compared to regions with low-carbon grids, where greater emphasis will be needed on space heating electrification measures. Further detail on the specific components and technologies that will be needed as part of retrofit pathway development is provided in the Appendix.

In addition to assessing the viability of technical retrofit solutions, key supportive actions and recommendations were developed during the Decarbonizing Canada's Large Buildings study. These considerations to help ramp up retrofit market activity and optimize deep carbon retrofits are outlined below:

- Align capital planning and regular infrastructure and equipment renewal timelines, with deep carbon retrofit opportunities.
- Leverage an integrated design process approach to retrofit project development, moving away from single system improvements, and include assessment of opportunities to maximize additional building performance and occupant comfort/health benefits.
- Start as soon as possible, either implementing proven emissions reduction and efficiency measures and/or developing zero carbon transition plans.
- Develop strategies to secure capital financing.

Through interviews with key retrofit market industry and policy stakeholders, the opportunity for specific deep carbon retrofit measures was further validated in comparison to their scalability and market readiness. As shown in **Error! Reference source not found.** below, the identified deep carbon retrofit measures that were discussed during industry engagement and the consensus for their relative readiness and scalability is outlined.

**Table 3: Scalability of Retrofit Technologies**

Technology	Can be developed at scale	Requires market development time
Heat pumps (includes heat pumps for domestic hot water and ground source heat pump technology)	X	
Fuel switching (electrification)		X
HVAC	X	
Building envelope		X
Energy efficient lighting	X	
Renewables	X	
Prefabrication of HVAC systems		X
Automation/optimization technologies	X	
Energy efficient windows	X	
Rapid conversion of transportation sector to electric vehicles and interface between buildings and cars		X
Bio source materials		X

### Equipment & Services

The study has described examples of technical interventions grouped by building system (i.e., electrical, enclosure, mechanical, and renewable energy systems) to achieve energy and carbon reductions in the Canadian building stock. For each of the interventions, we select individual actions that constitute a single improvement towards retrofitting, and the relevant equipment for each building system intervention. Thus, under the interventions, we have grouped together the following retrofit measures.

**Table 4: Retrofit Measures and Equipment/Services by Building System**

Building System	Sub-Building System Measures	Equipment / Service
Overhead Services	Whole building	Energy audit, measurement, and verification System planning and design Occupant engagement, management, and training
	Lighting	LED lighting products Control systems
Electrical	Plug loads / digitalization	Building management system controls
	Windows/doors	Clips, frames, cladding Energy efficient windows/window wall/curtain wall and doors
Enclosure	Walls and roofs	Insulation and air barrier systems
	Space heating/cooling	Heat pumps for electric heating and cooling Hybrid gas/heat pumps Geo- exchange systems
Mechanical	Hot water heating	Electric high efficiency domestic hot water
	Air distribution systems Ventilation	Heat and energy recovery systems Piping and duct work
	Renewables	PV systems Solar domestic hot water

### Key Occupations

As the retrofit market and economy is further developed in Canada, both industry professions and trades that are primary roles required for effective retrofit project implementation, as well as secondary support roles that are fundamental to project success, will be needed. Besides the more retrofit specific primary and secondary roles, there are also construction and restoration related trades, such as demolition (including hazardous waste management), heavy equipment operators, restoration, and interior finishers that will be called upon for general tasks that are needed whenever buildings are altered and upgraded. Roles that are engaged in occupant liaison, engagement, and management will also play a key part in the retrofit economy.

In addition to the required direct and indirect skills to ramp up retrofit activity, it will also be crucial for professions such as building owners, building managers, investment managers, and aggregators to become more familiar with the key strategies, considerations, and processes that support and optimize the development and implementation of deep carbon retrofits.

Summarized below are some of the core professions and trades and the secondary support roles that have been identified as being fundamental to deep carbon retrofit project success. These needed retrofit related professions and trades were also validated with industry experts that were engaged through this study. The list below is a sample, and a further breakdown of professions and roles is provided in the Appendix.

### **Primary Roles**

- Energy auditors, project assessors and modellers
- Building managers and operational staff
- Design engineers, including mechanical, structural, and electrical, as well as architects
- Quantity surveyors, cost consultants and estimators
- Construction general contractors, construction managers, and project managers
- Envelope trade specialist and insulation and air barrier installers
- Specialty glass façade and curtain wall providers and installers (high-rise)
- Architectural glass and metal installers (low rise)
- Electricians and lighting specialists
- Solar photovoltaic system designers and installers
- Geo-exchange system designers and installers
- Heating and ventilation related mechanical trades, with a focus on heat-pump related specialists
- Plumbers
- Building automation technicians
- Commissioning agents, both for retrofits specific measures and the whole building\
- Measurement and verification
- Occupant engagement and management

### **Secondary Roles**

- Energy managers and consultants
- Building information modellers
- Interior designers
- Municipal building permitting and support staff
- General construction trades and labourers, Construction Millwrights, carpenters, concrete finishers, masonry finishers, flooring installers, drywallers, painters,
- Hazardous materials specialists and trades
- Sheet metal specialists and trades
- Hoisting engineers, heavy equipment operators and drivers

### **Key Stakeholders for Further Support**

- Building owners
- Asset managers
- Property managers, facility managers
- Project managers
- Program managers
- Investment fund managers

## Policy Landscape

In March 2022, the Government of Canada announced [Canada's 2030 Emissions Reduction Plan](#) (ERP), which builds upon the actions and initiatives introduced in previous national climate plans, including decarbonizing the buildings sector. The ERP summarizes current progress and outlines key next steps including the Government's \$150 million investment to develop a national net zero by 2050 buildings strategy. In conjunction with other activities, the strategy will advance existing retrofit initiatives by developing a Low Carbon Building Materials Innovation Hub, launching a new Net Zero Building Code Acceleration Fund, and improving federal capacity and technical support.

Prior to the introduction of Canada's 2030 ERP, the Pan-Canadian Framework, adopted in 2016, had signatories committed to the development of a national code for existing buildings by 2030.<sup>2</sup> This timeline has since been accelerated and Canadians should expect a national retrofit code, titled Alterations to Existing Buildings, in 2025.

The [Canada Infrastructure Bank's recent \\$2 billion Building Retrofit Initiative](#) was created to drive reduction in greenhouse gas emissions through energy-efficient building retrofits as well as encourage innovative business models, bring together private capital, and establish retrofits as a distinct asset class. Alongside CIB's efforts, the Pan-Canadian Framework's [\\$2 billion Low Carbon Economy Fund](#) is another federal resource that is being tapped by provincial and municipal governments to mitigate the cost of energy efficient upgrades for homeowners, businesses, and industrial operations. Through Canada's 2030 ERP, the Government has renewed their commitment to the Fund with an additional \$2.2 billion. Other initiatives such as FCM's Green Municipal Fund and CMHC's minimum energy efficiency requirements for NHS funded projects show growing alignment in program objectives and resources at all levels of government.

Canada's national carbon tax on fuels and emissions is also a key policy driver. In 2020, The Government of Canada announced that the price of carbon will increase from \$30 per ton to \$170 per ton by 2030. This will further incentivize the decarbonization of buildings and associated electricity grids.

**Error! Reference source not found.** summarizes the high-level carbon reduction targets set by provinces and the policies that exist nationwide to drive the uptake of retrofits; specifically, those that also address commercial buildings in addition to residential retrofits. Of the provinces, British Columbia, Ontario, Quebec, and Nova Scotia are currently best positioned to drive widespread retrofits through the availability of several financing tools including:

- Incentives and Rebates
- Local Requirements and Incentives
- Energy Rating and Disclosure Programs
- Performance Requirements
- Net-metering and other Distributed Energy Policies

<sup>2</sup> See: <https://www.energycanada.org/national-retrofit-code-sooner/>

Currently, there are no existing mandatory provincially led mechanisms or focused targets in place to advance retrofits, but these policies are currently being developed in BC and Quebec.

**Table 5: Provincial Carbon Reduction Targets and Retrofit Policy Drivers**

Province	Retrofit Policies and Programs
BC	<p><b>Provincial Target:</b> reduce emissions in buildings and communities by more than a half by 2030.</p> <p><b>Policies and Programs Driving Retrofits:</b></p> <ul style="list-style-type: none"> <li>- Better Buildings BC</li> <li>- CleanBC Facilities Electrification Fund</li> <li>- CleanBC's Custom Incentives and Custom-Lite Incentives</li> <li>- The CleanBC Commercial Express Program</li> </ul> <p><b>Municipal Leadership:</b> Vancouver's Climate Emergency Action Plan that includes annual carbon pollution limits for existing buildings. At first, limits will only apply for detached homes and large commercial buildings with targets that must be achieved by 2025. By 2030, the City has set a target to reduce carbon pollution by 50 per cent from existing building by 2030.</p>
AB	<p><b>Provincial Target:</b> reduce emissions by 30 mt by 2030 — equivalent to an 11 per cent reduction of total emissions.</p> <p><b>Policies and Programs Driving Retrofits:</b></p> <ul style="list-style-type: none"> <li>- Clean Energy Improvement Program</li> <li>- Energy Savings for Business Program</li> </ul> <p><b>Municipal Leadership:</b> Within its plans to achieve a 50 per cent reduction in greenhouse gas (GHG) emissions from operations by 2030, the City of Edmonton has approved a \$12.4 million clean energy program for 100 building retrofits as part of a two-year pilot program to finance energy efficiency upgrades for homeowners and organizations.</p>
MB	<p><b>Provincial Target:</b> Efficiency Manitoba has a legislated target of reducing electricity consumption by 1.5 per cent and natural gas consumption by 0.75 per cent annually.</p> <p><b>Policies and Programs Driving Retrofits:</b></p> <ul style="list-style-type: none"> <li>- Efficiency Manitoba's Commercial, Industrial, and Agricultural program</li> <li>- Natural gas reduction program fund through Efficiency Manitoba</li> </ul>
ON	<p><b>Provincial Target:</b> Reduce emissions by 3 per cent below 1990 levels by 2030.</p>

	<p><b>Policies and Programs Driving Retrofits:</b></p> <ul style="list-style-type: none"> <li>- Mandatory energy ratings and disclosures for buildings, alongside province wide voluntary PACE programs and on bill financing programs.</li> </ul> <p><b>Municipal Leadership:</b> Toronto is one of the first cities to adopt Property Assessed Clean Energy (PACE) for commercial buildings.</p>
QC	<p><b>Provincial Targets:</b> 60 per cent reduction in emissions from government buildings and 50 per cent reduction of emissions related to heating for buildings by 2030.</p> <p><b>Policies and Programs Driving Retrofits:</b></p> <ul style="list-style-type: none"> <li>- SOFIAC was launched in January 2021 and is <u>the largest energy efficiency initiative in Canada</u>. It was created to provide financing and technical support for commercial, industrial and multi-residential buildings to undertake energy efficient infrastructure upgrades.</li> </ul> <p><b>Provincial Leadership:</b> The energy cost reduction target for all projects funded through SOFIAC ranges from 25 to 40 per cent per, which could reduce greenhouse gas emissions by 30 to 50 per cent, resulting in the complete decarbonization of these buildings.</p>
Maritimes	<p><b>Provincial Targets:</b> New Brunswick has a carbon reduction target of 47 per cent below 2005 levels by 2030. Nova Scotia's carbon reduction target is set at 53 per cent below 2005 levels by 2030.</p> <p><b>Policies and Programs Driving Retrofits:</b></p> <ul style="list-style-type: none"> <li>- Efficiency Nova Scotia's Retrofit Program for residential and business properties</li> <li>- New Brunswick's Commercial Buildings Retrofit Program</li> </ul> <p><b>Municipal Leadership:</b> The Halifax region plans to offer a retrofit program to help reduce energy consumption by 50 per cent. Municipal officials are designing the retrofit program to apply to the region's 50,000 commercial buildings.</p>
Northwest Territories	<p><b>Target:</b> reduce emissions 30 per cent from 2005 levels by 2030.</p> <p><b>Policies and Programs Driving Retrofits:</b></p> <ul style="list-style-type: none"> <li>- Arctic Energy Alliance (funded via Federal Green Homes Grant)</li> </ul>

### 3. Research Findings on the Demand for Retrofits

In speaking with organizations across municipal governments, construction, building owners and operators, financial institutions, and manufacturers, the following drivers of green retrofits were identified.

**Table 6: Summary of Drivers of Retrofits**

Driver	Description
<b>Electrification</b>	For manufacturers, electrification of buildings to reduce carbon intensity is driving the uptake of heat pumps as well as other green building technologies. Retrofits have also been a key driver of heat pump installations as the technology has been updated to be more easily installed across different buildings and HVAC systems, as well as in colder climates.
<b>Low Carbon Grids</b>	The GHG intensity of electrical grids varies from province to province which impacts the business case and uptake of retrofit technologies. For example, BC and QC were flagged as two provincial innovators and leaders when it comes to adopting heat pump technology. Both provinces rely on low carbon hydroelectricity which translates into a better environmental case for electrifying heating and cooling systems compared to provinces that rely on a mix of more carbon-intensive energy sources.
<b>Regional Climate</b>	The colder climate regions across Canada tend to show slower rates of green retrofit technology adoption due to concerns over reliability and efficacy of relatively newer technologies, particularly heat pumps, at colder temperatures.
<b>Carbon Tax</b>	Interviewees pointed to the carbon tax as a driver that will have a larger impact as time goes on. While some of the interviewees do not believe that many building owners or managers are taking the carbon tax seriously, they do expect this attitude to shift as carbon tax increases to 2030. We also heard that some building portfolio owners are already using a \$300/tonne shadow carbon price for transition planning purposes.

## Barriers

The most common barriers flagged by interviewees pointed to a lack of labour and skills in the retrofit industry, the relatively high cost of deep carbon retrofits, gaps in policy (i.e., lack of a green retrofit building code in Canada) and regulation driving the demand and awareness among contractors, building managers, and building commissioners, and lastly the significant variances in policy and funding for retrofits across provinces. The most common barriers based on interviewee feedback are summarized below.

- 1) **Knowledge and skills gaps in the workforce:** Due to the lack of knowledge and experience with green retrofit technologies among contractors and building owners, specifically in heat pumps and air tightness, customers are often guided toward the status quo or conventional technologies. The lack of knowledge and skills can also add to increased cost of labour and contractors who are not yet trained or experienced in the installation of technologies such as heat pumps within different building systems, adding time and cost to installation projects.
- 2) **Gaps in green retrofit policy and regulation nationally and provincially:** Policy and regulation plays a key role in building awareness and driving behaviour change across the green building supply chain. While some provinces are rolling out energy efficiency and low carbon requirements for new construction, and others have been leaders in incentivizing the uptake of heat pump technology (e.g., BC and QC), a lack of specific policies and regulations for retrofits is slowing the uptake of technologies that are ready to be deployed at scale.
- 3) **Limited knowledge and understanding of the business case and language around green retrofits:** This is a barrier that exists among homeowners, building managers, building owners, and building appraisers. The terminology and concepts that shape the business case for retrofits are still not widely accepted and understood, therefore there is a lack of a common language around retrofits across the supply chain. At one end of the supply chain, the lack of demand from consumers is seen by contractors as a reason to stay with conventional technologies and retrofits tend to be more focused on aesthetics than on energy efficiency, creating a self reinforcing dynamic that requires a catalyst such as incentivizing consumers or contractors to change BAU patterns.
- 4) **Limited supply chain and increasing cost:** Heat pump technology is the most readily scalable and adaptable retrofit technology; however, heat pump equipment is mainly sourced from Europe, and it is believed there is not enough supply to meet demand for net zero 2050 targets. In addition to a limited supply chain, global supply chains are becoming more expensive due to more common delays and interruptions. Given this and the knowledge and skills gap, it is common for green retrofit projects to go 20% over budget. This cost can be passed onto the consumer and couple with the relatively long payback period for installing green retrofit technologies, can also act as a deterrent to uptake.
- 5) **Availability of capital:** Linked to the barrier of cost of green retrofit technologies, availability or access to capital is also a barrier to the uptake of green retrofit technologies. Higher capital costs can be due to outdated technologies and deferred maintenance, longer payback periods, lack of access to attractive financing structures (such as the SOFICA model (described in subsequent section))

## Solutions Areas and Opportunities for Growth

The most common solutions that were brought forth by interviewees fell into the areas of financing, policy, education and awareness, and technology. Notably, one of the most common solutions brought forth by interviewees pointed to the role of financial institutions in driving behaviour change and demand for green retrofit projects. This can be done through loans or financing that favour projects with environmental or social co-benefits, such as implementing green retrofit technologies or achieving a certain level of energy efficiency, to drive demand for green retrofit technologies.

**Table 7: Solution Areas**

FINANCING	POLICY	EDUCATION & AWARENESS	TECHNOLOGY
<p><b>Barrier:</b> Cost of green retrofit technologies, availability of capital, and limited knowledge and understanding of the business case and language around green retrofits.</p>	<p><b>Barrier:</b> Gaps in green retrofit policy and regulation nationally and provincially.</p>	<p><b>Barrier:</b> Knowledge and skills gaps in the workforce and limited knowledge and understanding of the business case and language around green retrofits.</p>	<p><b>Barrier:</b> Limited supply chain and increasing cost.</p>
<p>Leverage the role of financial institutions to drive incentives for retrofits: Establish retrofit criteria for applications to qualify for investment or receive better lending rates for sustainable projects.</p> <p><i>Ongoing case study: Vancity is funding a high-level study on the typical measures required to get a building to near net zero. The findings are expected to improve understanding and awareness of the availability and cost of technologies for building and homeowners.</i></p>	<p>Create more transparency around building performance to provide benchmarking and set market scope on building inventory.</p> <p>Labelling and disclosure: in the UK, energy performance certificates are required for the sale, rental, or construction of all homes and commercial buildings with a floor area greater than 50m<sup>2</sup>.</p>	<p>Education campaigns targeted at homeowners to build familiarity with terms, concepts and business case for retrofits.</p> <p>Education for builders and trades on the business case for renovations and retrofits. The greater proportion of labour to materials gives builders more control over profitability.</p> <p>Consider working with RAIC and regional institutes to develop a dedicated qualification or specialization in working with existing buildings for architects and engineers.</p>	<p>Intelligent building technologies are mature. Worth investing in smart grid systems and building code system to exchange systems to make better usage of energy.</p>
<p>Providing financing tools that make it zero cost over the long term once incentives are factored in, through turnkey solution providers (such as SO-FIAC)</p>	<p>Continue to focus on carbon pricing to make electricity more affordable relative to natural gas.</p>	<p>Step by step guide to make a MURB net zero. Currently each step is so intricate that a detailed decision-making process is required. This could be a trade ally program.</p>	<p>Focus on warehouse solar rooftop and solar wall (these tend to be used on industrial buildings) to preheat ventilation air.</p>

Payback on green retrofit upgrades can be stretched out and be worked into the operating funds of the project once complete.	Start with social housing and looking at cooling requirements as a policy driver.	Education and awareness campaigns tailored for building owners, appraisers, and marketing advisors that is focused on the financial data that makes the case for retrofits	
	Adjust green building codes and standards to be carbon-based instead of energy.		

#### 4. Quantifying the Demand for the Retrofit Workforce

This section outlines the methodology and assumptions of the Scenario Analysis Tool, as well as the data sources that informed the tool. The Tool, an Excel-based calculator developed by the research team, quantifies the potential demand for labour from large building retrofits in Canada. It disaggregates the job impacts of the retrofit measures by mapping them to key occupations and relevant skills required for delivering retrofit pathways by province. This includes considerations for both trades and designer/consultant occupations.

The regions in scope of the study include British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Atlantic Provinces, and the Territories. Some provinces were disaggregated to capture the nuances related to their unique context – for example, the higher level of building construction activity in Edmonton and Calgary, the carbon-intensive electricity grids in Alberta and Saskatchewan, and the hydro-based electricity in Manitoba.

The Tool includes the current state of the Canadian building stock by estimating the total floorspace available for retrofit by vintage and geographical region. As outlined in Section 2, we define the most representative building for each type and map the scope of retrofit measure for the corresponding building type. To calculate the labour demand from each of the measures, the study estimates labour intensities of implementing these measures. We define "labour intensity" as the labour input required to implement a given measure per square meter of a building. The graphic below summarizes the methodology and relevant data sources.



## Inventory of Building Stock

The study primarily focuses on deep carbon retrofit opportunities across large residential and commercial buildings in Canada across different regions. Large building retrofits represent significant opportunities to meet Canada's climate target. Estimates by CaGBC suggest that large building retrofits could potentially reduce building-sector emissions by 51 per cent (21.2 million tonnes of CO<sub>2</sub>e).<sup>3</sup>

The building typologies in scope for this study include multi-unit residential buildings (high, mid, low-rise), office, retail, logistics, and hospitality. These typologies were chosen as they represent a significant portion of Canada's existing large building stock and associated emissions and have the potential to be the targets of aggregation and systematic approaches. Table 8 below describes the definitional framework of the building inventory.

**Table 8: Definitional framework of building types**

Building Type Category	Data Source Building Type
<b>Multi-unit residential building</b>	<ul style="list-style-type: none"> <li>• Low-rise multi-unit residential (Part 3 buildings over 600 m<sup>2</sup>):</li> <li>• Mid rise residential (~4 storey or 6,000m<sup>2</sup>)</li> <li>• High rise residential (~13 storey or 13,000m<sup>2</sup>)</li> </ul>
<b>Office</b>	<ul style="list-style-type: none"> <li>• Office building (non-medical)</li> <li>• Medical office building</li> </ul>
<b>Retail</b>	<ul style="list-style-type: none"> <li>• Food or beverage store</li> <li>• Non-food retail store</li> </ul>
<b>Logistics</b>	<ul style="list-style-type: none"> <li>• Warehouse</li> </ul>
<b>Hospitality</b>	<ul style="list-style-type: none"> <li>• Hotel or motel</li> </ul>

Building stock inventory by archetype (as outlined in section 2) was estimated at the provincial level. The inventory data is available for different vintages (i.e., pre-1920, 1920-2000 and post 2000).

To capture the commercial building data, the study utilizes the Natural Resources Canada (NRCan) 2009 Survey of Commercial and Industrial Energy Use (SCIEU) Database as well as the Comprehensive Energy Use Database (CEUD) for Commercial and Institutional Sectors. To update inventory from the SCIEU 2009 database (Table F-4. Building characteristics and energy use by region and primary activity, 2009), data is layered from CEUD, with the following assumption - the ratio of floor space across building types in 2009 from SCIEU remains valid for the revised floor space data for 2009 to 2018 in CEUD. The same sources were utilized to estimate the percentage by vintage group of the commercial

<sup>3</sup> [https://portal.cagbc.org/CAGBC/Advocacy/CaGBC\\_Research/Roadmap\\_for\\_Retrofits\\_in\\_Canada\\_2017/CAGBC/Advocacy/A\\_Roadmap\\_for\\_Retrofits\\_in\\_Canada.aspx?hkey=d5a3465a-e0d3-42f7-abe3-ba2d8514doec](https://portal.cagbc.org/CAGBC/Advocacy/CaGBC_Research/Roadmap_for_Retrofits_in_Canada_2017/CAGBC/Advocacy/A_Roadmap_for_Retrofits_in_Canada.aspx?hkey=d5a3465a-e0d3-42f7-abe3-ba2d8514doec)

buildings by regions (i.e., SCIEU Table F-2. Building characteristics) and energy use by region and year of construction (2009), and CEUD data. The commercial building stock in the territories was estimated by assuming that it is equivalent to 2% of the total commercial building stock of British Columbia.

Dwelling units by type data from the 2016 Census was used for multi-residential buildings. Census definition of apartments in buildings of five or more storeys, includes apartments that are defined as mid or high rise MURBs, whereas apartments with five or less stories can be defined as low-rise MURBs. This data is expressed as units in apartments. Floorspace was estimated by applying average unit sizes in square meters by type of structure that are published by NRCAN. Census data was also utilized to estimate the vintage.

### Labour Intensity Ratio

Using a bottom-up approach, the labour inputs for each of the retrofit measures were estimated, by climate region, and inform the average by the major groups of measures. Costing data from United States Department of Energy's *The Advanced Energy Retrofit Guides* (AERG) for Office Building, Retail Buildings and K-12 School was utilized for this exercise.<sup>4</sup>

The AERGs contain comprehensive lists of equipment costs and installation costs<sup>5</sup> for different retrofit measures for the following systems: lighting, envelope, HVAC – air side and HVAC – water side. For this study, the costs associated with deep carbon retrofits in marine and cold climate zones was considered.<sup>6,7</sup>

To estimate the costs associated with renewable systems, the study used two sources - NREL's solar photovoltaic system and energy costing data<sup>8</sup> and NRCAN's ground source heat pump costing data. It was assumed that the cost is the same across all regions and climate zones.

To calculate the labour inputs for each measure, the installation cost was divided by the mean hourly wage for a representative worker to implement that measure. For example, the costs associated with the lighting retrofit measures are divided by the hourly wages of an electrician. For each retrofit measure in a given typology, the required labour input is expressed as hours per square metre retrofit as shown in Appendix D. It was assumed that there is a linear relationship between cost and labour requirement, thus doubling of retrofitting measures will equate to doubling of labour inputs required.<sup>9</sup>

<sup>4</sup>U.S. Department of Energy, Advanced Energy Retrofit Guide - Office Buildings (2011) [https://www.pnnl.gov/main/publications/external/technical\\_reports/PNNL-20761.pdf](https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20761.pdf)

U.S. Department of Energy, Advanced Energy Retrofit Guide - Retail Buildings (2011) [https://www.pnnl.gov/main/publications/external/technical\\_reports/PNNL-20814.pdf](https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20814.pdf)

U.S. Department of Energy, Advanced Energy Retrofit Guide for K-12 Schools <https://www.nrel.gov/docs/fy14osti/60913.pdf>

<sup>5</sup> It is important to note that costs are expressed as total costs and not as incremental costs

<sup>6</sup> Seattle = Marine; Chicago = Cold

<sup>7</sup> We assume the following mapping for the costs: Office – Large Office, Retail – Retail, Hospitality – Large Office, Logistics – Retail, Low Rise MURBS – K-12 School, High-rise MURBs – Large Office.

<sup>8</sup> Solar Installed System Cost Analysis <https://www.nrel.gov/solar/market-research-analysis/solar-installed-system-cost.html>

<sup>9</sup> While this is our baseline approach to the analysis, we also expect to highlight areas where new technologies and other innovations can result in less labour-intensive measures

## Retrofit Scenarios

The study developed two scenarios for retrofitting to assess the occupational demand under different conditions – moderate and accelerated scenarios. Both scenarios reflect unprecedented rates of building retrofit activity to address the urgency of climate change.

The **moderate scenario** considers existing and announced climate strategies, targets, and building code updates. It adopts an almost linear implementation schedule, with completion of retrofits to the target building stock going beyond 2050 (5% residual beyond the study time period). Key assumptions include only those buildings with envelopes at least 40 years old (i.e., built in or before 1980) will receive a retrofit, with 25% of the target building stock receiving a full suite of retrofit measures. The scenario also considers that investment in green building retrofits will see increased activities compared to the historical trajectory.

The **accelerated scenario** reflects an ambitious retrofitting pathway to meet Canada's 2030 and 2050 emission targets. It assumes that local and provincial governments will adopt more stringent targets and implement strategies to accelerate green retrofit activity. It also includes increased investment into green building retrofits. Key assumptions include all available vintages of building stock receiving a comprehensive suite of carbon reduction retrofit measures.

The scenarios are characterized by three main variables within the model: vintage of buildings receiving retrofits, the combination of retrofit measures applied, and implementation timelines. The table below describes the scenario parameters.

**Table 9: Scenario Characterizations**

	<b>Moderate scenario</b>	<b>Accelerated Scenario</b>
<b>Vintage of building</b>	Focus on buildings with envelopes at least 40 years old (i.e., built in or before 1980)	All vintage pre 2021 is retrofit
<b>Retrofit measures</b>	Electric -100% of the inventory Enclosure – 50% of the inventory Mechanical – 80% of the inventory Renewables – 25% of the inventory	Includes all measures for the total inventory
<b>Retrofit completion</b>	Completion of retrofits to the target building stock going beyond 2050 (5% residual beyond the study time period).	All existing building stock is retrofit

**Table 10: Implementation Timelines**

	Moderate scenario	Accelerated Scenario
<b>Commercial Buildings</b>	<b>2022-2030:</b> constant rate annually to target 30% of the building stock	<b>2022-2030:</b> exponential rate annually to target 60% of the building stock
	<b>2030-2040:</b> rapid adoption; exponential rate targeting 50% of the building stock	<b>2030-2040:</b> constant rate targeting 30% of the building stock
	<b>2040-2050:</b> decelerating rate targeting 15% of the building stock  <i>*5% residual beyond the study time period</i>	<b>2040-2050:</b> decelerating rate targeting 10% of the building stock
<b>Residential Buildings</b>	<b>2022-2030:</b> constant rate annually to target 20% of the building stock	<b>2022-2030:</b> exponential rate annually to target 40% of the building stock
	<b>2030-2040:</b> rapid adoption; exponential rate targeting 40% of the building stock	<b>2030-2040:</b> constant rate targeting 40% of the building stock
	<b>2040-2050:</b> decelerating rate targeting 35% of the building stock  <i>5% residual beyond the study time period</i>	<b>2040-2050:</b> decelerating rate targeting 20% of the building stock

The retrofit pathways are modelled in annual time steps and based on the implementation schedule follow an S-shaped step curve.

### Employment Impacts Model

The labour demand is calculated by multiplying the given measure's labour intensity and the square metre of floor space in which this measure was applied in a given year, for a given typology of building in a given province. The area of floorspace undergoing retrofit measures is determined by applying the retrofitting rate in the baseline and alternative scenario. The labor demand is expressed as the full-time equivalent (FTE) set at 2,080 hours per year.

### Occupational breakdown

The labour demand at this stage represents the total person-hours required to complete a given measure for a building class and region and does not identify the occupations involved. Thus, to further disaggregate the labor demand of individual retrofit measures, the relevant occupations involved for each measure and their corresponding NOCs (as outlined in the appendix) were identified, and categorized by trade and designer-consultant groups. It was assumed that the total hours spent on implementing a retrofit measure/project is split by 80:10 between the trades and designer-consulting occupations respectively.<sup>10</sup> Put simply, if a project requires 100 hours to be completed, 80 hours are spent by trades while the remaining 10 hours are spent by designers, architects, energy modellers, etc. We assigned the residual 10% of the time to unskilled or semi-skilled labor. Based on industry consultation, we have grouped the relevant occupations for each retrofit measure into high-medium-low categories and have applied a corresponding set of percentages.<sup>11</sup>



**Figure 1: Overview of Occupational Breakdown**

By applying the approach described above, the study disaggregated that total labor hours to determine annual FTE counts by occupations (as represented by NOC codes) for each retrofit measure.

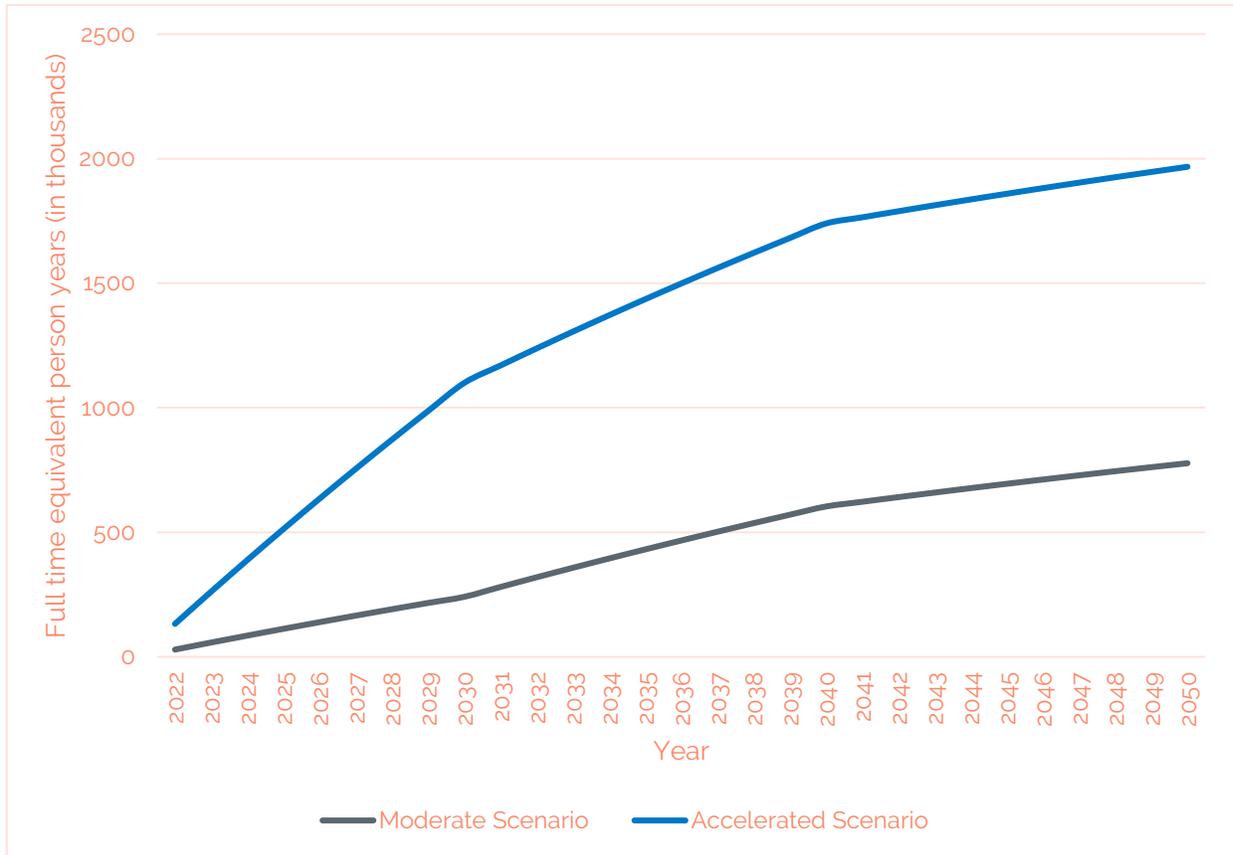
### Summary of Demand Scenarios

The results indicate that either scenario would lead to significant job demand. Under the moderate scenario, Canada could potentially expect **777 thousand direct job years** from **445 million square meters** of floor space undergoing retrofit projects. In contrast, under the accelerated scenario, **730 million square meters** of floor space is identified to undergo a retrofit, resulting in an estimated **2 million direct job years** (Figure 3). In other words, a sixty percent increase in retrofitted floor space yielding in more than double the associated job demand. In both scenarios a comprehensive transition of

<sup>10</sup> The occupational breakdown between the trades and consultants was designed to reflect the on-site labor intensity and activity by these different groups of occupations. Field expert suggestions were taken into account to determine the 80:10 split.

<sup>11</sup> We have assigned a 50-30-10 time split based on the high-medium-low categorization. The prioritization exercise data was collected through interviews and two workshops. Information collected was corroborated with secondary research..

existing buildings to net-zero carbon operations, supported by strengthened policies and substantial investments, will generate a sustained demand for highly skilled green jobs.



**Figure 2: Green retrofit occupational demand in Canada (2022-2050), under moderate and accelerated scenarios**

### Demand by Region & Building Type

#### Regions

Ontario and Quebec contain the largest inventory of building stock in scope for this study, and correspondingly the greatest number of job years created, as shown below.

**Table 11: Total inventory of retrofit and direct green retrofit and GDP by regions in the accelerated scenario**

<b>Region</b>	<b>Total inventory of retrofit floor space 2022-2050 (million m2)</b>	<b>Number of job years (thousands)</b>
<b>Alberta</b>	89.34	270
<b>Atlantic</b>	30.47	88
<b>British Columbia</b>	107.87	318
<b>Manitoba</b>	25.64	76
<b>Ontario</b>	258.57	644
<b>Quebec</b>	108.67	505
<b>Saskatchewan</b>	20.48	61
<b>Territories</b>	0.89	4
<b>Canada</b>	731.93	1967

### **Building Type**

Low-rise MURBs and offices represent the largest share of Part 3 building inventory available for retrofit across Canada. (Figure 4). Offices provide a compelling business case for retrofits, as upgrades to these buildings can result in greater electricity savings and higher Net Present Value (NPV), compared to other archetypes.<sup>12</sup> Given their higher baseline energy usage as well as energy intensive systems such as dual-duct or constant volume with reheat, office archetypes provide significant opportunities to gain energy savings and a logical place to start when prioritizing retrofit programs. Figure 5 represents the regional distribution of the building typologies.

<sup>12</sup> [https://portal.cagbc.org/cagbcdocs/advocacy/2021\\_CaGBC\\_Decarbonization-Retrofit-Costing-Study\\_2DEC21\\_EN.pdf](https://portal.cagbc.org/cagbcdocs/advocacy/2021_CaGBC_Decarbonization-Retrofit-Costing-Study_2DEC21_EN.pdf)

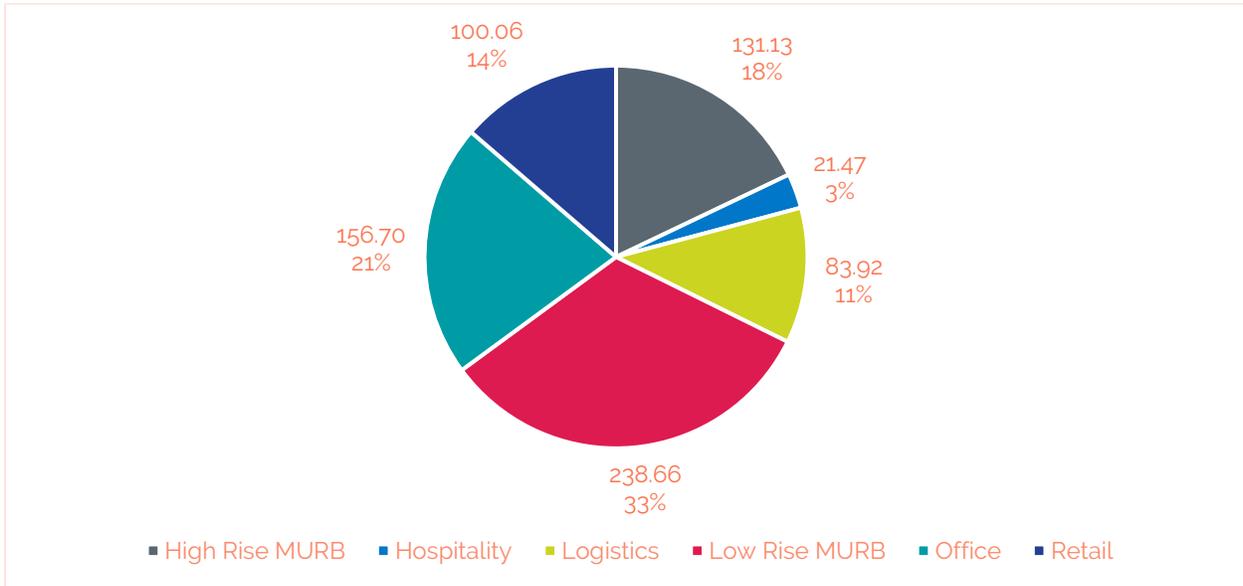


Figure 3: Total floorspace by building archetype (million m<sup>2</sup>)

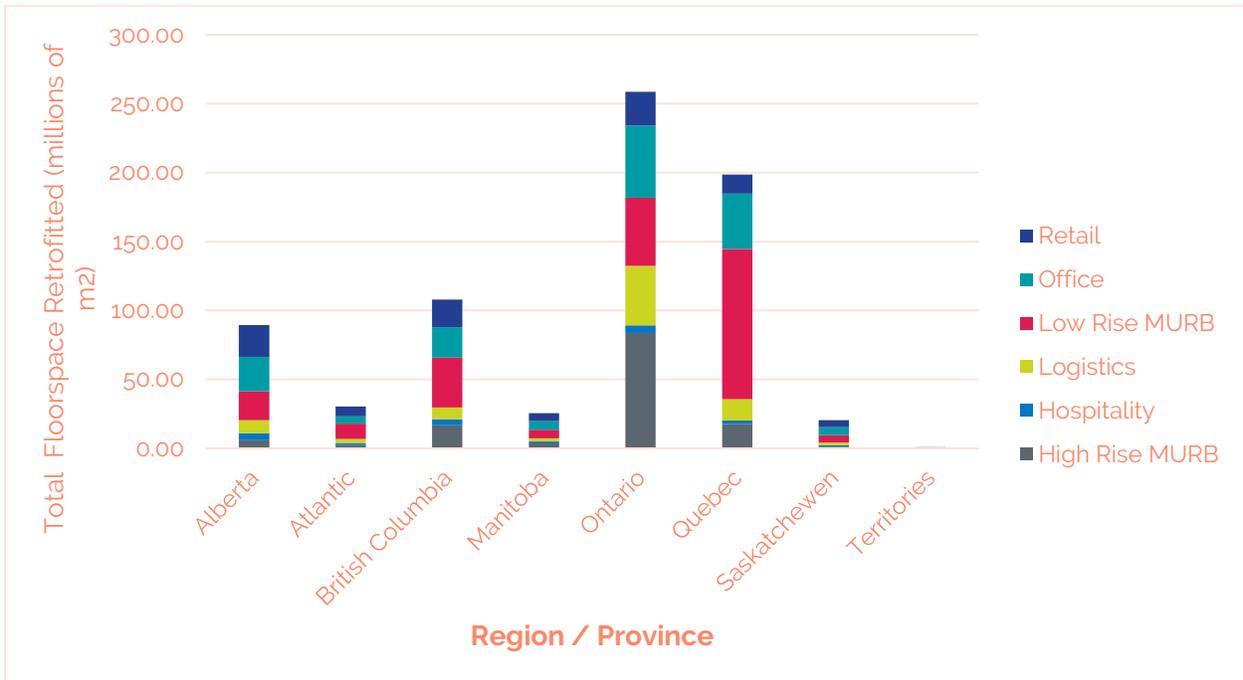


Figure 4: Total retrofit inventory by region and building archetype, accelerated scenario

The technical solutions available and professionals required for retrofit pathways are similar across the various building types, despite differences in building operation and performance systems. Significant variation in priorities and sequences in retrofit measures arise with differences in electricity grid intensity and energy use. Buildings with higher domestic hot water loads (e.g., multi-unit residential and hotels) or higher energy demand and plug loads (e.g., retail grocery and malls) will require different sequencing of retrofit measures than their less energy intensive counterparts. Similarly, for buildings in regions that have more carbon-intensive electricity grids, there may need to be a greater emphasis on achieving emissions reductions through electrical demand reductions as compared to regions with low-carbon grids, where greater emphasis will be needed on space heating electrification measures.

### **Vintage**

The vintage of a building is a marker of the amount of and the associated cost of heating. In other words, the older the building is the less energy efficient it is likely to be. Compared to new buildings, the existing building stock in Canada experiences a greater rate of thermal leakage.<sup>13</sup>

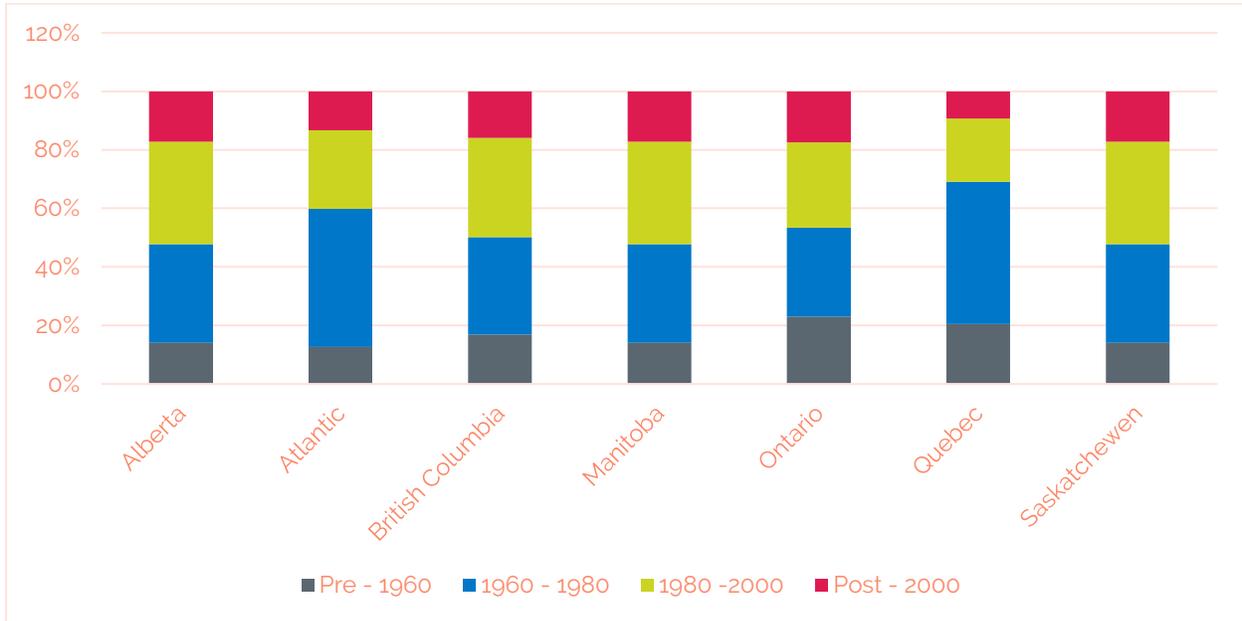
Given that the median age of commercial and residential building stock in Canada is approximately 40-50 years, there are significant opportunities to achieve GHG savings by focusing retrofits on the older building stock. Buildings built in 1970 and earlier are at a key stage in their renewal cycle for critical mechanical and enclosure systems, which enables a business case for whole building retrofit projects. For example, the replacement of HVAC distribution systems, windows, and opaque enclosures requires buildings to be at least 40 years old.<sup>14</sup> For the purpose of the scenario analysis, 1980 was chosen as a representative vintage to capture the building stock at its prime renewal stage.

Figure 6 illustrates the percentage distribution of vintages of commercial building across regions.<sup>15</sup> The vintages 1960-1980, and 1980-2000 represent the majority of the commercial building stock in Canada, cumulatively accounting for sixty percent of the total. This distribution of building stock is similar across most provinces, except Atlantic provinces and Quebec, where much of the existing building stock was built between 1960 and 1980.

<sup>13</sup> <https://www.corporateknights.com/built-environment/recovering-stronger-building-low-carbon-future-green-renovation-wave/>

<sup>14</sup> [https://portal.cagbc.org/cagbcdocs/advocacy/2021\\_CaGBC\\_Decarbonization-Retrofit-Costing-Study\\_2DEC21\\_EN.pdf](https://portal.cagbc.org/cagbcdocs/advocacy/2021_CaGBC_Decarbonization-Retrofit-Costing-Study_2DEC21_EN.pdf)

<sup>15</sup> The percentage distribution of multi-unit residential buildings vintage by total floorspace is not available

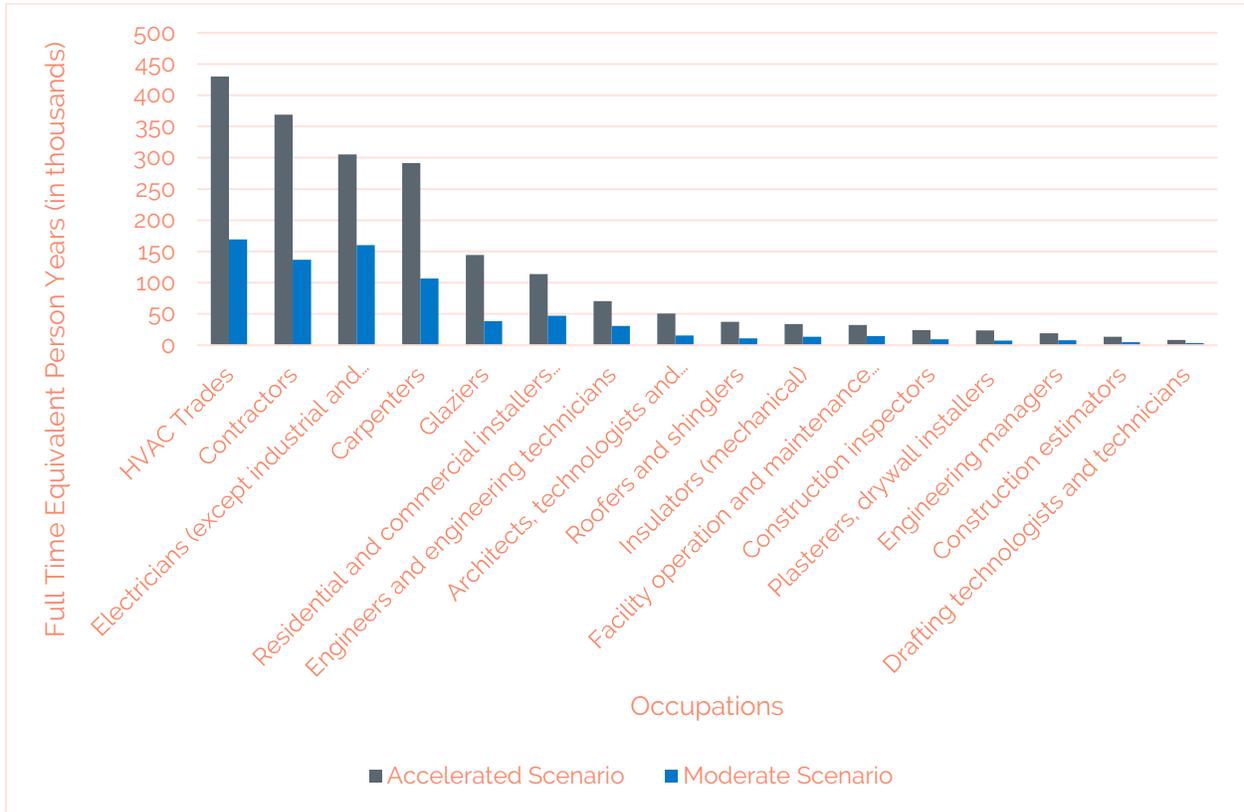


**Figure 5: Percentage distribution of commercial building floorspace vintage by region**

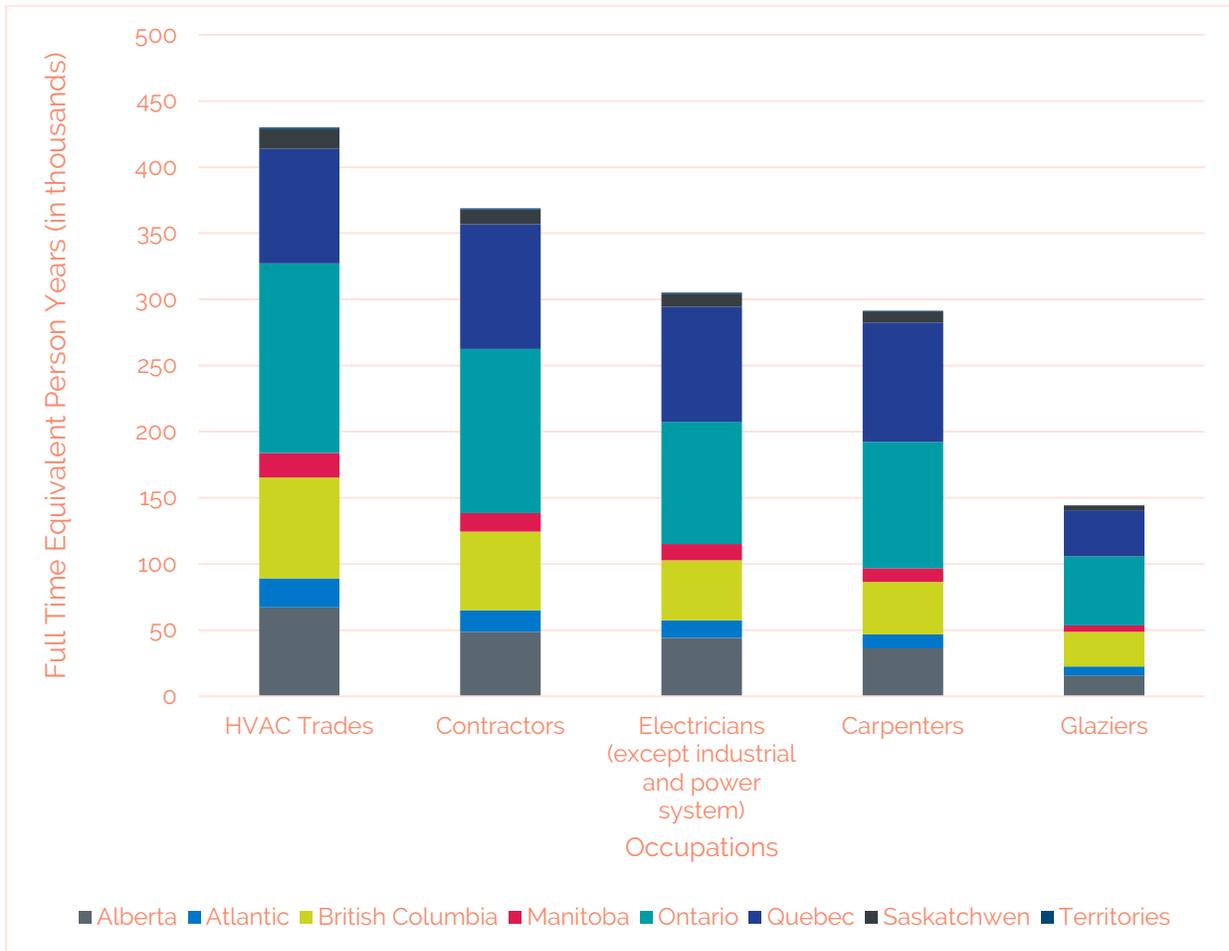
### Professions

The analysis results indicate that electricians, contractors, and HVAC trades (plumbers, gasfitters, steamfitters, pipefitters, and air-conditioning mechanics) will be the occupations in highest demand, across both the scenarios (Figure 7). Both electricians and contractors are relevant across the four main retrofit measures. HVAC trades also play a critical role in mechanical systems retrofits. Given the greater on-site involvement of trades during a retrofit project, the demand for trade occupations in terms of person years is higher than the consultant classes.

Among the regions, Ontario and Quebec have the potential to generate the greatest number of employment opportunities through green retrofit activities. It is estimated that these provinces have potential contribute to 644 thousand and 505 thousand jobs respectively under the accelerated scenario – this cumulatively represents more than half of the total green jobs expected to be created nationally. Figure 8 represents the regional breakdown of the top five occupation projected to be in demand.



**Figure 6: Total occupational demand by scenario (2022-2050)**



**Figure 7: High demand occupations by region (2022-2050), accelerated scenario**

**In summary, widespread expansion of green retrofit activity will be a significant driver to employment generation.** In the accelerated scenario, which represents ambitious climate forward policies and targets, the retrofit economy could generate almost two million jobs over the next three decades. Among the relevant occupations, electricians, contractors, and HVAC trades are expected to be in the highest demand as retrofit activities scale up.

## Appendix A: Provincial Retrofit Targets

### British Columbia

CleanBC is the main driver of retrofits in BC. The Better Buildings BC program is one that offers a range of incentives for building owners, operators and developers reduce greenhouse gas (GHG) emissions for both existing and new commercial buildings. Alongside this program, the [CleanBC Facilities Electrification Fund](#) is available to fuel switching projects that reduce emissions and helps to reduce the cost of connecting into BC Hydro's clean electricity grid. Additionally, the [CleanBC's Custom Incentives](#), offers support to explore fuel switching as well as other electrification measures in larger buildings. Meanwhile [Custom-Lite Incentives](#) are focused on facilitating smaller electrification upgrades for the commercial and institutional building sector. In addition to the incentives, [The CleanBC Commercial Express Program](#) was developed to streamline the application process and offers eligible customers a free energy coaching services to improve greater education and awareness around fuel-switching and other electrification measures.

BC Hydro is also a key player in driving uptake of green technologies to improve energy efficiency in existing Part 3 and Part 9 buildings. For example, for building owners or managers operating across retail, hospitality and office buildings that choose to upgrading lighting, HVAC, refrigeration and mechanical technologies qualify for funding of 25% of the up-front cost.<sup>16</sup>

### Alberta

For municipalities across Alberta, the provincially led [Clean Energy Improvement Program](#) is a voluntary initiative available to residential and commercial building owners for projects focused on energy efficiency or on-site renewable energy such as solar power, insulation upgrades, and high-efficiency heating. To qualify for the program, municipalities must pass a bylaw and work with Energy Efficiency Alberta to develop and deliver the program to residents.

In addition to the Clean Energy Improvement program, Emission Reduction Alberta is focusing their carbon reduction efforts on businesses through the [Energy Savings for Business program](#), giving businesses accelerated access to a minimum incentive amount of \$500, as well as \$250,000 per project, and up to \$1 million per parent company to cover costs of products and services for energy efficient retrofits.

### Prairies

The province of Saskatchewan is also leaning on incentive-based policies aimed at residential homeowners through [the Saskatchewan Home Renovation Tax Credit](#), introduced in December of 2020. Manitoba also participates in voluntary on bill financing programs via a [natural gas reduction program fund through Efficiency Manitoba](#) and the Low Carbon Economy Leadership Fund (totalling \$32.3 million<sup>17</sup>). The program offers rebates and incentives for energy efficient equipment and retrofit measures that reduce use of natural gas.<sup>18</sup> Additionally, [Efficiency Manitoba's Commercial, Industrial, and](#)

<sup>16</sup> See: <https://www.bchydro.com/powersmart/business/programs/business-incentives.html>

<sup>17</sup> See: <https://www.cbc.ca/news/canada/manitoba/manitoba-energy-efficiency-incentive-upgrade-retrofit-1.5893615>

<sup>18</sup> See: <https://news.gov.mb.ca/news/index.html?item=50457>

**Agricultural program** includes rebates and incentives for mechanical upgrades of space and process heating, building envelope renovations and equipment upgrades.

## **Ontario**

The province is among the leaders in driving green retrofit uptake and is the only province with mandatory energy ratings and disclosures for buildings, alongside voluntary PACE programs. Most buildings in Ontario over 100,000 square feet (50,000 square feet starting 2023) are required to report their annual energy and water consumption while utilities are required to make whole-building data available to owners for reporting.

## **Quebec**

The leading retrofit policy in Quebec is **SOFIAC**, officially launched in January 2021 by Fondation and Econoler, with support from Quebec Ministry of Energy and Natural Resources through a start-up grant of \$ 5.5 million. SOFIAC offers both financing and technical support to businesses in the commercial and industrial sectors to undertake energy efficient infrastructure upgrades. The province's 2021-2026 Green Economy Plan also contains measures focused on identifying the most promising forms of innovative financing and support for retrofits.<sup>19</sup>

## **Maritimes**

Nova Scotia and New Brunswick are the two maritime provinces most ready to finance and drive retrofits. **Efficiency Nova Scotia's Retrofit Program** aimed at helping businesses reduce their electricity consumption, while New Brunswick's **Commercial Buildings Retrofit Program** provides incentives for energy audits and eligible energy-saving upgrade projects. To drive uptake of the commercial building program in the short term, it is offering participants the opportunity to get 100% back on the costs of an energy audit as well as increased incentives on select upgrades such as LED lighting and heat pumps.

## **Northern Territories**

Similar to the Prairies, the Northwest Territories rely on retrofit incentives and rebates through the Canada Greener Homes Grant, which is distributed through the Arctic Energy Alliance. Since its kick off in the spring of 2021, the demand overwhelmed the AEA's capacity to process applications and conduct energy audits as part of the grant requirements.<sup>20</sup> It has created a wait list for the new year to continue to provide energy audits and grants to allow homeowners to undertake retrofits. The situation has underscored the need for more energy auditors or evaluators in the North to meet the growing demand for retrofits.

<sup>19</sup> See: <https://database.energycanada.org/policies/>

<sup>20</sup> See: <https://www.nnsi.com/news/federal-home-retrofit-program-swamped-by-nwt-demand/>

## Appendix B: Definitional Framework for Assessing Retrofit Demand

### Types of Buildings

1. Multi unit residential (based on residential building inventory from 2016 census)
  - a. High rise (five or more storeys)
  - b. Mid rise (fewer than five storeys)
  - c. Low rise
    - i. Semi-detached house
    - ii. Row house
    - iii. Apartment or flat in a duplex
2. Commercial (from commercial building inventory)
  - a. Commercial (retail)
  - b. Trade and services
  - c. Warehouses
  - d. Service stations
  - e. Office buildings
  - f. Recreation
  - g. Hotels and restaurants (hospitality)
  - h. Other (mixed use)

### Types of buildings based on NRCan Building Stock Data

- Office building (non-medical)
- Medical office building
- Elementary or secondary school
- Nursing or residential care facility
- Warehouse
- Hotel or motel
- Hospital
- Food or beverage store
- Non-food retail store
- Other\*

### Key Technical Solutions

- a. Reduce demand for energy
- b. Reduce fossil fuel use for space heating, mainly through electrification
- c. Add onsite renewable energy generation

Detailed building systems and associated retrofit measures:

- **Electrical – Lighting:** LED retrofit, including full lighting system redesign
- **Electrical – Plug loads:** Optimized building operations and building automation systems, reduced energy waste
- **Windows and doors:** Upgrade to triple glazing windows
- **Walls:** Upgrade of performance with exterior insulation, including improved air barrier system
- **Roofs:** Upgrade of performance with installation of exterior insulation to meet Reff-20 to Reff-40 performance
- **Space heating and cooling:** Replacement of existing system with low ambient air-to-air or air-to-water heat pump system (may need to include updates to terminal heating units or enclosure upgrades to reduce heating demand)
- **Ventilation:** Installation of energy recovery ventilators
- **Hot water heating:** Replacement of gas system with a dedicated air to water heat pump, supported by a condensing gas boiler for temperature top-up or a wastewater heat recovery heat pump and storage tank.
- **Renewables:** Maximized on-site renewable energy generation through solar PV system installation, dictated by three factors, available roof area, utility regulations, and not greater than 100% of the annual electrical load.

## Equipment Required for Retrofit Measures

Categories from unit product and labour costs table:

### **Envelope:**

- Air tightness
- Framing
- Drywall
- Sheathing
- Insulation
- Ceiling insulation
- Insulating concrete forms (ICF) walls
- Structural insulated panels
- Windows
- Foundation walls
- Basement floor
- Additive components for thicker wall systems

### **Mechanical and electrical:**

- Ducting and piping
- Heat recovery ventilators (HRV) and ERVs
- Electric domestic hot water (DHW) heaters – on demand, HE tanks, hot water heat pumps
- Air conditioning
- Cold climate air source heat pump
- Electric combined space and water heating systems
- Other electric space heating systems
- Lighting
- Switching and controls
- Drain water heat recovery
- Other

### **Renewable energy and community systems:**

- Photovoltaic (PV) systems
- Solar domestic hot water
- Connection to low carbon NEU
- Other

## Professions Required for Retrofits

### Primary Professions

- **Owner**
  - Asset Managers
  - Property Managers, Facility managers
  - Project managers / owners rep
  
- **Consultants**
  - Architects
  - Lighting Designers
  - Mechanical Engineers
  - Structural Engineers
  - Electrical Engineers
  - Quantity surveyors, cost consultants
  - Envelope consultants, Façade Engineers
  - Energy Modellers & simulation
  - Energy Auditors
  - Commissioning Agents
  
- **Builders and Trades**
  - Construction GCs, CMs, PMs
  - Cost Estimators & Specifiers
  - General Carpenters
  - Insulators
  - Steel stud and drywall installers
  - Envelope trades
  - Specialty glass façade and curtain wall providers (high-rise)
  - Architectural glass and metal installers (low rise)
  - Electricians
  - Solar Installers
  - HVAC and mechanical trades
  - Roofers
  - Plumbers
  - Building Automation Technicians
  - Heat and Frost Insulators
  
- **Regulators**
  - Building officials
  - Municipal sustainability staff / planners

### Secondary Professions

- Interior Designers
- Construction Millwrights
- General Construction Labour
- Spec writers / specification consultants
- Drywall Finishers
- Hoisting Engineers
- Sheet Metal Workers
- Heritage Planners/Architects
- Hazardous Materials Workers
- geothermal drillers
- BIM technologists
- Concrete finishers
- Painters
- Flooring Finishers
- Tile setters
- Brick/Stone Masons
- Heavy Equipment Operators
- Drivers