Examining the Interplay between Building Codes and Canadian FPT Policies, Programs, and Targets Related to Reducing GHG Emissions

Report to the National Research Council

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Key Messages

- There are many emissions-mitigation-focused policies in Canada — across federal, provincial, and territorial jurisdictions — with those affecting the building sector accounting for about a third of total policies.
- Most policies affecting the building sector are "carrots", designed to incentivize voluntary action rather than require emissions mitigation, and so may have limited effect on total emissions.
- The number of policies is relatively similar across Canada, though the federal government and BC have the greatest number of policies.
- The number of policies is not indicative of the strength or stringency of a policy regime; a high number of policies can mean duplication of incentives with little incremental effect on emissions.
- The scope of policies ranges from narrow (project or technology-specific) to broad (economy-wide or multiple sectors).
- A large majority of building-sector policies target the existing building stock; expansion of the building codes to comprehensively address retrofits can support voluntary actions.
- Approximately one-third of policies indirectly affect the building sector through energy source decarbonization.
- Effectively designing and implementing building performance standards will require additional data and evaluation approaches.
- Building codes complement existing policy and fill policy gaps in several important ways:
    - Avoiding technology or capital lock-in for high-emitting technologies, preventing future emissions and costly retrofits
    - Provide policy and performance predictability and consistency for producers and consumers
    - Address misaligned incentives between cost-minimising builders and building users that could face higher energy bills
    - Performance standards that prevent inefficient electrification (e.g., baseboard heating chosen over heat pumps)
    - Supports increased electrification, further reducing operational emissions

Executive Summary

This report discusses how federal, provincial, territorial (FPT) climate change mitigation policies interact with building codes in Canada. Our purpose is to inform potential changes to Canada's buildings codes, specifically upcoming changes to the National Model Codes. The National Model Codes are set to update energy efficiency requirements and include operational emissions intensity requirements in 2025, expanding to include operational and embodied emissions in 2030. We ground this with context on existing residential and commercial building energy use and emissions, and explore the drivers of Canadian buildings' emissions over time. We also discuss jurisdictional authority and how these authorities interact with the building sector.

Climate policy affects building emissions in multiple ways. Specifically, emissions pricing can affect operational energy use through energy conservation, fuel switching and incentivizing upstream changes to lower the emissions intensity of fuels, and embodied building emissions through incentivizing lower emissions-intensity of inputs to the building sector (e.g., lower-emissions steel). Voluntary policies like offset markets can change the composition of upstream energy (e.g., incenting renewable natural gas supplies), and subsidy programs can create additional incentive for fuel-switching and energy efficiency improvements. Building codes also affect operational building emissions as the codes determine the conditions for operational energy use.

We provide a summary of federal, provincial, territorial (FPT) climate mitigation legislation, regulation, policies, programs, and targets — collectively, policies — that are relevant for Canadian building codes. The initial inventory of Canadian mitigation policies resulted in 437 distinct policies; screening reduced the number of relevant polices to 151.[†] The majority of policies we include for further analysis are in force (142), with three proposed and six announced.

We include policies based on whether they are expected to affect or interact with GHG emissions from buildings. Specifically, we include policies that affect the operational or embodied emissions from buildings and policies that affect energy use in or emissions from buildings (both supply and demand sides). The criteria we applied for policy inclusion was fourfold: whether policies implement energy-source decarbonization, end-use fuel-switching, end-use energy efficiency improvements, or reduce embodied emissions. This list includes pricing, including pricing systems for large industrial emitters. We excluded policies that target other sectors (i.e., agriculture, industry, waste, transportation except those for EV charger installation in buildings), policies no longer in force, and policies focused on other goals such as adaptation. We also exclude utility-initiated and utility-implemented programs due to scope, but include FPT programs funded by government and implemented by utilities.

We find most jurisdictions have similar total numbers of policies, though Canada, BC, Manitoba and Northwest Territories are outliers. Canada and BC have the most density of policies, and the largest number of policies targeting the building sector, followed by policies specific to electricity generation and policies covering multiple sectors. Importantly, a high number of policies does not

[†] This inventory is current to the end of February 2023, and does not include announcements from federal, provincial, and territorial budgets for 2023/24.

necessarily translate into high policy stringency or cause material emissions reductions. Material emissions reductions depend on stringency (a high effective price) and broad coverage (a large share of emissions subject to the policy). We find the majority of policies are voluntary abatement-support programs, which provide a subsidy for actions that reduce emission for those that opt in to participating. The scope of policy tools ranges from very narrow and project-focused (e.g., the New Brunswick Total Home Energy Savings Program) to multi-sectoral (e.g., Quebec's cap and trade program) to economy-wide (e.g., BC's carbon tax). Most policies target the existing building stock, mitigating emissions from past choices rather than preventing emissions in new buildings. Sixty-five percent of policies explicitly target the building stock, with the remainder indirectly affecting building emissions. Mandatory policies account for 22 percent of those affecting the building sector, but will likely account for the majority of emissions reductions due to their broader scope (e.g., economy-wide emissions pricing) and the fact that mandatory policies require compliance.

Despite their relative narrow focus, non-mandatory policies can partially fill gaps by encouraging broader uptake, though their effectiveness will depend on the broader policy environment. As a compliance-based instrument, building codes have an important and arguably more influential role in addressing policy gaps.

Specifically, building codes can address barriers, market failures and other challenges that current policy initiatives are unable to fully overcome. First, **building codes prevent technology and capital lock-in**. The building stock is slow to change, and few policies target new buildings — a policy gap. This means building codes have an important role in setting standards that minimize operational emissions in line with Canada's net-zero targets. Second, **building codes can correct misaligned incentives**, where the builder makes choices that affect operational energy use and emissions, but it is the owner or occupants that face the bill and society overall that faces the damages from emissions. By requiring specific actions by builders, the building code prevents future (costly) retrofits and aligns the choices of builders with the users of their product. Third, **building codes performance standards are mandatory**. In contrast, policy coverage and density vary widely across Canada, and the majority of building-sector policy is voluntary. This highlights a potential role for GHG standards in building codes to fill policy gaps and incent or require emissions reductions from unregulated activities. Fourth, **a tiered approach to emissions intensity standards can provide a signal and a pathway to full decarbonization**. Building sector emissions are a function of PT energy sources, and the tiered approach provides options that are fit-for-purpose of the needs and challenges of each PT. Fifth, **building emissions performance standards have the potential to take advantage of electricity decarbonization policy through encouraging electrification**. By shifting residential and commercial energy use from fossil fuels to low-emitting electricity, buildings' Scope 1 and Scope 2 emissions will decrease. Future work will be very important for understanding the intricacies and scope of these interactions.

Building codes also have an important role in addressing barriers faced by different stakeholders that interact with the building sector. The misaligned incentives we discuss above means there are barriers to owners, investors and developers to invest in design solutions that minimize emissions. Builders wish to minimise their initial building costs, and may avoid specific technologies due to perceived risks. Owners and occupants may lack willingness-to-pay for low-carbon buildings, due to information barriers or funding constraints. Mandatory requirements can address this problem. Different orders of government also face barriers to harmonized implementation of climate policies and standards for buildings, due to competing political drivers such as addressing affordability for low- and middle-income constituents, funding healthcare and education, and other pressures of the day. National model building codes can provide a foundation for consistency, provided that PTs and local authorities adopt those national standards in a timely fashion. The fourth set of barriers are those faced by institutions implementing legislation. These agencies, boards and commissions operate in a way that reflects the scope of their legislative mandate, which may limit their ability to respond to emerging issues such as decarbonization of buildings. Also relevant is the slow process to amend legislation (including due to competing policy priorities). These institutions take building codes as given, and can help enhance the effect of the building code. The final set of barriers are those faced by energy utilities. In addition to public interest decisions around energy infrastructure and prices, these utilities are responsible for demand-side measures that promote energy conservation and efficiency. Building codes support the roles of utilities by improving building performance, lowering demand for energy.

In many instances, the National Model Codes are a key option for mitigation of the market failures and barriers we describe above. Current National Model Codes focus on new building construction, though Codes Canada is also developing a building code for alterations to existing buildings (the Alterations Code). The expansion of National Model Codes to apply to existing buildings will expand emissions mitigation benefits. Building codes and the National Model Codes specifically are an important policy tool for advancing buildings-sector emissions reductions via complementing and reinforcing existing policy actions.

Introduction

This report provides a summary of federal, provincial, territorial (FPT) climate mitigation legislation, regulation, policies, programs, and targets — collectively, policies — that are relevant for Canadian building codes. We provide a comprehensive enumeration of the relevant policies;[1] classify these policies by instrument type, abatement channel, scope, and jurisdiction, among other characteristics; and describe their interactions. Our purpose is to identify which policies affect operational and embodied emissions in buildings, how these policies may affect these sources of emissions, and inform potential building code regulations related to emissions.

Climate policy affects building emissions in multiple ways. Specifically, emissions pricing can affect operational energy use through energy conservation, fuel switching and incentivizing upstream changes to lower the emissions intensity of fuels, and embodied building emissions through incentivizing lower emissions-intensity of inputs to the building sector (e.g., lower-emissions steel). Voluntary policies like offset markets can change the composition of upstream energy (e.g., incenting renewable natural gas supplies), and subsidy programs can create additional incentive for fuel-switching and energy efficiency improvements. Building codes also affect operational building emissions as the codes determine the conditions for operational energy use.

The federal government jointly develops building codes in Canada with provinces and territories. Called the National Model Codes, these include guidance for building, fire, plumbing and energy regulation (National Research Council Canada 2023). The Canadian Board for Harmonized Construction Codes (CBHCC) has responsibility for code development and is the core decision-making body. The Canadian Table for Harmonized Construction Codes Policy (CTHCCP) sets strategic policy direction and oversees the CBHCC (Canadian Board for Harmonized Construction Codes 2022; National Research Council Canada 2022b; 2022c). In September 2022, the Provincial/Territorial Policy Advisory Committee on Codes (PTPACC; predecessor to CTHCCP) provided a policy recommendation to the Canadian Commission on Building and Fire Codes (CCBFC; predecessor to the CBHCC):

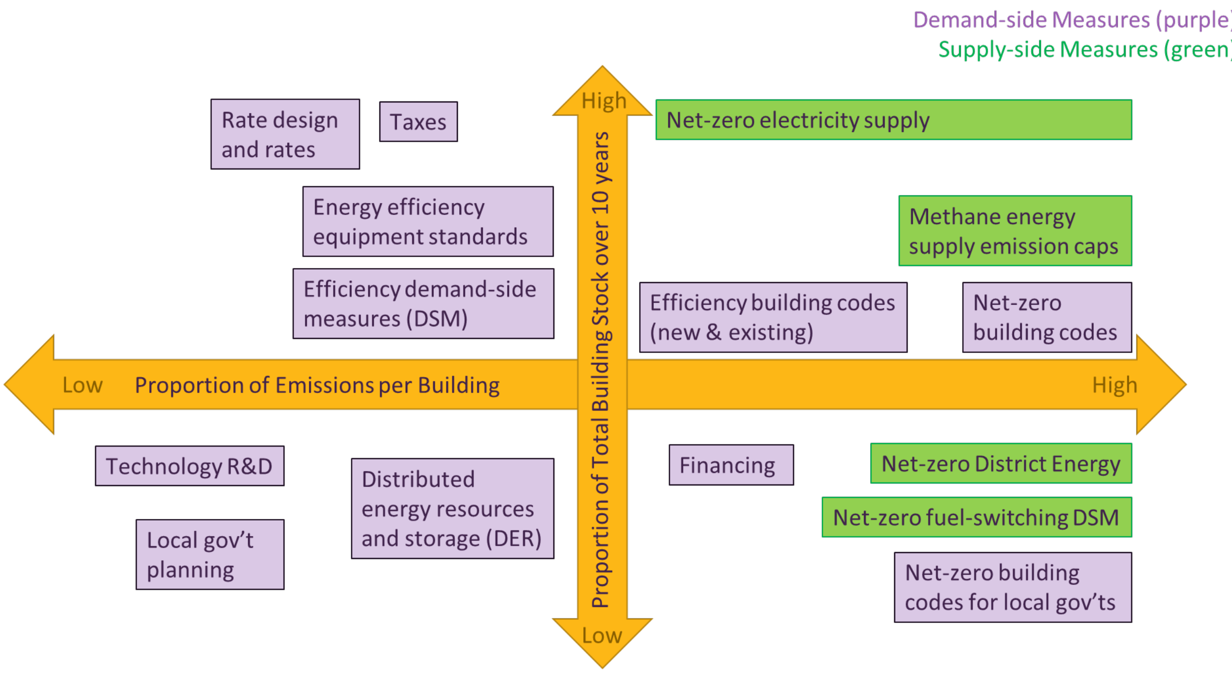
> *While not unanimous, the PTPACC has noted a strong level of consensus that the National Model Codes should include an objective for GHG emissions to enable provincial and territorial regulation, and this objective should be incorporated into the 2025 codes. This objective includes regulation of both operational and embodied carbon with operational being addressed in the 2025 codes and embodied carbon in the 2030 codes.*

The CBHCC adopted all direction from the previous CCBFC and PTPACC on the climate change mitigation code policy priority. Accordingly, this report is intended to inform the CBHCC code-development process, by identifying where extant FPT emissions-mitigating policies affect the building sector, potential overlaps, and where there are gaps or unaddressed market failures that

[1] This inventory is current to the end of February 2023, and does not include announcements from federal, provincial, and territorial budgets for 2023/24.

revisions to the building codes can address. Figure 1 categorizes broad measures for reducing emissions in buildings, qualitatively identifying how these measures affect each building's emissions (intensive margin of emissions) and the proportion of the building stock (extensive margin of emissions). In this report we provide more detailed analysis of the types of policies present in Canada, and how they interact with the building sector.

Figure 1: Methods to Decarbonize Buildings



Source: Adapted from Figure 14 in Athienitis et al. (2022). Reproduced with permission.

The top right quadrant in Figure 1 contains the measures with the highest potential overall emissions reductions, and the bottom left is measures with the smallest emissions reductions. Starting with the top left and moving clockwise, we detail these interventions and how they affect building emissions.

- Rate Design and Rates: This is the domain of the public utility regulator in setting rates (prices) for electricity, natural gas, propane, district energy and hydrogen utilities that sell such fuels to consumers in buildings. Rate design determines components of energy expenditure such as energy and demand charges and connection charges for new service in buildings. Both can influence energy/fuel choice and overall consumption, and apply to all buildings. Energy consumption is the principal source of GHG emissions in buildings.
- Taxes: This is the domain of the FPT ministries of finance or revenue, with sales taxes applied to energy purchases and carbon taxes applied to the majority of combustion from building energy. Taxes affect the relative cost of different energy sources, which affects choice and consumption. These apply to all buildings. There are also tax credits such as the BC Clean Buildings Tax Credit that applies to major retrofits (British Columbia n.d.a);

these programs act as a consumption subsidy for non-emitting energy, though they have much more limited reach as they rely on voluntary uptake.

- Energy Efficiency Equipment Standards: These include PT and NRCan *Energy Efficiency Act* standards that apply to new equipment that is installed in new construction or replacement of existing assets. This includes imported products and transfer of products between PT jurisdictions, triggering Natural Resources Canada legislation. It applies to a proportion of buildings each year when equipment is installed or replaced, but over time will touch most buildings, as the equipment lifetime is shorter than building lifetimes. These affect building emissions is due to lower energy consumption, but do not prescribe fuel choice.

- Demand-Side Efficiency Measures (DSM): These are programs that promote energy efficiency, including education, incentives, financing, and support to governments and standards development organizations to revise and implement codes and standards. These are often led by public utilities, as authorized through PT legislation, but can also include government programs such as the Canada Greener Homes Grant. These apply only to those buildings that participate in the DSM. However, over time, a large proportion of the building stock is expected to participate due to widespread accessibility to subsidies such as appliance rebates.

- Net-zero Electricity Supply: The electrical grids of BC, Yukon, Manitoba, Québec and Newfoundland and Labrador have been predominantly hydroelectric for several decades with very low Scope 2 emissions and zero Scope 1 emissions.[2] Some jurisdictions have policy or legislation mandating low emissions from electricity systems, such as the BC announcement to create a 100% non-emitting electricity standard (British Columbia 2021). While this policy measure itself does not deliver significant incremental GHG emissions reductions for buildings, it ensures that other policy measures that promote switching from fossil fuels to electricity deliver reductions. Other PT electrical grids use unabated fossil fuels for a substantial share of supply; electricity use in buildings then has moderate to high Scope 2 emissions, despite Scope 1 emissions being zero. These grids are transitioning toward low- and zero-carbon electricity supplies, recently bolstered by the 2023 federal budget (Department of Finance Canada 2023). FPTs may require legislation to mandate decarbonization of the electrical grid, reinforced by public utility regulators. The impact for decarbonizing buildings is most pronounced when the starting fuel source for the electric grid is coal or oil, and is transitioned to renewable or nuclear energy. It can also include natural gas with carbon capture and storage, RNG, or hydrogen sourced power plants. These apply to all buildings. The extent of emission reductions depends on the proportion of energy use from electricity (e.g. a 100% electric building could be fully decarbonized with such a measure).

[2] Scope 1 emissions are direct emissions at a facility (e.g. onsite combustion or process emissions) and Scope 2 emissions are indirect emissions from purchase of electricity, steam, heating or cooling (US EPA 2020).

- Decarbonized Methane Energy Supply Emission Caps: This supply-side measure gradually reduces the net emissions intensity of fuels transported in natural gas pipelines and compressed and liquified gases. This may include blending of fossil fuels such as natural gas with renewable natural gas and hydrogen. While in-building methane combustion produces Scope 1 emissions, and there may be fugitive Scope 2 emissions, the net emissions are reduced through use of renewable natural gas. This reduces Scope 3 emissions in sources such as landfills, sewage treatment, and forestry sites, among others. Use of carbon capture and storage also reduces Scope 3 emissions. Hydrogen combustion produces zero Scope 1 emissions. These apply to all buildings that have a natural gas, propane or district energy connection and have a significant emission reduction potential. As the carbon content of abated methane increases the magnitude of emission reductions per building and across the building stock increases. A 100% abated gas blend, coupled with 100% net-zero electricity supply could address 100% of emissions in the building stock.

- Efficiency Building Codes: These include energy efficiency standards at the time of construction or alterations to existing buildings. They apply to a small proportion of the building stock each year, but can yield significant emission reductions per building, including zero- or net-zero-emissions. BC is moving towards regulating building emissions via performance standards, intending to phase-in performance-based standards for new buildings over three tiers (in 2022, 2027 and 2032), leading to net-zero energy ready buildings (focused on efficiency) and allowing for a variety of options including electrification, low carbon fuels like renewable natural gas, and low carbon district energy (British Columbia 2021). Few jurisdictions have building code standards for existing buildings, but those will be introduced in Canada in 2025 (Canadian Commission on Building and Fire Codes 2020). Over a 10-year timeframe, efficiency building codes could influence more than half of the building stock, including new and existing buildings. Lower energy consumption reduces building emissions; this lever does not prescribe fuel choice.

- Net-Zero Building Codes: Not yet implemented at the FPT level, this would add a greenhouse gas intensity standard to building standards in addition to energy efficiency, thereby influencing fuel choice to allow a variety of decarbonization options including electrification, low carbon fuels like renewable natural gas, and low carbon district energy (British Columbia 2021). This can substantially reduce building emissions over a 10-year timeframe.

- Financing: These programs are a direct subsidy to lower the cost of investments in reducing energy use or emissions. They include government backed programs such as property-assessed clean energy financing made available to building owners to install energy efficiency and decarbonization technologies. They are accessed voluntarily, applying to a small proportion of the building stock annually, but can deliver deep emission reductions of a similar or greater magnitude than the building code.

- Net-Zero District Energy: This local energy supply model provides thermal energy to buildings, mainly for new construction, and offers an opportunity for deep decarbonization potential compared to natural gas. Scope 1 emissions are zero, and scope 2 can be minimized with renewable energy resources. Existing buildings can be retrofitted to accept district energy, provided the temperature is sufficient for the mechanical system.

- Net-Zero Fuel Switching DSM: This is an emerging measure that enables utilities to incentivize fuel switching in existing buildings or new construction to use zero-carbon fuels. For example, BC's *Greenhouse Gas Emission Reduction Regulation* enables public utilities to offer such incentive programs and cover the costs across the entire rate base (British Columbia n.d.c). The CleanBC program also provides direct subsidies to builders for efficient, zero-emission houses (British Columbia n.d.b).
- Net-Zero Building Codes for Local Governments: These codes regulate carbon in a building regulation or bylaw led by local governments. These are ideally informed by voluntary PT building codes, but allow local governments to adopt one of the leadership tiers in advance of prospective or planned PT-wide adoption. Emission reductions can be significant per building, but apply only to new construction in the communities of the participating local governments. As an example, the 2023 amendments to the BC Building Code include a new GHG reduction objective and voluntary targets for estimated annual emissions per square metre of floor area that can be mandated by local governments (Energy Step Code Council 2023).
- Technology R&D: Research and development provides the basis for transformative or disruptive technologies such as gas heat pumps that can accept hydrogen fuel. It is funded by the federal government, universities, provincial agencies and public utilities. Research and development has limited direct effects, but over longer time frames with technology adoption can affect all aspects of building emissions.
- Local Government Planning: This defines the long-term urban design, building types and orientation, density, and community infrastructure such as district energy. In several cities development requests for more density than allowed under the zoning bylaw trigger local government policies that can include decarbonization objectives. The City of Vancouver Green Buildings Policy for Rezoning is an example, pre-dating building code requirements that have since been adopted for all new construction (City of Vancouver 2022b).
- Distributed Energy Resources and Storage**:** These are building-specific or neighborhood systems for electricity that mimic district thermal energy, including distributed resources such as solar photovoltaics or cogeneration, battery storage or resilient electrical microgrids that can operate autonomously, for example during a grid outage. They can also be used to control smart appliances such as space and water heaters that can be turned off for short periods. These are often considered to be demand-side measures by utilities, but could also be owned or implemented by public utilities (as is the case in other countries).

The main pillar of Canadian climate policy is emissions pricing (Environment and Climate Change Canada 2016; 2020). However, in addition to pricing, FPT and municipal jurisdictions are implementing a mix of policy tools and instruments to achieve emission mitigation goals. While pricing and incentive-based policies are generally considered most efficient and effective (Ragan et al. 2015; Keohane and Olmstead 2016), there are several reasons why pricing can be insufficient and other approaches are warranted. Most obvious is when emissions pricing is insufficiently stringent to meet stated political or policy goals. However, this approach means emissions reductions will be higher-cost, as non-pricing policies overlap with existing pricing policies. Ragan et al. (2017) identify three rationales for non-pricing policies: gap-filling (policies that apply to GHG emissions not covered by a carbon price); signal-boosting (addressing market failures or problems that undermine the effectiveness of carbon pricing); and benefit-expanding (achieving GHG mitigation and other objectives). The Ragan et al. approach is most relevant here, as there are gaps, externalities and market failures in choices around the built environment — buildings and the energy infrastructure servicing those buildings — where additional policy is complementary and the building codes can address some of these challenges.

Examining the current policy environment for regulating building-sector GHG emissions requires an initial policy inventory, and then identifying the relevance of the policies in the inventory for both operational and embodied building emissions. We develop the initial inventory from multiple sources, including federal biennial reports to the United Nations Framework Convention on Climate Change and a policy inventory created by the Canadian Climate Institute. We verified this list with provincial, territorial, and federal climate plans and program websites. With this process we attempted to identify the universe of Canadian FPT greenhouse gas mitigation policies.

We screened policies for inclusion based on whether they were expected to affect or interact with operational GHG emissions from buildings or embodied emissions in building construction. We used a fourfold criterion for policy inclusion: energy-source decarbonization, end-use fuel-switching, end-use energy efficiency improvements, or reducing embodied emissions. We included economy-wide policies (e.g., BC's carbon tax) and excluded policies that target other sectors (i.e., agriculture, industry, waste), policies no longer in force, and policies focused on other goals such as adaptation. We exclude industrial policy outside of emissions pricing or large-emitter pricing programs. We exclude utility-initiated programs due to scope, but include FPT programs required by FPT policy and implemented by utilities and those funded by government and implemented by utilities. For example, we include Ontario's demand-side management program for natural gas which requires the utility (Enbridge Gas) to implement energy conservation and efficiency programs (Independent Electricity System Operator 2020), but exclude Enbridge's voluntary renewable natural gas program which allows customers to elect to pay an additional $2 per month to support blending of renewable natural gas (Enbridge Gas n.d.). Our rationale for this exclusion is twofold: our focus is on FPT (government) policy, and we face scope issues in accurately identifying all utility-led interventions. We also exclude municipal policies, again due to scope, but supplement our discussion with case studies highlighting municipal action.

We find 151 policies relevant for the building sector,[3] out of 437 total FPT policy tools for emissions mitigation. Of the 151, 142 are implemented and in force with the remainder announced or under development, and 71 directly target the buildings sector. BC and the federal government have the greatest number of policies. Importantly, a high number of policies does not necessarily translate into high policy stringency (a high effective emissions price) or cause material emissions

[3] As of the end of February 2023.

reductions. We find the majority of policies are voluntary abatement-support programs, which provide a subsidy for actions that reduce emission for those that opt in to participating. The scope of policy tools range from very narrow and project-focused (e.g., the New Brunswick Total Home Energy Savings Program) to multi-sectoral (e.g. Quebec's cap and trade program) to economy-wide (e.g. BC's carbon tax). The majority of policies target the existing building stock, mitigating emissions from past choices rather than preventing emissions in new buildings.

Detailing the interactions of extant policy with FPT building codes is beyond our scope, as it requires precise understanding of policy implementation and building code design. However, we can reach some broad conclusions on how building codes can address barriers, market failures and other challenges that current policy initiatives are unable to fully overcome. First, building codes prevent technology and capital lock-in. The building stock is slow to change, and few policies target new buildings — a policy gap. This means building codes have an important role in setting standards that minimize operational emissions in line with Canada's net zero targets. Second, building codes can correct misaligned incentives, where the builder makes choices that affect operational energy use and emissions, but it is the owner or occupants that face the bill and society overall that faces the damages from emissions. By requiring specific actions by builders, the building code prevents future (costly) retrofits and aligns the choices of builders with the users of their product. Third, and relatedly, policy coverage and density vary widely across Canada, and the majority of building-sector policy is voluntary. This highlights a potential role for GHG standards in building codes to fill policy gaps and incent or require emissions reductions from unregulated activities. Fourth, building sector emissions are a function of PT energy sources, and a tiered approach to emissions intensity standards can provide a signal and a pathway to full decarbonization that is fit-for-purpose of the needs and challenges of each PT. Fifth, building emissions performance standards have the potential to take advantage of electricity decarbonization policy through encouraging electrification. By shifting residential and commercial energy use from fossil fuels to low-emitting electricity, buildings' Scope 1 and Scope 2 emissions will decrease. Future work will be very important for understanding the intricacies and scope of these interactions.

The report proceeds as follows. We first discuss relevant context for understanding the policy landscape: current energy sources and use in the building sector, and how building codes interact with jurisdictional responsibilities of each level of government. We provide an overview of our search methodology, then detail the results from our search, characterising policy counts by categories of interest (e.g., abatement channel, scope). We supplement this analysis with a few jurisdictional case studies highlighting specific actions related to reducing building emissions. In the penultimate section, using the inventory of policy types we discuss how building codes can supplement and reinforce policy-driven decarbonization efforts. We then discuss gaps in current policy and research and data. We summarise and conclude in the last section.

Context: Buildings' Energy Use and Emissions

This section reviews relevant history and context for understanding how emissions-mitigation policies interact with the building sector. We first discuss the built environment — energy sources and use — by province and territory, as this provides important context for understanding the landscape of climate policy and how the building codes may need to adapt to address energy use and emissions in buildings. We then discuss the historical drivers of building-sector emissions, in terms of emissions intensity of energy use, the intensity of energy use, and population growth.

Energy End-Use and Emissions from Canada's Built Environment

Canada has committed to reduce its economy-wide greenhouse gas emissions by 40–45 percent below 2005 levels by 2030 and achieve net-zero emissions by 2050. In 2020, Canada's emissions were 672 megatonnes of carbon dioxide equivalent (Mt CO_2e) across seven economic sectors (agriculture, buildings, heavy industry, oil and gas, electricity, transport, and waste and others[4]). This represents a net decrease of 69 megatonnes or 9.3 percent from 2005 levels. The focus of this report, the buildings sector, was the third largest source of emissions after oil and gas and transportation and responsible for about 13 percent of national emissions in 2020 (Table 1). This share increases to almost 20 percent if electricity and fuel-use emissions are included[5] and would be even higher if embodied GHG emissions from the manufacturing of building materials are considered.[6] As the building sector only includes residential and service-industry in-building stationary combustion (see Appendix II), this share would increase still further if accounting for energy used in heating and lighting industrial buildings. In contrast to most other economic sectors, building emissions have increased since 2005 (Table 1, Figure 2). The change in building-sector emissions is mostly due to commercial buildings; these emissions have risen steadily since 2005 whereas residential building emissions have begun to decline (Canadian Climate Institute n.d.). We discuss these trends further below.

[4] Others includes coal production, light manufacturing, construction, and forest resources.

[5] Using 2019 data (as 2020 is likely an outlier due to pandemic restrictions changing both residential and commercial building energy use), building emissions (92.0 Mt) plus residential electricity emissions (20.2 Mt) and commercial electricity emissions (17.58 Mt) represents 18% of 2019 total emissions (Environment and Climate Change Canada 2022c; Natural Resources Canada 2022c; n.d.).

[6] Dobson and Fellows (2017) compare production-based emissions to consumption-based emissions for Canada, provinces and territories, and find the largest contributors to household emissions are purchases of manufactured goods, personal transportation, residential combustion, and utilities for provinces and territories with primarily fossil fuel-generated electricity.

Table 1: Canada's GHG Emissions by Economic Sector, select years (Mt CO_2 equivalent)

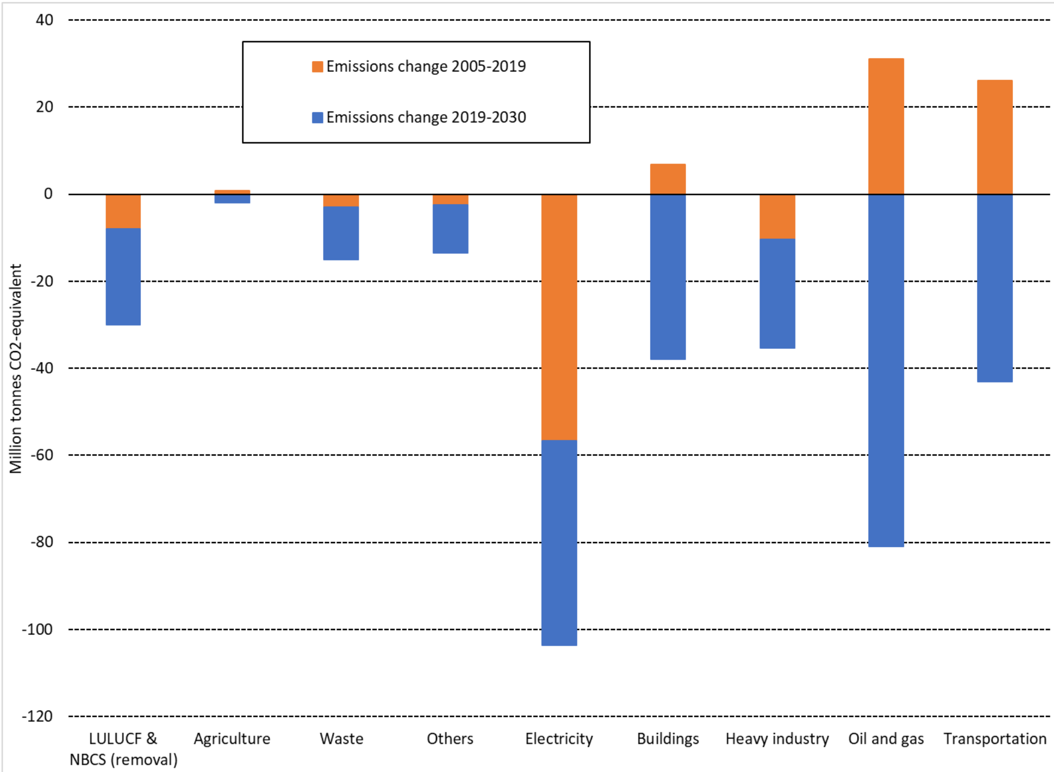
Sector	**2005**	**2016**	**2017**	**2018**	**2019**	**2020**
Oil and Gas	171	194	196	205	203	179
Electricity	118	74	73	63	62	56
Transportation	160	173	179	184	185	159
Heavy Industry	87	76	76	77	77	72
Buildings	84	82	87	93	92	88
Agriculture	66	65	64	66	67	69
Waste and Others	55	50	50	51	52	50
Total	741	715	725	740	738	672

Note: Totals may not add up due to rounding. 'Others' includes coal production, light manufacturing, construction, and forest resources. Building sector emissions only include direct sources: stationary combustion and process emissions (air conditioning) emissions from residential and service-sector buildings.
Source: Environment and Climate Change Canada (2022c).

The federal 2030 Emissions Reduction Plan projects a 41.7 percent reduction in building emissions by 2030 from 2019 levels, or 38 Mt (Environment and Climate Change Canada 2022b).[7] Figure 2 shows the changes in Canada's emissions by economic sector between 2005 and 2019 (historical data) and between 2019 and 2030 (projections to meet Canada's emissions reduction plan). Notably, while building sector emissions have increased, emissions reductions in electricity generation (Figure 3) has reduced buildings' Scope 2 emissions. Emissions reductions in electricity generation are a result of fuel-shifting in many provinces (Figure 4); Alberta and Saskatchewan in particular have moved from coal to natural gas, and New Brunswick has shifted from coal to nuclear. Fossil-based electricity remains a substantial portion of generation in Nova Scotia, Northwest Territories and Nunavut.

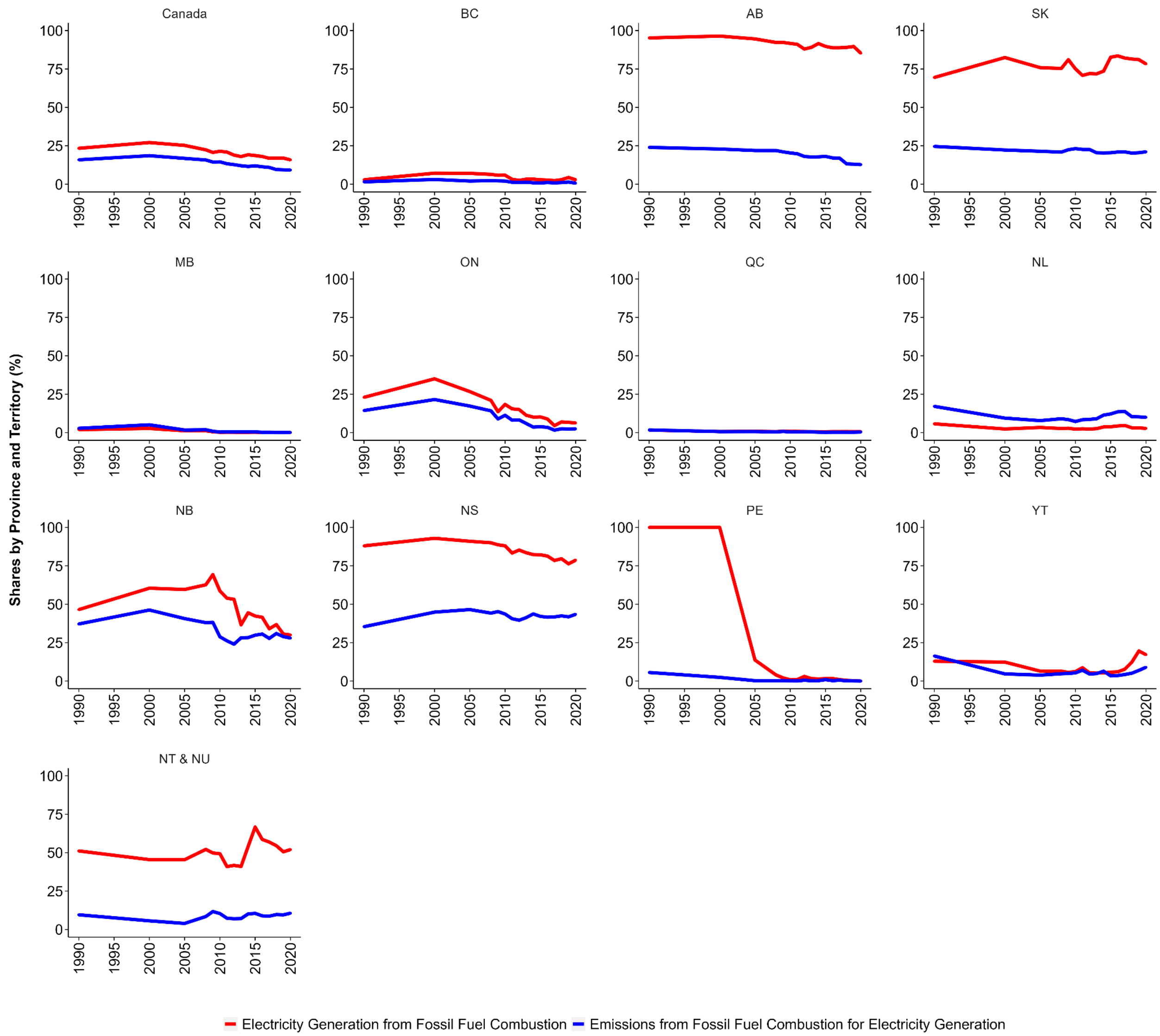
[7] We note that the National Inventory Report (NIR) methodology is constantly under revision. Importantly, the 2030 Emission Reduction Plan (ERP) is based on 2021 NIR data. The most recent data available from the 2022 NIR revised the 2019 buildings emissions estimate to 92 Mt from 91 Mt, and 2020 buildings emissions are 88 Mt instead of 85 Mt originally projected in the ERP. This means buildings-sector emissions reductions are "behind schedule" relative to the ERP by 4 Mt.

Figure 2. Emissions Changes by Economic Sector, 2005 to 2019 and 2019 to 2030



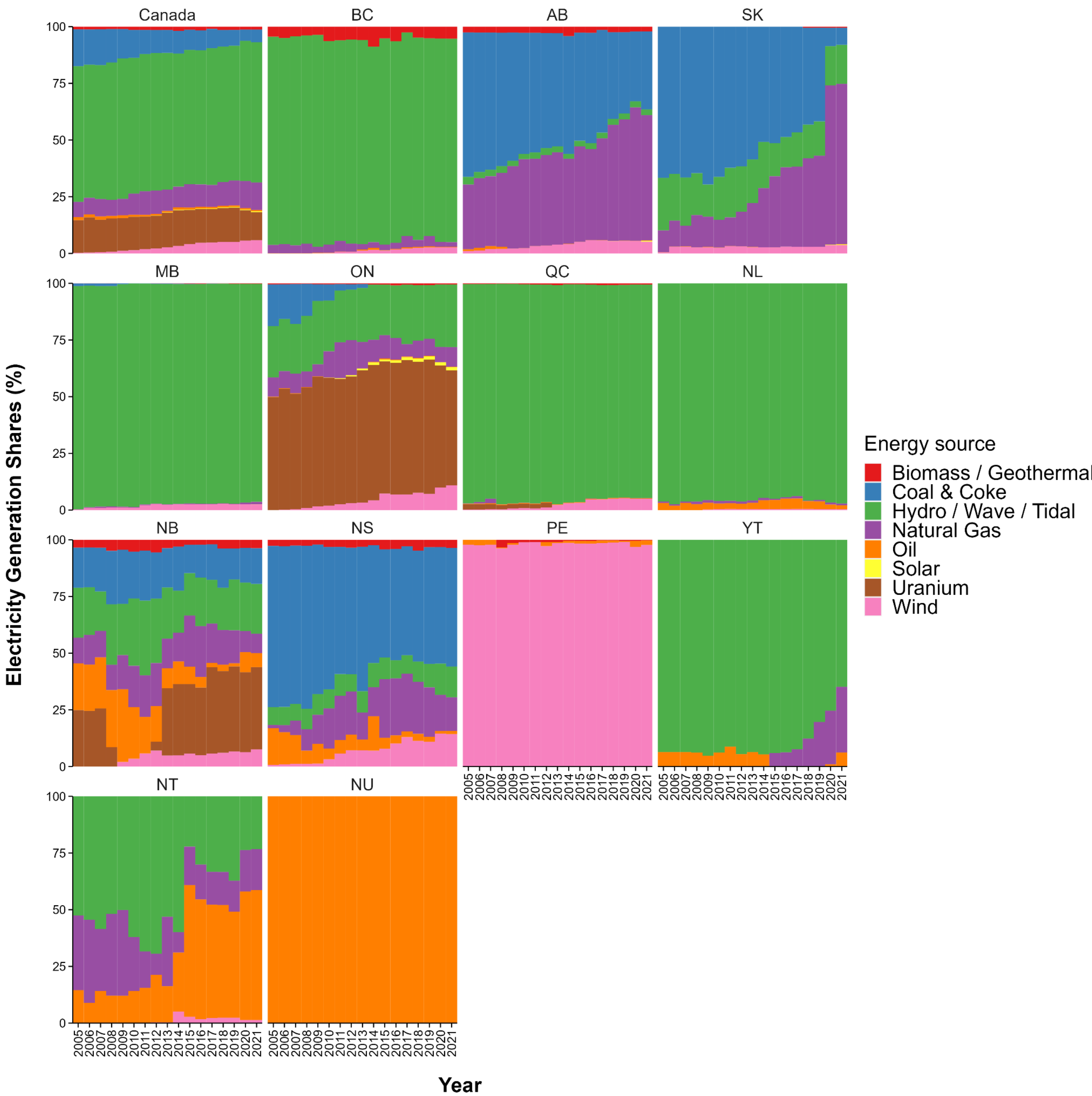
Source: Environment and Climate Change Canada (2021a; 2022b).

Figure 3. Electricity Sector Emissions by Province and Territory



Note: The red line displays electricity generation from fossil fuels as a share of total electricity generation within each jurisdiction. The blue line displays emissions from fossil fuel combustion for electricity generation as a share of total jurisdictional emissions.
Source: Environment and Climate Change Canada (2022c).

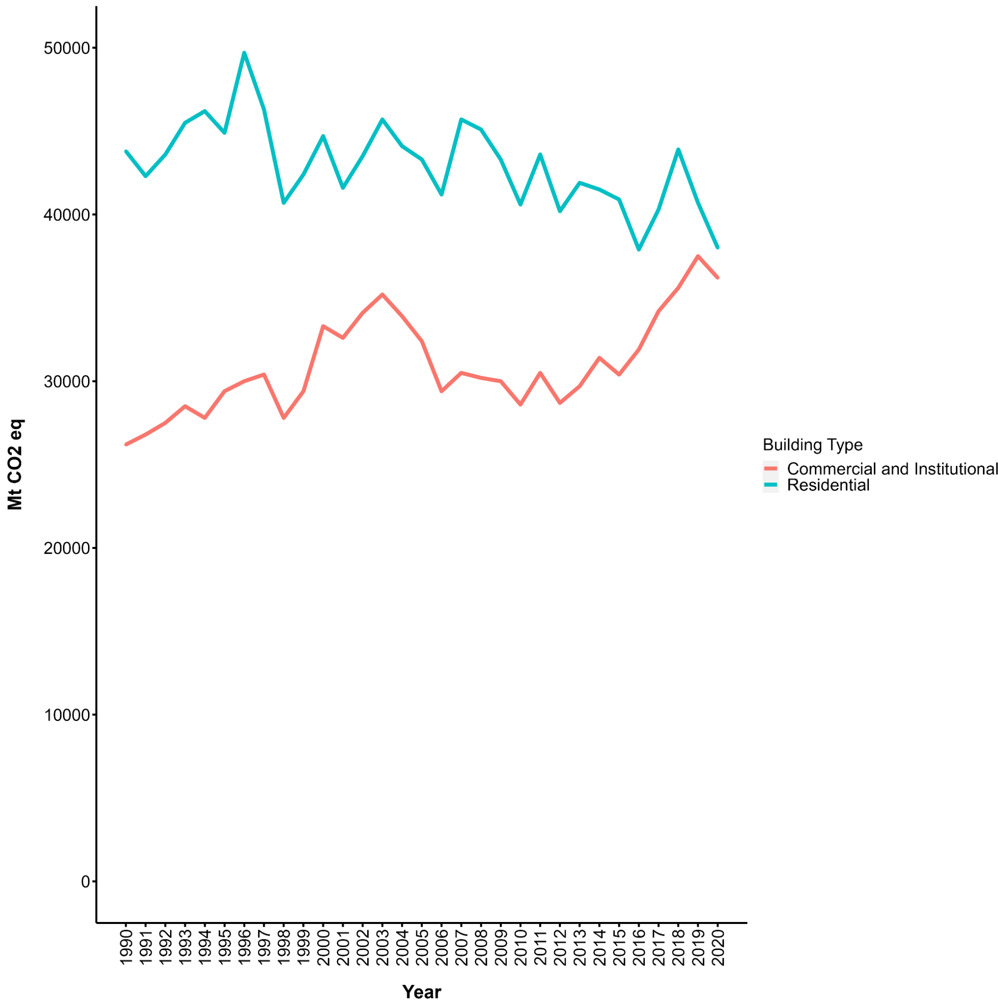
Figure 4. Electricity Generation Shares by Energy Source, 2005 to 2021



Source: Canada Energy Regulator (2023).

Canada's built environment includes about 16 million residential and 482,000 commercial and institutional buildings (Natural Resources Canada 2014; n.d.). As Figure 5 shows, commercial and institutional buildings emit about the same amount as residential buildings yet from fewer buildings.

Figure 5. Canada's Building Sector Emissions, 1990 to 2020.

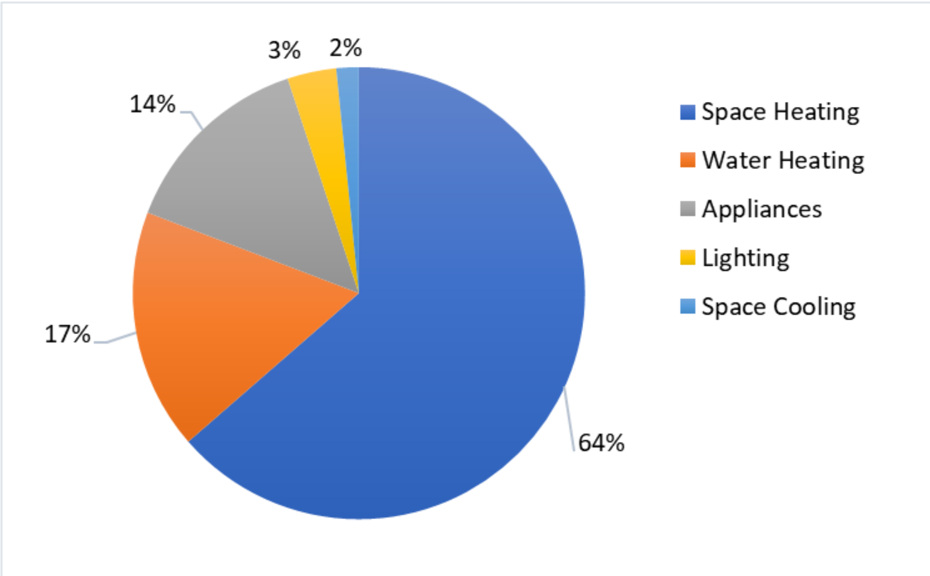


Source: Environment and Climate Change Canada (2022c).

In 2019, space and water heating accounted for the largest amount of energy consumed in Canada's residential buildings at about 81 percent of total energy consumed (Figure 6). This was followed by appliances (14 percent), lighting (four percent) and space cooling (two percent). While there is regional variation, overall shares are very similar across the provinces and territories.

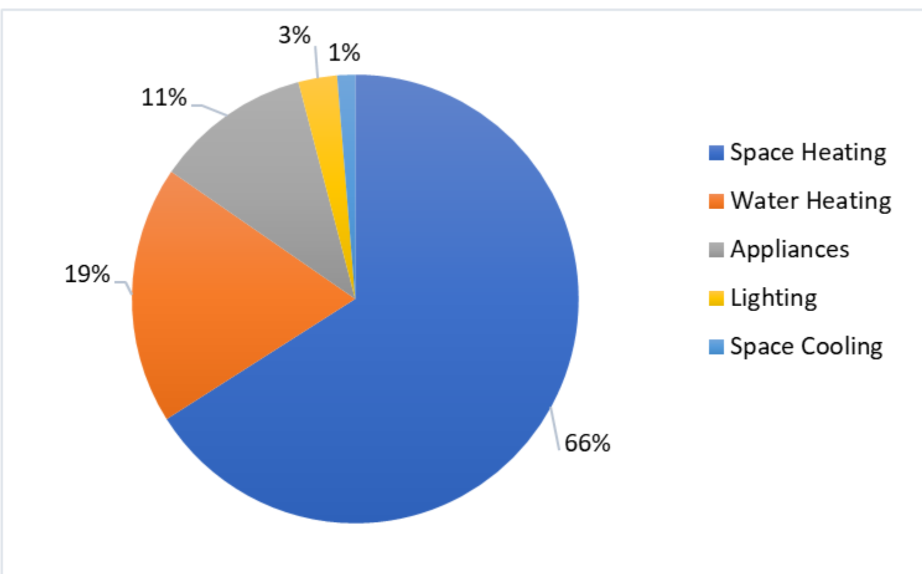
In Canada, more than 80 percent of GHG emissions in residential buildings come from space and water heating (Figure 7). Non-heating related processes such as appliances and lighting emit less than 15 percent of total residential emissions. However, there is substantial variation across provinces and territories (Figure 8). Hydro provinces — BC, Manitoba, Quebec and Newfoundland and Labrador — have much lower per-household emissions, with the majority of these emissions coming from space and water heating. In contrast, provinces and territories with fossil-heavy electricity grids have substantial proportions of household emissions from appliance use.

Figure 6. Canadian Residential Buildings' Shares of Energy End-Use, 2019



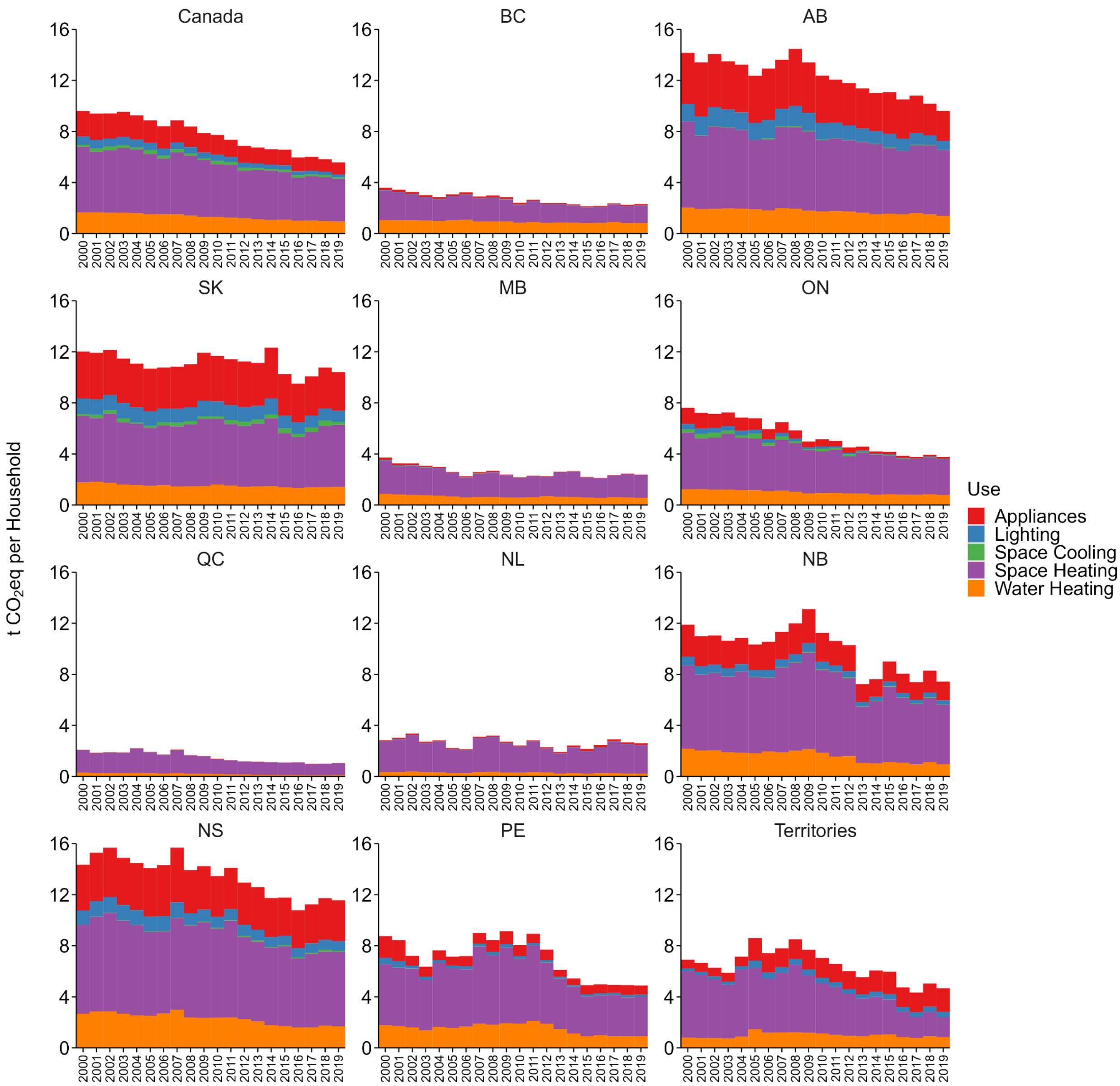
Source: Natural Resources Canada (n.d.).

Figure 7. Canadian Residential Buildings' GHG Emissions by End-Use, 2019



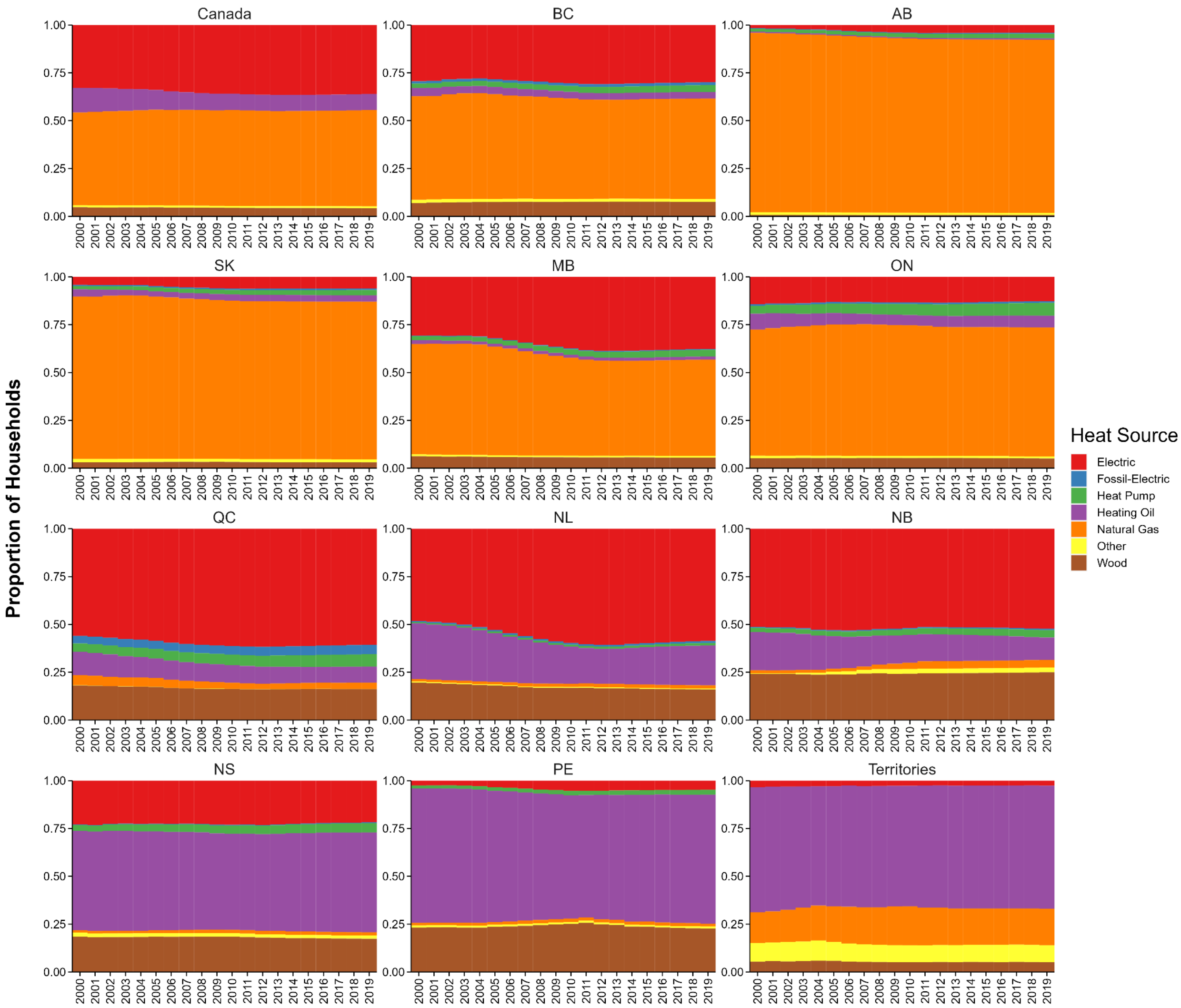
Source: Natural Resources Canada (n.d.).

Figure 8. Residential Buildings' GHG Emissions per Household, 2000 to 2019



Source: Natural Resources Canada (n.d.).

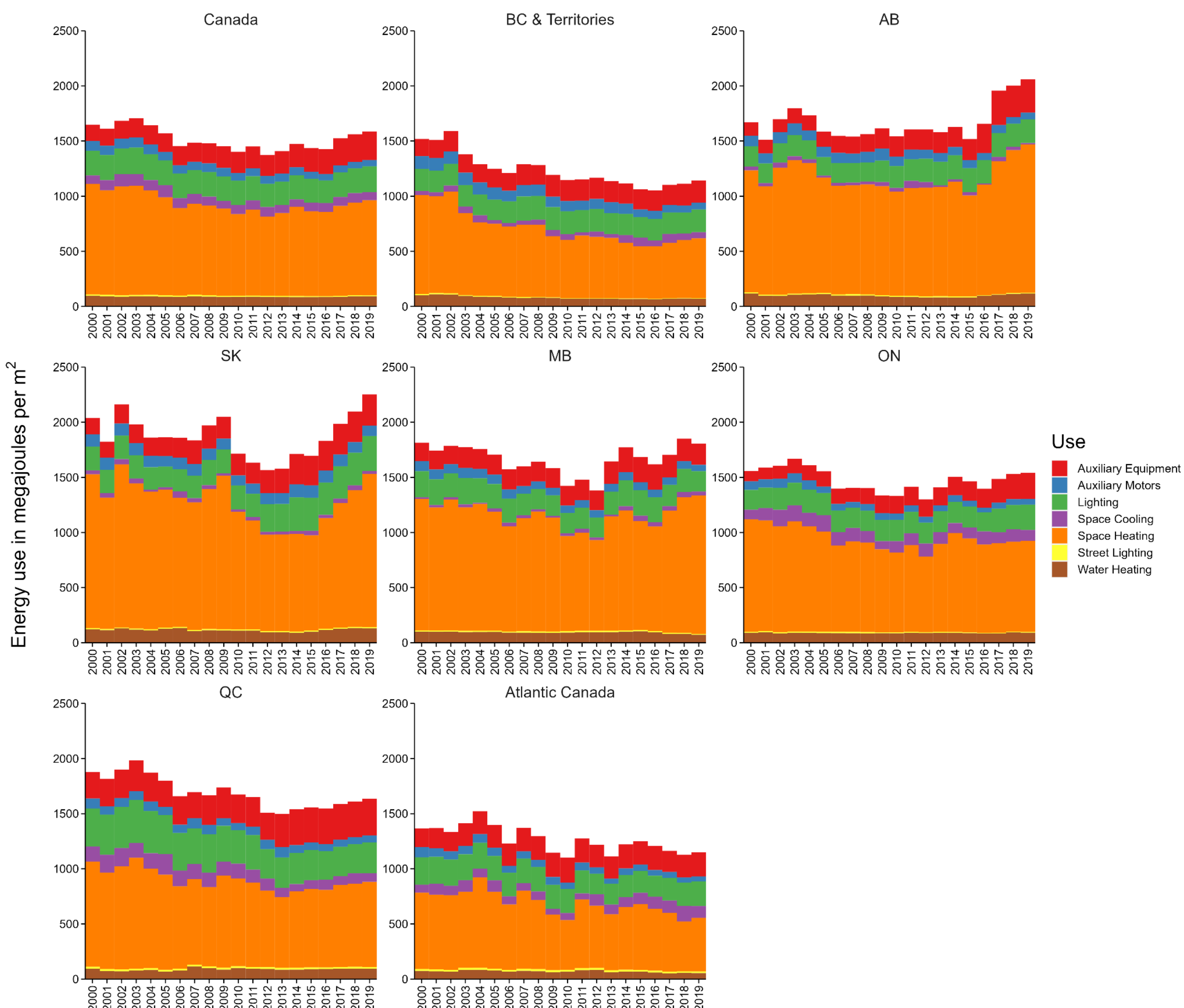
Figure 9. Residential Buildings' Home Heating Technology Shares, 2000 to 2019



Note: Fossil-Electric includes heating systems that are natural gas and electric, and heating and electric. Wood includes wood, wood and electric, and wood and heating oil heating systems. Other includes coal and propane.
Source: Natural Resources Canada (n.d.).

Also important in determining residential building emissions is home heating technologies (Figure 9). Provinces with higher per-household heating emissions rely on natural gas or heating oil for space heat. These could be reduced by using lower-carbon fuels such as renewable natural gas and biodiesel that offset continued Scope 1 emissions with reductions in Scope 3 emissions associated with biogenic resources. However, tracking and accounting of the associated Scope 3 emissions reductions and preventing double counting may require the development of a national registry. An indisputable method to reduce such emissions is to promote fuel switching to fuels with zero Scope 1 emissions such as electricity and hydrogen. This will require equipment retrofits; replacing furnaces and gas-fired boilers with air-to-air and air-to-water heat pumps which can be affordably installed at the end-of-life time of replacement. Despite heat pumps being two to three times more efficient than natural gas furnaces and boilers, a switch to electricity (or hydrogen) as the main space heating fuel could increase energy bills in some regions of Canada due to higher fuel costs. These can be partly or fully offset by also increasing the efficiency of the building enclosure/envelope, along with the heat distribution system, leading to potentially extensive building retrofits. Such super-efficient construction or deep energy retrofits of existing buildings, including insulation, windows and airtightness, can be cost-effective if the capital costs are less than the present value of electricity savings over the economic life of the building improvements. In summary, while the decarbonization of buildings can be simply achieved through equipment replacement and fuel switching, affordability may be enhanced through energy efficiency improvements to the building enclosure, albeit at a higher capital cost.

Figure 10. Commercial Building Energy Consumption by Use per m²*, *2000 to 2019

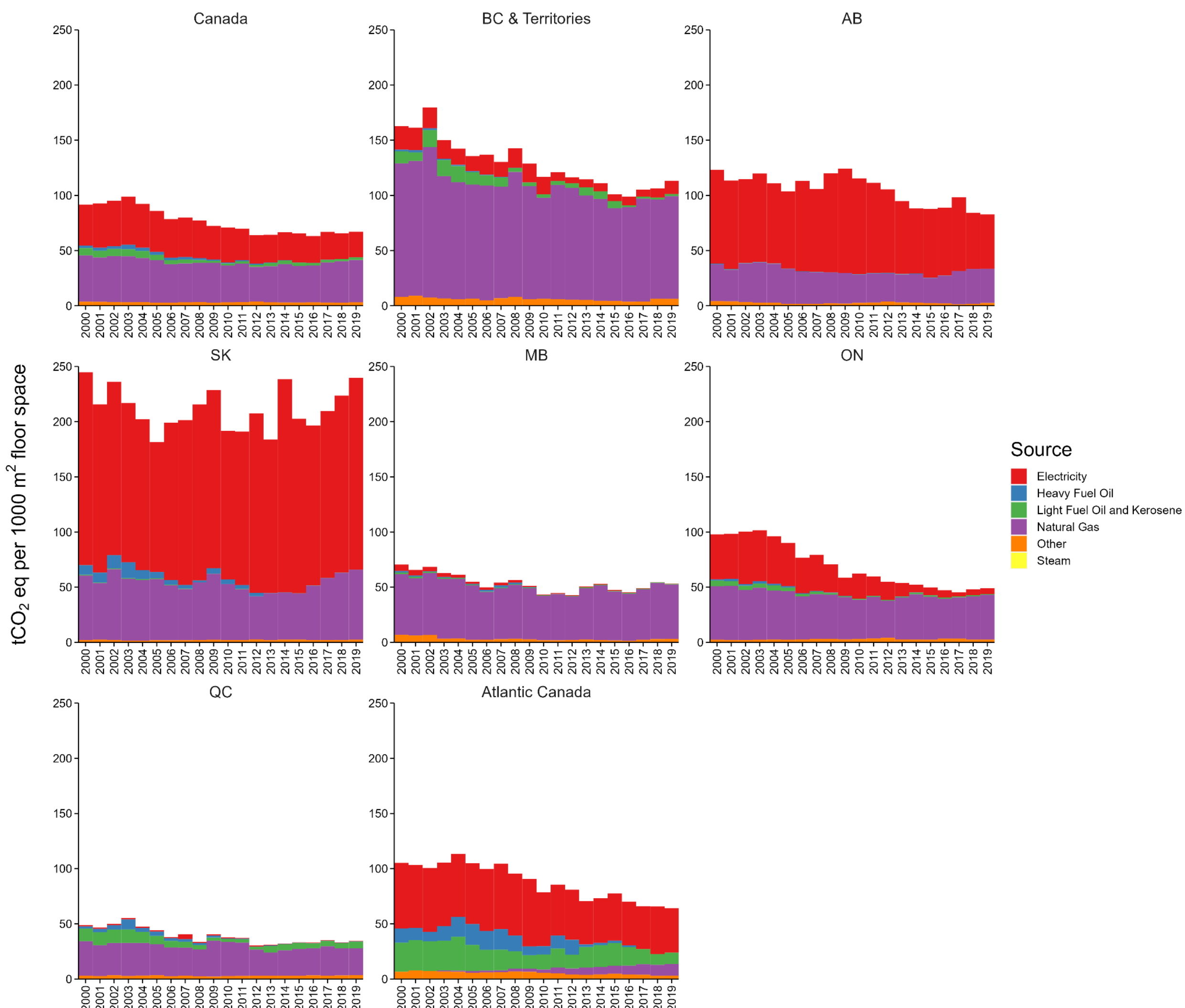


Source: Natural Resources Canada (n.d.).

In contrast to residential end-use patterns, commercial buildings' energy end use is similar across provinces (Figure 10). The majority of energy use is space heating, with energy for lighting and equipment use roughly tied. Commercial buildings' emissions differ substantially by jurisdiction (Figure 11). Natural gas use is a major source of emissions in all provinces and territories, though swamped by emissions from electricity in provinces with fossil-based grids. There is very little change in the per m^2 emissions intensity over time, and the emissions intensity of the grid matters the most for commercial buildings emissions. Reducing fuel oil use in Quebec and Atlantic Canada is a potential near-term source of intervention to reduce commercial emissions.

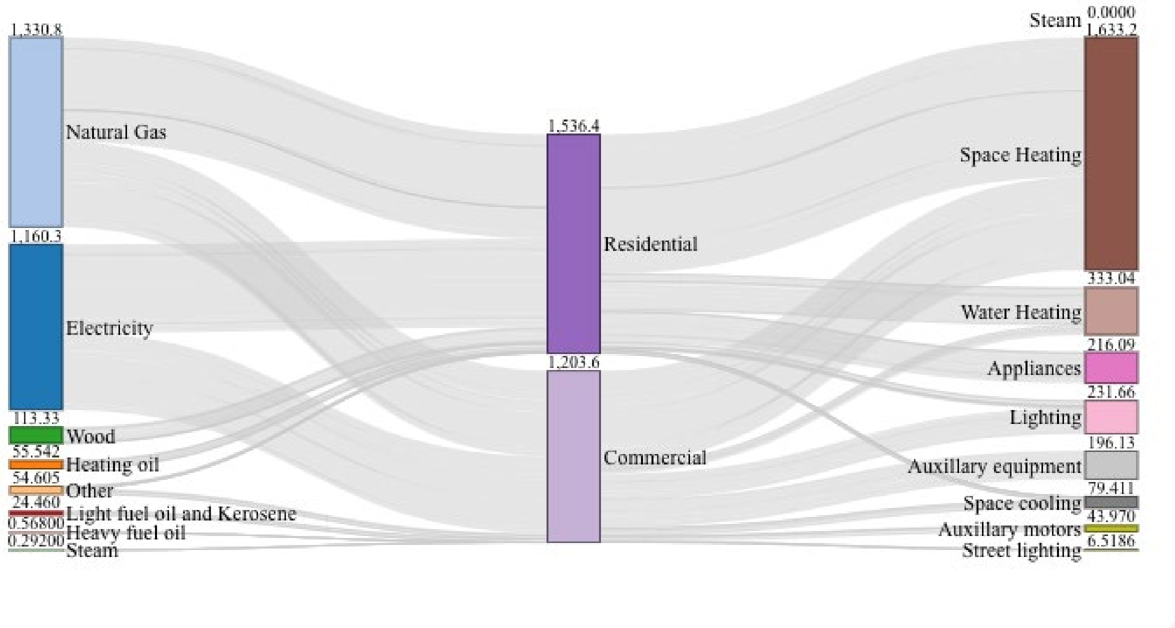
To summarise, Figure 12 plots residential and commercial energy sources and end use flows. Approximately 50 percent of residential and commercial energy use is for space heating, and natural gas accounts for about 40 percent of building-sector energy use. Wood and heating oil are exclusively residential, while heavy fuel oil is exclusively commercial.

Figure 11. Commercial Buildings' GHG Emissions per m^2 ***by Energy Source, 2000 to 2019***



Source: Natural Resources Canada (n.d.).

Figure 12. Buildings' Energy Sources and Use, 2019



Note: Figure does not distinguish energy waste from energy flows.
Source: Natural Resources Canada (n.d.).

GHG Emissions Decomposition for the Canadian Building Sector with the Kaya Identity

The policy inventory and the emissions and energy use trends over time provide useful descriptive statistics and help us understand the current policy environment for regulating GHG emissions associated with the building sector. However, further analysis is required to gain insights regarding the key drivers of change in building sector emissions. Using the Kaya identity (Kaya 1989), we perform a decomposition analysis of the key drivers that contribute to total building sector emissions. The Kaya identity can also be used to examine the effectiveness of different emission reduction measures and their interactions.

The Kaya identity is a simple equation where a variable of interest (in this case the GHG emissions associated with buildings in Canada) is written in terms of the product of a list of factors which can reasonably be the drivers of the variable examined.[8] Considering available data and the focus of this report, the Kaya identity for the building sector emissions in Canada can be written as

$$C = \frac{C}{E} \times \frac{E}{Pop} \times Pop$$

[8] The selection of factors for inclusion in a Kaya identity also depend on data availability.

where C is the building sector emissions, E is energy consumption, and Pop is population.[9] These factors form a series of drivers of the building sector emissions. More specifically, C/E represents the emissions intensity of energy supplied to buildings (tonnes CO_2e emitted per TJ of energy), E/Pop is an energy intensity term representing the energy consumption per capita (TJ energy per million people).

Table 2. Parameters required for the Kaya identity for Canada's Building Sector Emissions

	Population (millions)	RESIDENTIAL		COMMERCIAL	
		Total energy demand (TJ)	***GHG Emissions (Mt CO_2e)***	***Total energy demand (TJ)***	***GHG Emissions (Mt CO_2e)***
2005	32.244	1,324,415	43.6	899,381	40.0
2006	32.571	1,282,430	41.5	861,676	37.0
2007	32.889	1,400,215	46.0	899,863	38.3
2008	33.247	1,417,223	45.4	927,401	38.7
2009	33.629	1,401,097	43.8	938,493	38.8
2010	34.005	1,340,347	41.3	924,967	38.2
2011	34.339	1,431,863	44.3	965,607	40.4
2012	34.714	1,379,110	40.9	922,559	42.4
2013	35.083	1,464,667	42.6	953,699	41.7
2014	35.437	1,487,875	42.5	1,030,586	42.3
2015	35.703	1,446,553	42.1	945,938	41.8
2016	36.109	1,366,531	39.0	1,015,888	43.3
2017	36.545	1,429,676	41.6	1,100,886	45.0
2018	37.065	1,528,949	45.6	1,131,919	47.4
2019	37.601	1,458,852	42.6	1,178,687	49.4
2020	38.007	1,417,933	39.9	1,134,219	47.9
2021	38.226	1,474,681	42.1	1,222,751	50.9
2025	40.466	1,405,305	40.0	1,163,548	43.6
2030	42.844	1,387,808	38.1	1,185,934	38.0

Source: Canadian Climate Institute (n.d.).

Using this identity, total emissions from buildings decrease when any of the Kaya identity factors decline, holding everything else constant. The choice of which driver(s) to target in an emissions reduction strategy depends on aspects like policy priorities, available technology, cost, policy interactions, administrative complexity, etc. In the above identity, building emissions can be reduced due to changes in the amount of economic activity, measured by population as a proxy for

[9] The Kaya identity can be adapted accordingly for different variables of interest. Mavromatidis et al. (2016) present an alternative version of this identity where they include the floor area of buildings instead of population. For an analysis focused on commercial and institutional buildings emissions, this approach can be more informative. In this alternative form, the second factor would be an energy intensity term representing energy consumption per unit floor area. If the variable of interest is emissions from residential buildings only, an alternative formulation can maintain the population term and introduce floor area per capita as another driver of emissions. For comparability and to take advantage of projections included in Canadian Climate Institute (n.d.), we follow their approach and use population.

demand; the efficiency level, measured by energy consumed in buildings per capita; and the decarbonization efforts, measured by GHG emissions released per unit of energy used.

Table 2 presents the source data required to complete the decomposition analysis for the main drivers of GHG emissions in the Canadian buildings sector. Since Canada's population continues to grow, it is reasonable to expect energy efficiency and decarbonization efforts to be the main drivers of GHG emissions from the buildings sector. Projections for 2025 and 2030 are based on the Canadian Climate Institute (n.d.) evaluation of the legislated policy commitments from the federal 2030 Emissions Reduction Plan. Table 3 presents the respective values of the Kaya factors calculated using the Kaya identity and data from Table 2.

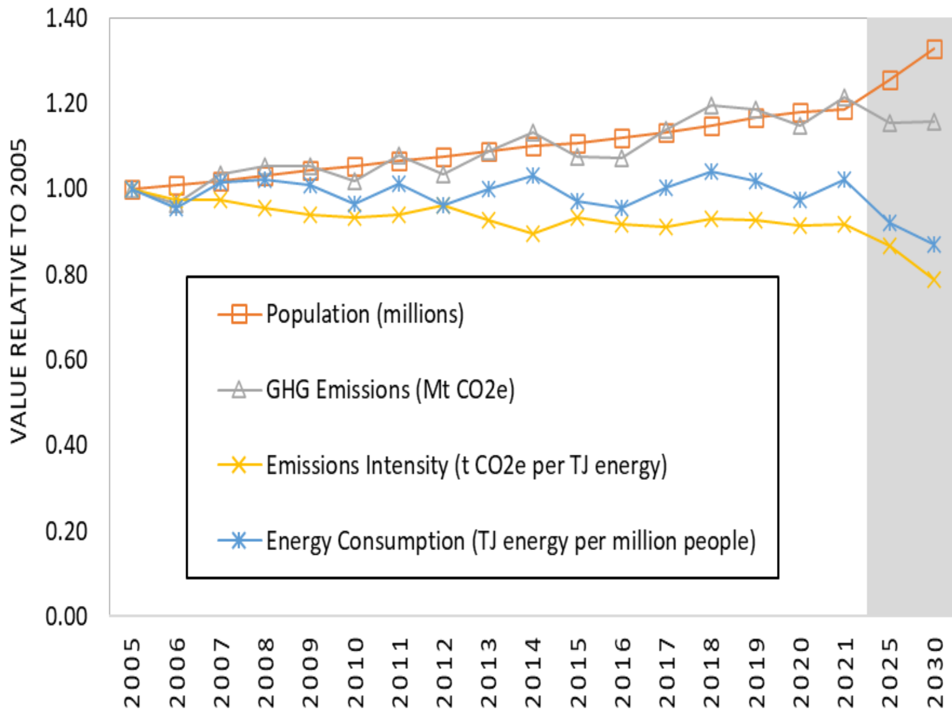
Table 3. Kaya factors for Canada's Building Sector Emissions

	RESIDENTIAL		**COMMERCIAL**	
	Emission Intensity (t CO_2e per TJ energy	***Energy Consumption (TJ energy per million people)***	***Emission Intensity (t CO_2e per TJ energy)***	***Energy Consumption (TJ energy per million people)***
2005	32.92	41,074.77	44.48	27,892.97
2006	32.36	39,373.37	42.94	26,455.31
2007	32.85	42,573.96	42.56	27,360.61
2008	32.03	42,627.09	41.73	27,894.28
2009	31.26	41,663.36	41.34	27,907.25
2010	30.81	39,416.17	41.30	27,200.91
2011	30.94	41,697.87	41.84	28,119.83
2012	29.66	39,727.78	45.96	26,575.99
2013	29.09	41,748.62	43.72	27,184.08
2014	28.56	41,986.48	41.04	29,082.20
2015	29.10	40,516.29	44.19	26,494.64
2016	28.54	37,844.61	42.62	28,133.93
2017	29.10	39,120.97	40.88	30,124.12
2018	29.82	41,250.48	41.88	30,538.76
2019	29.20	38,798.22	41.91	31,347.22
2020	28.14	37,307.15	42.23	29,842.37
2021	28.55	38,577.96	41.63	31,987.42
2025	28.46	34,728.04	37.47	28,753.72
2030	27.45	32,392.12	32.04	27,680.28

Source: Authors' calculations using Canadian Climate Institute (n.d.).

The relative contribution of each Kaya factor to the change in total sectoral emissions (normalizing each component to their respective 2010 values) is presented in Figure 13 for the buildings sector, including both residential and commercial buildings. Total sectoral emissions are consistently higher than the 2005 baseline between 2006 and 2030. While the emissions intensity of energy used in buildings has been declining, increased energy consumption per capita and increased economic activity (measured by population change) have prevented total emissions from declining.

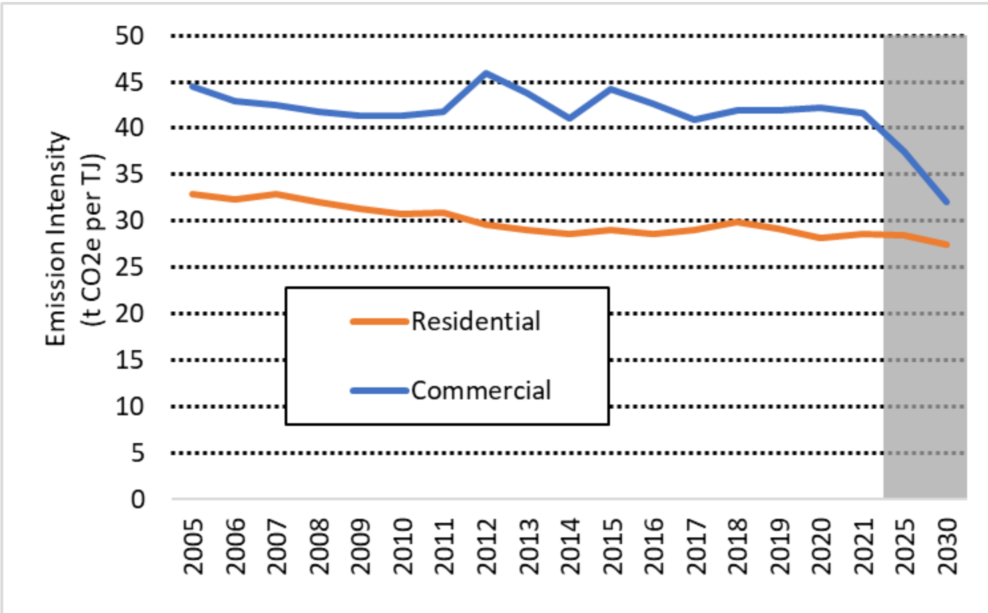
Figure 13. Trends in the Drivers of GHG Emissions for the Canadian Building Sector, 2005 to 2030



Note: All values normalized so that 2005 equals one. Grey shading is projections in 2025 and 2030.
Source: Authors' calculations using Canadian Climate Institute (n.d.).

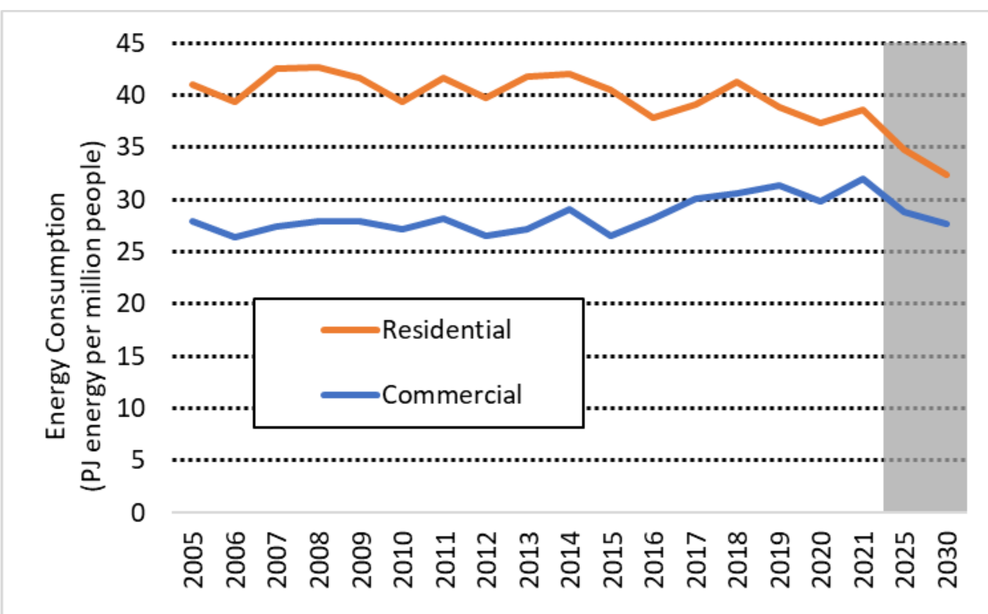
Figure 14 and Figure 15 present the trends for emissions intensity (Figure 14) and energy consumption (Figure 15) for residential and commercial buildings. In contrast with the trend for population, the projections for 2025 to 2030 show a decrease in per capita energy consumption and emission intensity for both types of buildings. The emissions intensity of commercial buildings is historically higher than residential buildings while per capita energy consumption is lower. While energy consumption per capita for residential buildings fluctuates, there has been an overall decreasing trend since 2005. On the other hand, energy consumption per capita has increased for commercial buildings due to an increase in total energy consumption.

Figure 14. Emissions Intensity Kaya Factor for Residential and Commercial Buildings (t CO_2e per TJ)



Note: Grey shading is projections in 2025 and 2030.
Source: Authors' calculations using Canadian Climate Institute (n.d.).

Figure 15. Energy Consumption Kaya factor for Residential and Commercial Buildings (PJ energy per capita)



Note: PJ equal petajoule. Grey shading is projections in 2025 and 2030.
Source: Authors' calculations using Canadian Climate Institute (n.d.).

Context: Building Codes and Jurisdictional Interactions

All four orders of government — federal, provincial and territorial (PT), regional and municipal, and Indigenous — affect the building sector through policy decisions and regulation. Section 92(10) of the *Constitution Act* (local works and undertakings) designates buildings as PT jurisdiction. Importantly, each level of government has a distinct primary role. Also relevant for our purposes is jurisdiction over energy development (PT, except for nuclear and energy transmission crossing subnational boundaries) and emissions (shared). However, building regulation is not explicitly defined in the constitution (buildings are implicitly, not explicitly subsumed in the local works and undertakings definition), and is affected by both federal and PT regulatory oversight and jurisdiction, alongside norms of governance. Together, these factors mean there is significant jurisdictional overlap. In this section, we describe and discuss the distinct roles and the jurisdiction of different levels of government for regulating the built environment and specifically the building sector, as these overlaps are relevant for determining responsibility for operational and embodied emissions in buildings.

Provincial and Territorial Governments

Provincial and territorial governments have primary jurisdiction to regulate building construction and building energy sources; the latter may be within government or through arms'-length regulatory bodies. Direct regulation of building construction is via building codes and safety standards; the former includes buildings' energy use. For example, British Columbia regulates "building activities" which include the construction of new buildings, or the alteration, repair or demolition of existing buildings (British Columbia 2015). PTs indirectly regulate through a variety of other policy levers, including land and resource management, delegation of authority to regional or local governments, fiscal policy, labour force oversight[10], and climate policies. Direct regulation of building energy use is twofold. First, via PT adoption of the National Energy Code which guides the energy efficiency of new buildings. Second, energy efficiency regulations that determine the energy efficiency of equipment used in buildings (which applies at the time of replacement). PTs also provide economic regulation of energy utilities and supplies, public-interest regulation of allowable energy infrastructure, and climate policies (particularly emissions pricing). Provincial and territorial governments also regulate (or delegate to regional governments to manage) criteria for air contaminants in airsheds, which can affect allowable economic activity and building emissions. Indirect regulation of energy use includes oversight of demand-side management programs and energy efficiency programs. These programs include energy utility initiatives, PT programs, and programs by separate agencies. Relevant fiscal policy includes provincial sales taxes (including exemptions for energy efficient equipment) and provincial corporate tax credits for deep energy retrofits of buildings, amongst other examples.

[10] For example, oversight of the building sector labour force, including carpentry, plumbing, electrical, mechanical; qualifications of building officials and inspectors; and oversight of professional governance bodies.

Federal Government

Federally, the Government of Canada finances and the Canadian Board for Harmonized Construction Codes[11] develops national model building codes, technical documents that are implemented through separate legislation and regulations by other orders of government. The National Building Code provides the "technical requirements for the design and construction of new buildings" and "alteration, change of use and demolition of existing buildings" (National Research Council Canada 2022a), and are minimum acceptable requirements to meet the objectives of safety, health, accessibility, fire and structural protection of buildings, and limiting environmental impacts (Canadian Commission on Building and Fire Codes 2022a). The National Energy Code supplements the National Building Code by providing "technical requirements for the energy-efficient design and construction of new buildings and additions" (National Research Council Canada 2022a), and establishes criteria for energy use efficiency (Canadian Commission on Building and Fire Codes 2022b).

PTs can adopt the model codes as-is, or adapt the codes to their specific circumstances. Upon adoption, the codes become regulation. PTs may also implement their own codes, particularly in areas not covered by national codes. Historically, PTs have implemented modifications to national codes reflecting their priorities. This means the national codes are models for adoption, rather than a minimum standard that subnational jurisdictions must comply with. The model energy codes provide tiers of building energy performance requirements, which can be applied in lieu of prescriptive performance requirements (Canadian Commission on Building and Fire Codes 2022b).

The Government of Canada also facilitates policy harmonization through the Regulatory Reconciliation and Cooperation Table, which identifies potential barriers to trade — "diverging or duplicative regulation that impedes the flow of goods" or services — and facilitates negotiations towards regulatory reconciliation (Canadian Free Trade Agreement 2023). This has led to the Reconciliation Agreement on Construction Codes, which supports reducing differences between PT construction codes and the national codes by 2025 and avoiding future differences or misalignments (Canadian Free Trade Agreement 2019; Treasury Board of Canada Secretariat 2021). Moreover, Codes Canada established an institutional framework for harmonized construction codes in late 2022 (National Research Council Canada 2022c).

The Government of Canada develops minimum energy efficiency standards through Natural Resources Canada (NRCan) for specific types of equipment that crosses PT borders or is imported into Canada, legislated and regulated through the *Energy Efficiency Act* and the *Energy Efficiency Regulations* (Natural Resources Canada 2022b). As we note above, several provinces also have their own energy efficiency regulations (Natural Resources Canada 2022d).

Also relevant is that the Government of Canada creates a minimum emissions pricing standard through the *Greenhouse Gas Pollution Pricing Act* and the benchmarking process that reviews

[11] This is a new organization, formed in late 2022, that consists of federal, provincial and territorial representatives following a move to an FPT governance model. Prior to these changes, the Canadian Commission on Building and Fire Codes was responsible for code development (National Research Council Canada 2022b).

provincial and territorial pricing systems for compliance. The principles informing compliance evaluations by Environment and Climate Change Canada include common scope and coverage, a clear price signal, appropriate stringency of competitiveness support mechanisms, verifiable offset markets, and transparent reporting (Environment and Climate Change Canada 2021b; 2022f). While provinces and territories have the ability and flexibility to create their own pricing systems, they must demonstrate equivalency in coverage (share of priced emissions) and stringency (price level).[12]

The federal government also indirectly regulates the building sector through energy efficiency and fuel-switching programs, supporting research and development, providing open data, and federal tax exemptions and incentives. It also has oversight of the substantial stock of federal buildings.

Municipal and Regional Governments

Provinces delegate authority to regional (e.g., counties) and municipal governments, with varying levels of delegated authority. Both municipal and regional governments create (and enforce) building and land-use bylaws to enforce building codes, which may include variations from PT codes. For example, Vancouver's bylaws include greenhouse gas emissions for new builds (Kanduth 2020; City of Vancouver 2022a). In contrast, the current provincial codes are based on the 2015 National Building Code and the National Energy Code, and do not include emissions-intensity requirements (British Columbia 2018). The BC approach includes an optional tiered performance approach that local governments can require or incentivize, and builders voluntarily use (Building Codes and Safety Standards Branch 2018).

Municipalities engage in community planning, neighborhood planning, and create development permit area guidelines and zoning restrictions. Regional governments do the same for rural areas. Land use planning and zoning, as well as permitting, means local governments have an important and disproportionate role in how Canadians live and work and interact with the built environment (Winter 2022). An important policy lever is property-assessed clean energy programs, which enables commercial and residential property owners to finance retrofits through property taxes. These governments may also offer explicit property tax incentives or preferential treatment in permitting for low-emission buildings.

Municipal and regionally-coordinated climate plans directly affect the building sector through guidance and rules on allowable activity. For example, Vancouver requires zero-emission space and water heating in low-rise residential buildings (City of Vancouver n.d. d). These climate plans also indirectly affect the building sector through other orders of governments' interpretations. For example, in 2022 the Ontario Energy Board referenced the City of Ottawa plan to reduce fossil fuel use in its decision to not allow a natural gas pipeline replacement (Beer 2022). Lastly, local governments also manage water supply, sewage and solid waste, which indirectly affects the building sector.

[12] In practice, this is a federal cabinet decision, and true equivalency is not always in place (Dobson, Winter, and Boyd 2019).

Indigenous Governments

Indigenous governments have a role somewhat similar to municipal governments, in that they have local control over housing, transportation and building code enforcement. These governments also engage in community planning and resource management. This may include participating in regulatory hearings in instances where the Crown's duty to consult is triggered.

Regulatory Bodies

An important additional layer is the role of (public) utilities and their regulators. Canada's "regulatory compact" ensures a fair price for consumers and a guaranteed rate of return for public utilities, balancing differing economic interests (Orenstein 2019). With economic regulation, regulators determine "fair" or just and reasonable rates for consumers based on prudently incurred costs by utilities. Some regulators (e.g., BC's Utilities Commission) are also charged with ensuring rates are not unduly discriminatory or preferential (British Columbia 1996, sec. 59). These rates include the variable energy charge and fixed monthly charges to recover system costs. This means regulators' rate decisions have an important role in determining the intensity of building energy use, including the incentives for fuel-switching and energy efficiency investments.

In addition to economic regulation, regulators determine if energy system infrastructure investments are in the public interest. This has a much longer-term effect on building energy use and emissions, as these types of decisions affect the availability of different energy sources. Definitions of the public interest and guidance on how regulators should interpret the public interest varies substantially, however, and are often vague with provisions for inclusion of "other relevant factors" (Goodday, Winter, and Westwood 2020). Importantly, regulators have no explicit mandate with respect to climate change — mitigation or adaptation — beyond their interpretation of the public interest. In making these long-term infrastructure decisions, regulators' interpretation of policy matters a great deal. For example, in 2022 the Ontario Energy Board denied an application for a natural gas pipeline replacement project in Ottawa, stating the project proponent failed to demonstrate replacement was the least-cost option and Ottawa's decarbonization plans risked creating a stranded or under-used asset that would impose additional costs on ratepayers (Beer 2022; Ontario Energy Board 2022). In contrast, Newfoundland and Labrador's Public Utilities Commission recently decided against an application to fund an EV-charging network through the rate base (Ping 2023).[13] These two examples demonstrate the tension between the public interest test for just and reasonable rates, the public interest test for infrastructure, and policy to support emissions reductions. It also demonstrates the power of regulators to affect building energy use and the availability of different energy sources. Changes to building codes to increase electrification or lower the emissions-intensity of energy use in buildings could hasten existing fossil-fuel infrastructure becoming a stranded asset — due to policy-induced fossil-fuel demand destruction — and detrimentally affect the existing building stock. This depends on legal treatment

[13] Denial of EV charging is often due to the fact that provision of charging networks is a competitive market, whereas public utilities are regulated natural monopolies. One of the roles of economic regulators is to protect or enhance competition. The natural monopoly utility can use its captive customers for marketing or embedded costs to cross-subsidize in order to gain a competitive advantage over a non-regulated entity operating an EV fast charger.

of allowable costs and stranded assets, which differ across Canada (Cusano et al. 2018). A potential solution to this tension is taxpayer-funding of infrastructure or payouts for stranded assets (Davis and Hausman 2022; Dolter and Winter 2022), like Alberta did with its coal phase-out (Bellefontaine 2016).

Jurisdictional Overlap and Conflict

Table 4summarizes key government levers applied to the buildings sector. Each column represents a building sub-sector. Each row represents a regulatory framework with specific legislation by one or more levels of government and institutions established and/or delegated to implement the framework.

Table 4. Government Regulatory Oversight of the Building Sector and Sources of Overlap

Regulatory Frameworks for Buildings	**Residential**	**Commercial**	**Institutional**	**Rental & Social Housing**
Land Use Planning	Local/Regional/Indigenous government planning			[P/T emerging]
New Construction	Building codes; advanced energy efficiency standards; government energy efficiency policy, incentives and programs			
Equipment	Federal and provincial energy efficiency acts, energy efficiency programs			
Asset Management	Mandatory depreciation reports	N/A	Capital asset management framework	
Building Renewal	Building codes, energy efficiency, tax exemptions and credits			+ Design guidelines, rent control, government funds
Real Estate	Real estate labelling	Benchmarking	Greening government buildings	Tenant protection
Electricity Supply	Public utility commission oversight (resource planning, project approvals, supply, rates), clean electricity policies, utility demand side management programs			
Fossil fuel and other methane and H_2	Public utility commission oversight (resource planning, project approvals, supply, rates), emerging carbon policies, utility demand side management programs			
Distributed and District Energy	Public utility commission oversight (resource planning, project approvals, supply, rates), net metering, government ownership, mandatory local connection bylaws			

Source: Adapted from Figure 15 in Athienitis et al. (2022). Reproduced with permission.

Two key examples of overlapping jurisdiction include building codes and energy efficiency standards for equipment used in buildings. As we describe above, federal, provincial, territorial, Indigenous, regional, and municipal governments all have a role in regulating building activities. Conflicts can arise when standards are inconsistent between a bylaw, a PT regulated building code, model national codes, or equipment standards. One example of such an inconsistency is the energy efficiency or “U-value” of windows in BC, with three separate regulations by a municipality, the provincial *Energy Efficiency Act* and the BC Building Code. The most stringent standard would apply when multiple regulatory requirements overlap. This sends mixed signals to window manufacturers that need to invest in certification costs per individual government target. This is particularly detrimental for regional Canadian manufacturers with lower sales volumes than multinationals. This inconsistency has been addressed in some PTs by harmonizing with model national building codes or mandating a default building code across the PT and explicitly delegating certain matters conducive to lower levels of government within their geographic jurisdiction. Another example of concurrent authority for energy efficiency within building codes is the BC Building Code providing multiple levels of performance more stringent than the provincial standard, and enabling voluntary adoption of more advanced standards by local authorities.

Similarly, the federal *Energy Efficiency Act* regulates standards for inter-jurisdictional trade and imports of equipment into Canada, while certain provincial governments have their own legislation to regulate equipment sales within their jurisdiction. In some cases, the provincial regulations are more stringent, leading to conflicts. Canada’s energy ministers established a framework for cooperation on energy efficiency standards which also requires consideration of global market transformation efforts (Natural Resources Canada 2022e). For example, the International Energy Agency Roadmap for Net-Zero by 2050 has called for all new gas boilers that are sold in 2025 be capable of burning 100 percent hydrogen and therefore are zero carbon-ready (International Energy Agency 2021, 146).

Methodology

In this section, we briefly describe our process including methods, selection criteria, data collection and analysis. To examine current policy environment for regulating GHG emissions associated with buildings, we initially developed a policy inventory from multiple sources, including federal biennial reports to the United Nations Framework Convention on Climate Change (Environment and Climate Change Canada 2019; 2023) and a policy inventory created by the Canadian Climate Institute (2023). We verified and cross-checked the inventory using provincial, territorial, and federal climate plans; and reviewing legislation and program websites. Our preliminary inventory included basic policy information such as names and description; see Appendix III (the inventory itself) for sources for each policy. With this process we attempted to capture the universe of mitigation-focused federal, provincial and territorial climate policies in Canada. We do not include municipal policies due to scope.

Initial Screening

The initial inventory resulted in 437 distinct mitigation policies. This inventory is current to the end of February 2023, and does not include announcements from federal, provincial and territorial budgets for 2023/24. Policies were screened for inclusion in this study based on whether they were expected to affect or interact with GHG emissions from buildings. Specifically, we include policies that affect the operational or embodied emissions from buildings and policies that affect energy use in or emissions from buildings (both supply and demand side). The criteria we applied for policy inclusion was fourfold: whether policies implement energy-source decarbonization, end-use fuel-switching, end-use energy efficiency improvements, or reduce embodied emissions. We excluded policies that target other sectors (i.e., agriculture, industry, waste), policies no longer in force, and policies focused on other goals such as adaptation. We generally exclude transportation policies (e.g., renewable fuel content or public transit subsidies), except for those that incentivize the installation of EV charging infrastructure in buildings — which will support EV adoption but will increase increase electricity demand and potentially associated emissions from those buildings. We exclude industrial policy outside of emissions pricing or large-emitter pricing programs. We also exclude utility-initiated and utility-implemented programs due to scope, but include FPT programs funded by government and implemented by utilities. Our rationale for this exclusion is twofold: first, our primary focus is FPT (government) policy and how these policy actions affect building-sector emissions; and second, we face scope issues in accurately identifying and classifying all utility-led interventions. The latter is scope for future work.

Table 5. Initial Screening Results

Jurisdiction	Included Policies	Excluded Policies	Total
Canada	30	72	102
British Columbia	28	36	64
Alberta	5	18	23
Saskatchewan	8	29	37
Manitoba	2	14	16
Ontario	6	19	25
Québec	10	36	46
New Brunswick	9	9	18
Nova Scotia	9	5	14
Prince Edward Island	10	20	30
Newfoundland and Labrador	9	11	20
Yukon	7	8	15
Northwest Territories	12	4	16
Nunavut	6	5	11
Total	**151**	**286**	**437**

In applying the screening criteria, we reduced the number of relevant policies to 151 from 437 (Table 5). The majority of policies we include for further analysis are in force (142), with three proposed and six announced. We define ‘proposed’ as a policy where regulations or guidance is drafted, design principles are clear, but compliance is not required or voluntary uptake is not yet available. We define ‘announced’ as a policy where a government has committed to the policy, but timelines and details are unclear. For example, we classify the federal Clean Electricity Regulations as announced rather than proposed because, while there are public documents framing the policy and its general approach (Environment and Climate Change Canada 2022a; 2022e), substantive details of the policy design, stringency, and implementation timing are unavailable. When details of the policy are released in Canada Gazette I, the policy would then be coded as proposed.

Coding Approach

With the final list of policies complete, we categorised, or coded, the policies to create a searchable database of relevant policy characteristics. We include basic information such as jurisdiction, the policy name, sector, implementation year, and a brief description. We then classify each policy according to the way it impacts emissions from the building sector including building emissions targeted (embodied, operational, or both), building sub-sector, and building stock covered (new, existing, or both). Policies are then coded according to their design. Table 6 through Table 10 contain the policy design characteristics and coding categorizations, including definitions. In addition to these, we collected information on funding and implementing agencies, where applicable. A complete list of attributes and categories can be found in Appendix I.

To illustrate this approach, consider the example of the federal Greener Homes Grant which provides financial support of up to $5,000 to homeowners implementing energy efficiency retrofits on their homes (Natural Resources Canada 2022a). In coding this policy across the attributes described above, we identified this policy as implemented by the federal government (Natural Resources Canada), targeting the building sector and implemented in 2021. Based on eligibility for the program, this policy was classified as targeting the *operational* emissions of buildings and specifically targeting the *residential* building sub-sector, and the *existing* building stock based on its application to retrofits. The abatement channel through which this policy contributes was classified as *end-use efficiency.* The design of the policy reflects an *abatement support* policy, specifically using the instrument of a *consumption subsidy.* The policy scope is the *project* level, as individual households apply for the funding for their specific project. The program is supported by $2.6 billion in funding over the period 2021-2028, representing average annual funding of $371.4 million.

Table 6. Policy Status

Status	Definition
Implemented	Compliance with the policy is currently required
Proposed	Regulations have been drafted, design is clear, but compliance is not yet required
Announced	A policy has been announced but timelines and stringency are unclear

Table 7. Instrument Type

Instrument Type	Definition
Abatement support	Encourages voluntary abatement activities (e.g., subsidies for heat pump adoption).
Framework	A plan or strategy for decarbonization efforts.
Information	Policies that help inform choices for decarbonization (i.e. home energy labelling).
Mandatory	Requires a certain activity or outcome (e.g., federal fuel charge).
Voluntary	Sets a policy objective with no binding compliance mechanism or direct abatement support (i.e., targets for wood use in the construction of public buildings).

Table 8. Abatement channel coding

Abatement channel	Definition
Demand management	Reduces absolute energy consumption
Embodied emissions	Reduces embodied emissions in materials used by the building sector
End-use efficiency	Reduces the energy input required to achieve a certain outcome
End-use fuel switching	Policy incentivizes switching from a high-emitting energy carrier to a lower emitting fuel (i.e., switching from heating oil to an electric heat pump).
Energy source decarbonization	Reduction in emissions from energy sources upstream of the building sector
End-use efficiency and demand management	Reduces the energy input required to achieve a certain outcome and absolute energy consumption.
End-use efficiency and end-use fuel switching	Reduces the energy input required to achieve a certain outcome and the energy source used.
All	Policy targets all abatement channels listed in this table

Table 9. Policy sector coding

NIR Economic Sector	Definition
Buildings	Policy specifically targets energy use or emissions in commercial, residential or public buildings
Electricity	Policy affects emissions from combustion and process emissions from utility electricity generation, steam production (for sale) and transmission. Excludes utility owned cogeneration at industrial sites.
Industry	Stationary combustion, onsite transportation, electricity and steam production, and process emissions from mining, smelting and refining, pulp and paper, iron and steel, cement, lime and gypsum, and chemicals and fertilizers.
Oil and gas	Stationary combustion, onsite transportation, electricity and steam production, fugitive and process emissions from natural gas and oil production and processing, petroleum refining, and local distribution of natural gas.
Transportation	Mobile related emissions including all fossil fuels and non-CO_2 emission from biofuels. Includes passenger and freight transport, recreational fuel use, and portable engines.
Multiple	Policy targets or covers multiple economic sectors (e.g., federal fuel charge).

See Appendix II for detailed sector definitions.

Table 10. Policy Scope

Scope	Definition
Class	Policy targets or covers a class of activity
Multi	Policy targets or covers multiple economic sectors (e.g., Quebec cap and trade)
Project	Policy enables project-based activities
Sector	Policy targets or covers a single economic sector
Sub-sector	Policy targets or covers a sub-sector
Technology	Policy targets or covers a specific technology type (e.g., appliance energy efficiency standards)

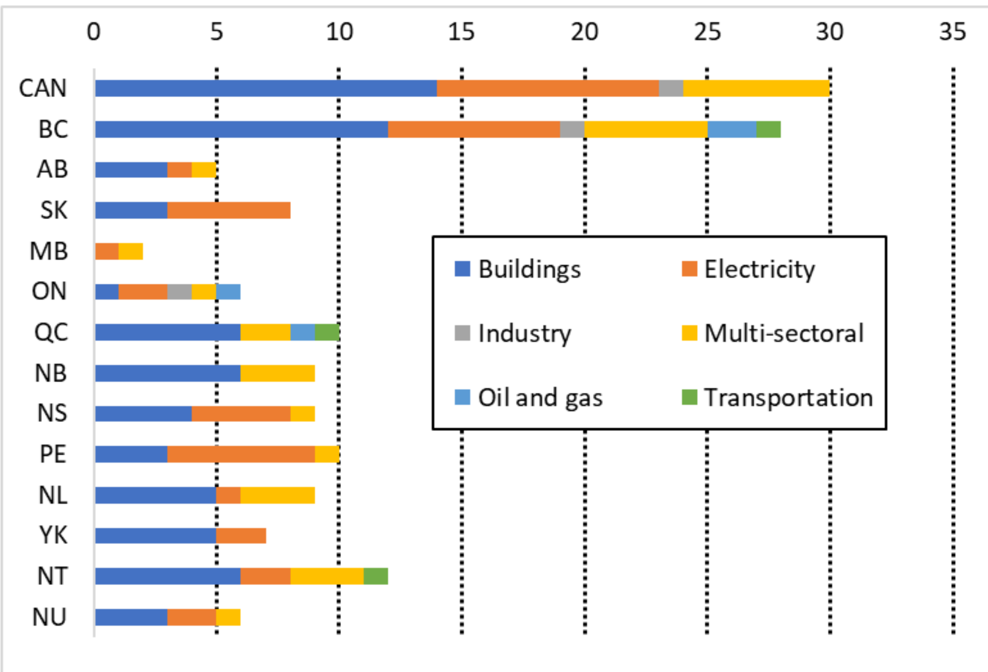
Results

In this section, we describe characteristics of the policy environment by jurisdiction and policy characteristics of interest. An important caveat to our discussion is that we present policy counts, or policy density, but a higher number does not necessarily reflect greater policy stringency or a larger emissions reduction-incentive. Instead, these results are indicative of the landscape of the Canadian policy environment, showing the typology of instruments and their scope. We end the section with a small number of jurisdictional case studies highlighting specific actions related to reducing building emissions to supplement our higher-level analysis of the nature of policy across jurisdictions.

Policy Density Patterns

Figure 16 shows policy count by FPT jurisdiction and targeted sector. Most jurisdictions have similar total numbers of policies, though Canada, BC, Manitoba and Northwest Territories are outliers. Canada and BC have the most density of policies, and the largest number of policies targeting the building sector, followed by policies specific to electricity generation and policies covering multiple sectors. With the exception of Manitoba, Saskatchewan and Prince Edward Island, policies specific to the building sector dominate in all provinces and territories. Manitoba is unique in that it has the lowest number of policies (three), with two covering electricity and one multi-sector policy. Also of note here is the limited number of jurisdictions with policies explicitly linking transportation choices to the building sector.

Figure 16. Policy Count by Jurisdiction and Targeted Sector



Note: oil and gas policies in the figure are policies targeting downstream emissions or use. Economic sector definitions from Canada's National Inventory Report; see Appendix II for sectoral definitions.

Figure 17 shows policy counts by abatement channel — energy source decarbonization, end-use fuel switching, end-use efficiency, embodied emissions, or combinations of multiple — and by instrument type. Most policies target specific abatement actions, rather than providing a broad incentive. The majority of policies are abatement support; they subsidise abatement activities (e.g. heat pump) or otherwise encourage voluntary actions. The greatest number of policies target end-use energy efficiency, followed by energy source decarbonization. Importantly, the majority of abatement channels are complementary to each other.

Figure 17. Policy Count by Abatement Channel and Instrument Type

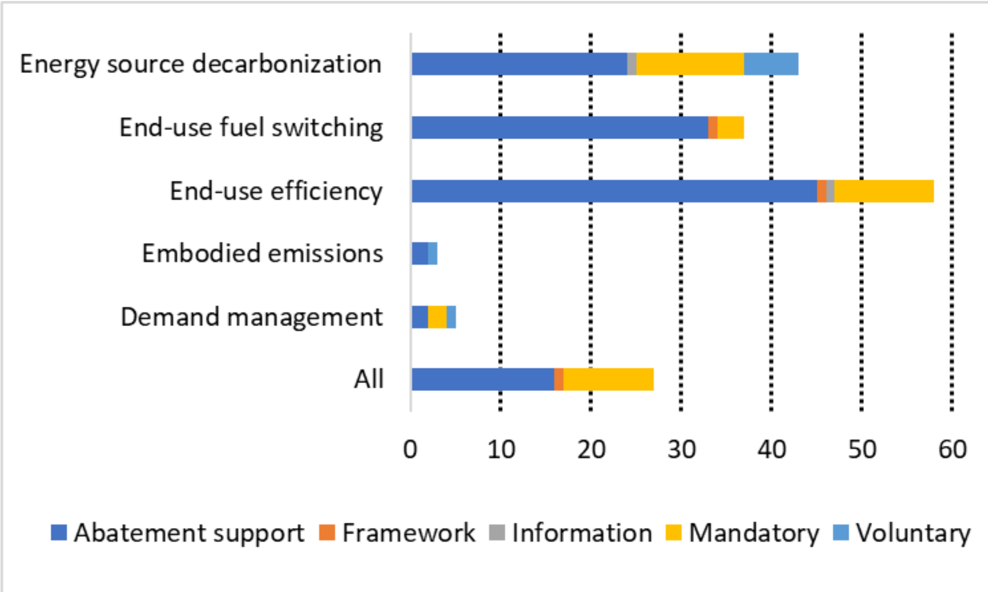
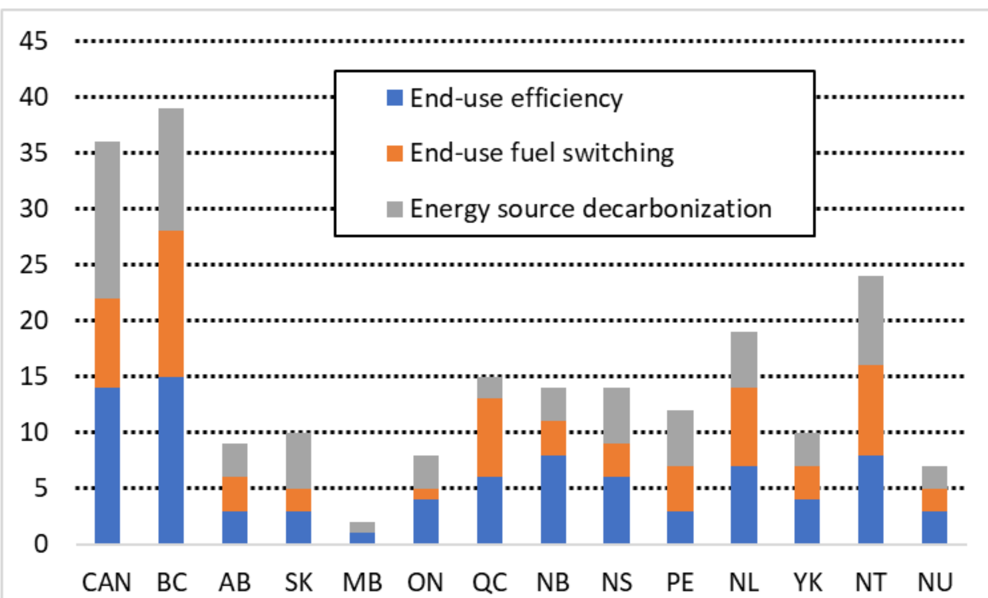


Figure 18 displays counts for policies addressing operational building emissions by jurisdiction. All jurisdictions rely on a mix of policy levers, though the most common is end-use efficiency. BC and the Government of Canada have the greatest density of implementation; Manitoba is an outlier with its small number of policies.[14]

Figure 18. Policy Count by Abatement Channel for Operational Building Emissions and Jurisdiction



[14] Small policy counts in some jurisdictions may be due to utility-led programs substituting for government-initiated abatement policies. As the former is out of scope for us, we may be 'under-counting' action in some PTs.

The scope of policies ranges from narrow to broad (Figure 19). The majority of policies are targeted, either enabling project-specific activities — e.g. the New Brunswick Total Home Energy Savings Program, which provides an evaluation of home energy use, a report on energy efficiency improvements and upgrades, and rebates for eligible upgrades (NB Power 2023) — or a specific type (class) of activity — e.g. Ontario's Electricity 2021-2024 Conservation and Demand Management Framework, which provides information and funding support for energy efficiency improvements to reduce electricity demand (Independent Electricity System Operator 2020). Of note is that policies that cover multiple sectors are mainly mandatory (require compliance) whereas other policy scopes consist of predominantly voluntary policies.

Figure 19. Policy Count by Scope and Instrument Type

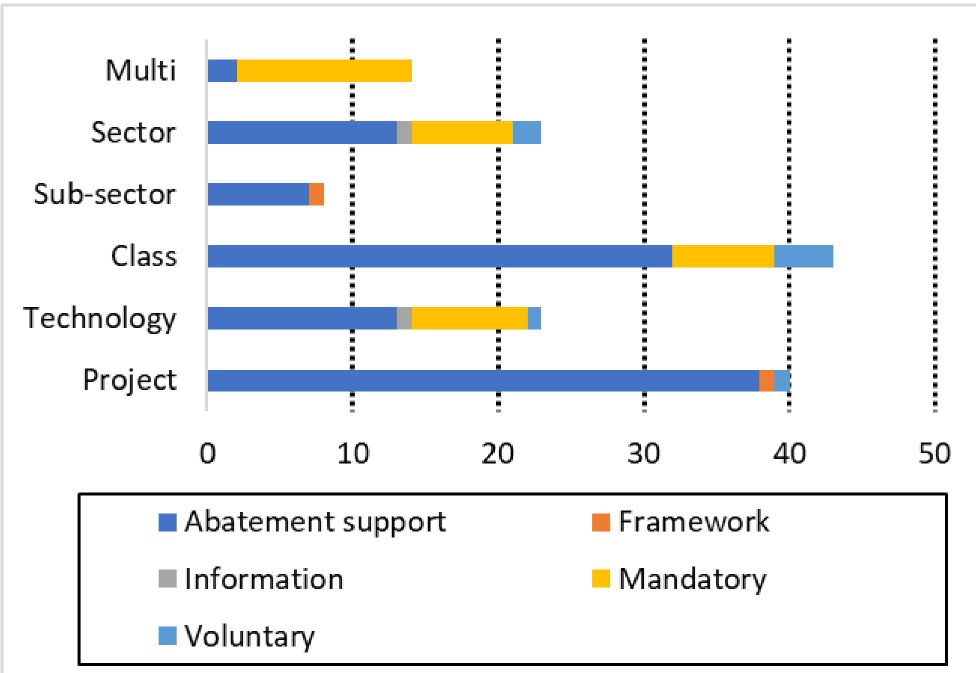


Figure 20 presents policy scope by FPT jurisdiction. Again, the scope of policy choices varies substantially by jurisdiction. No policy scope is common across all PTs and the federal government, though project-based policy is present in all jurisdictions except Manitoba. Policies focusing on building sub-sectors are present in only a few jurisdictions. Another interesting distinction is that four provinces — Manitoba, Ontario, Quebec, and New Brunswick — do not have policies explicitly targeting buildings and instead rely on lower orders of policy intervention.

There is also substantial jurisdictional variation in which building subsectors the various policies target (Figure 21). All provinces and territories, as well as the federal government, have policy targeting all building subsectors. The variation comes from some PTs implementing targeted subsector policies, while others stick to more general policies. Very few jurisdictions (Canada, BC, and Nova Scotia) have policies targeting building stock used by Indigenous Peoples. While Ontario and Manitoba have policies affecting all building subsectors, they are notable in that these two provinces do not have policies directed solely at residential buildings. Similarly, the majority of provinces and territories do not explicitly target commercial buildings.

Figure 20. Policy Count by Scope and Jurisdiction

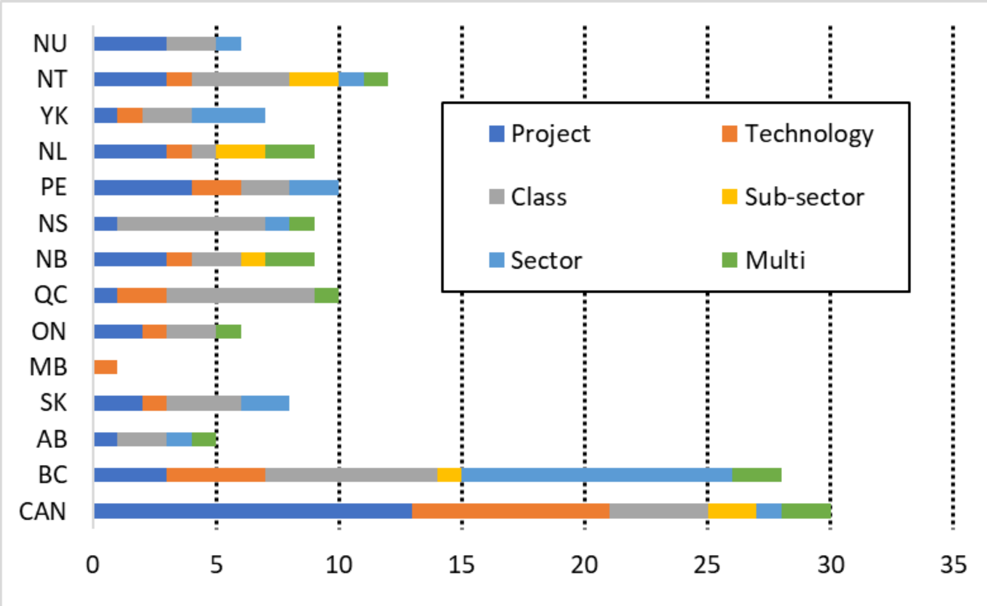


Figure 21. Policy Count by Building Sub-sector and Jurisdiction

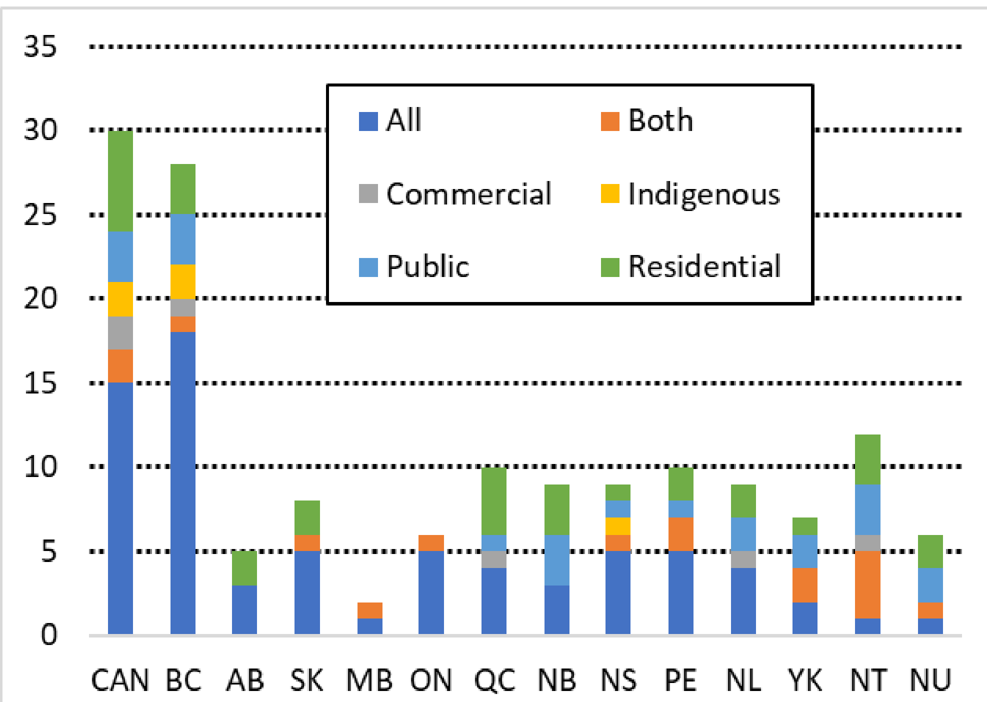
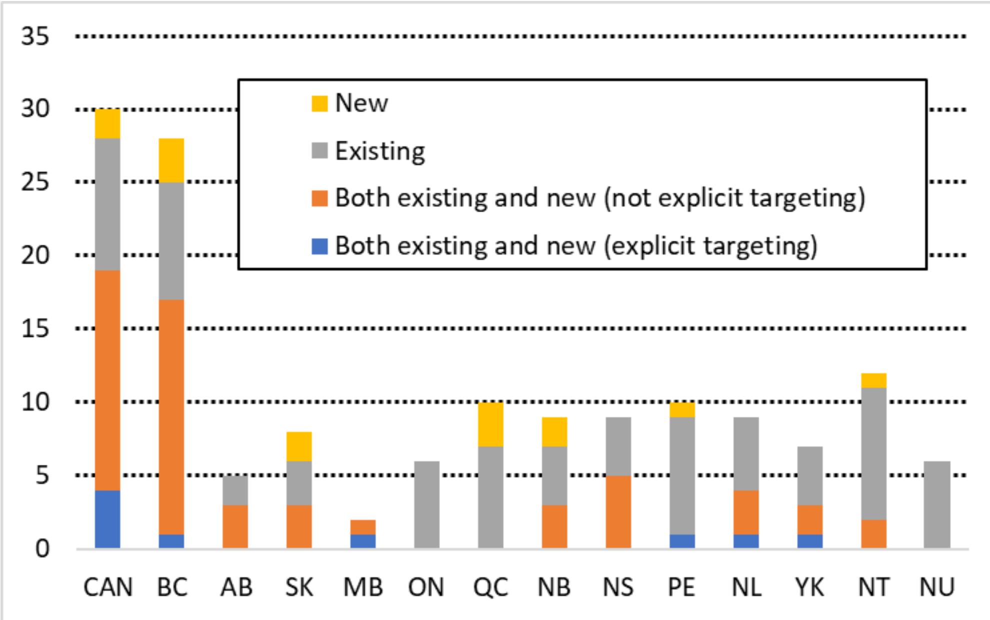


Figure 22 shows the policy counts by jurisdiction and the type of building stock these policies target. Importantly, the majority of policies focus on the existing building stock. Policies that target both are generally not explicitly oriented to affect building sector emissions; very few policies explicitly target the building sector and address new and existing building stocks.

Figure 22. Policy Count by Building Stock and Jurisdiction



Jurisdictional Case Studies

This section provides a brief overview of select provincial and municipal actions to reduce emissions that are relevant to the building sector, highlighting approaches and challenges.

Edmonton

In 2017, the City of Edmonton launched its building energy benchmarking program, a voluntary program that collects information about the building energy performance of commercial, institutional and multi-family buildings over 1,000 square feet (City of Edmonton 2023). Participating buildings receive a report on the property's energy and emissions performance in levels and intensity, and recommendations for energy saving opportunities including relevant federal and provincial funding (City of Edmonton 2023). Commercial and institutional buildings may also apply for rebates to offset the costs of energy efficiency upgrades and installing renewable energy systems (City of Edmonton n.d.). Retention of building participation was 75 percent between 2016 and 2020; 2020 participation included 419 properties (704 individual buildings), comprising a combined gross floor area of almost 6 million square metres (City of Edmonton 2022). The energy use intensity of participating buildings fell, on average, by 15% over the program's first five years (City of Edmonton 2022).

Ontario

Ontario currently has no provincial policies in place targeting emissions in the building sector.[15] The most recent energy-efficiency updates to the Ontario Building Code (regulation under the *Building Code Act* of 1992) were in 2016 (Efficiency Canada 2022). The province is currently consulting on changes to its building code, with the intent of increasing alignment with the national model codes (Ontario 2022b; 2022c; 2023). The proposed changes include adopting the 2020 national energy codes (Ontario 2022a).

Ontario's Liberal government planned to roll out a home energy rating and disclosure (HER&D) program in 2019. The first program of its kind in Canada, the HER&D would have required prospective home sellers to undergo energy audits before putting their homes on the market. The purpose of these audits was to ascertain an energy rating, which would then be included in the property's real estate listing. The Ford government's *Green Energy Repeal Act*, 2018, terminated the previous government's plans for mandatory energy audits. One casualty of the repeal of the Green Energy Act was the elimination of dozens of energy efficiency standards for energy-using equipment that had been in place prior to the initial introduction of the legislation. These were reinstated through the *Electricity Act* in 2018.

One major policy effort in Ontario relevant to the building sector was its efforts to reduce electricity-sector emissions. In 2004, Ontario began to roll out feed-in-tariffs (FITs), which are a government-guaranteed price for electricity meant to incentivize certain types of investment. FITs were first implemented as a competitive RFP process. In 2006, Ontario added guaranteed 20-year prices for small hydro, wind, and biomass projects at 11 cents per kWh, with solar at 42 cents per kWh (Office of the Auditor General of Ontario 2011). Due to higher than anticipated uptake, the government's 10-year target of 1,000 MW of additional capacity was exceeded within a year (Office of the Auditor General of Ontario 2011).

Ontario reintroduced and revamped feed-in tariffs in the *Green Energy and Green Economy Act* in 2009 (Office of the Auditor General of Ontario 2011; Yatchew and Baziliauskas 2011; Mabee, Mannion, and Carpenter 2012). The new FIT program included a tariff schedule for larger projects up to 10 MW. The act also introduced MicroFIT, a renewable energy microgeneration program for projects generating less than 10 kW. The new FIT program offered higher prices, and the contracts also included a cost escalator that increased 20% of the contracted rate in line with the consumer price index (Yatchew and Baziliauskas 2011; Mabee, Mannion, and Carpenter 2012). While the FIT programs helped Ontario aggressively build out renewable capacity, they are widely criticized for increasing electricity prices above market rates and being a costly avenue for emissions reductions (Dachis and Carr 2011; Office of the Auditor General of Ontario 2011; Yatchew and Baziliauskas 2011; Mabee, Mannion, and Carpenter 2012; Goulding 2013).

Toronto

In 2010, the City of Toronto introduced the Toronto Green Standard (TGS): a two-tiered set of performance measures designed to promote sustainable development and reduce CO_2 emissions in the city's residential and non-residential building sectors (City of Toronto n.d.b). The City has

[15] Ontario does have a demand-side management program for natural gas conservation that affects the building sector, but the program targets energy conservation — to reduce emissions and energy bills — rather than natural gas use in buildings specifically (Walker and Yurek 2020; Ontario Ministry of Energy n.d.).

subsequently updated the TGS; the most recent edition, TGS Version 4, came into effect on May 1, 2022 (City of Toronto 2022a). To be compliant with the TGS, all planning applications for new developments must meet Tier 1 (mandatory) performance measures, which address air and water quality, greenhouse gas emissions, energy efficiency, solid waste, and other pertinent environmental issues. Developers who meet Tier 2 or above, a voluntary higher level of environmental performance, are eligible for a partial development charge refund (City of Toronto n.d.a). The City of Toronto (2022b) estimates the TGS annual GHG emissions reductions are 169,383 tonnes CO_2e.

Vancouver

Vancouver has more than two decades of experience with policy initiatives for reducing emissions in buildings and other sectors, starting with targets for 2020 in 2009 (City of Vancouver 2011; 2012). Its 2020 targets for buildings were two-fold (City of Vancouver 2012). First, for all new buildings to be operationally carbon-neutral starting in 2020. Second, to reduce existing buildings' energy use and emissions by 20 percent below 2007 levels. Vancouver's Greenest City Action Plan used five tools to achieve its targets: municipal policies, bylaws, and building codes requiring energy efficiency improvements across the building stock; financing tools; promoting economic incentives from non-city sources; local capacity building; and user engagement, education and outreach (City of Vancouver 2011). Vancouver did not meet its targets, but did reduce buildings' emissions per square metre by 81 percent and reduced total building emissions to 10 percent below 2007 levels (City of Vancouver 2021).

As part of the Greenest City Action Plan, Vancouver released a Zero Emissions Building (ZEB) Plan in 2016 (City of Vancouver 2016). The goal of the ZEB plan was to eliminate operational emissions from the majority of new buildings by 2025, and all new buildings by 2030 (City of Vancouver 2016). The City uses emissions and thermal energy limits to implement the plan, coordinated with the provincial Energy Step Code, to phase the limits to zero over time (City of Vancouver 2016; n.d.c). Vancouver has an additional target of reducing buildings embodied emissions by 40 percent below 2018 levels by 2030 (City of Vancouver 2020; n.d.c).

Vancouver building bylaws are enabled by a special provincial delegation of authority to the city via the Vancouver Charter (City of Vancouver n.d.b). The ZEB plan requirements were made mandatory in the bylaw for many building types, extending to all multi-family, high rise office, retail and hotels (City of Vancouver 2016; British Columbia 2023). Starting January 1, 2022 the building bylaw has required zero emissions equipment for space and water heating in new low-rise (up to three storeys) residential buildings (City of Vancouver n.d.a). Recent amendments to the Vancouver building bylaw include more stringent GHG limits for new buildings in 2023 and 2025 including embodied carbon standards (City of Vancouver 2022d).

In 2022, Vancouver enacted its Annual Greenhouse Gas and Energy Limits bylaw to address emissions from large (floor space over 4,645 m2) existing buildings and buildings with other specified uses (City of Vancouver 2022c). It includes a detailed annual energy and emissions reporting requirement for large buildings with a floor area over 9,290m2 in 2024 and 2025, depending on building type, followed by reporting for buildings over 4,645m2 in 2025 and 2026. Collectively, the reporting covers all occupancy types. The bylaw also signals building operational GHG emission and heat energy limits by 2026 and 2040. The bylaw is intended to fully decarbonize buildings by 2050 and limit heat energy required from purchased natural gas and district energy (excluding electricity).

Discussion and Recommendations

This section discusses how building codes can complement and supplement the existing policy environment, using the lens of market failures[16] and barriers that extant policy is unable to fully address. We begin with a discussion of potential interactions between the building code, building code design, and the policy environment. We follow with a discussion of barriers from the perspective of different stakeholder groups that interact with buildings.

Building Code Design and Interactions with the Current Policy Environment

The building sector faces many additional barriers to decarbonization beyond the well-known environmental externality (where the private costs of consumption differ from the social costs, such that these costs are not reflected in market prices, resulting in excessive emissions). For example, builders make design and technology choices that are not necessarily in the best interests of the occupant (or society as a whole) in terms of their operational costs and effect on emissions. This implies that even in a scenario where the cost of damages associated with emissions were internalized with a sufficiently high carbon price, there may be a need to implement additional policy to reduce emissions from buildings to address these additional market failures.

In practice, there exist a wide range of climate policies across jurisdictions in Canada described throughout this report which target different components of building decarbonization, from energy source decarbonization, to energy efficiency, to end-use fuel switching. In considering the role of building energy and emissions performance standards to drive decarbonization within this broader policy mix, it is necessary to examine how standards can help address existing market barriers.

Below, we outline six key considerations in decarbonizing the building sector and examine the potential role of building emissions standards and more stringent energy standards in addressing them.

Preventing technology and capital lock-in

The building stock is slow to change. The average remaining lifetime of commercial buildings in Canada is more than 55 years (Statistics Canada 2023b). This demonstrates how the building choices made today will affect emissions from the sector for decades into the future. For example, buildings designed with natural gas as the main source of space and water heating will need to undergo complex and costly retrofits to achieve Canada's decarbonization goals in the absence of non-emitting energy sources using the same infrastructure. Therefore, in setting the stringency of building performance standards, it is important to consider the role of technological lock-in and set standards in line with Canada's emissions objectives.

As we note above, relatively few policies explicitly target the new building stock — including four PTs with no policies that directly target new builds. Therefore, building codes can have an important role in addressing this issue. By incentivizing and in some cases requiring installation

[16] Where the allocation of resources does not maximise or optimize collective welfare.

of low-emissions technologies, building performance standards can help prevent the need for more costly future technology retrofits.

Buildings constructed under the 2020 and 2025 building codes will likely still be in their useful lifetime in 2050. As the target year for Canada to reach net-zero emissions, this means that in the absence of retrofits and negative emissions technologies, Canada would not meet its target. By setting ambitious performance standards as well as a clear path of increasing stringency through time, standards can help provide predictability to builders and producers of low carbon technologies and energy sources.

Addressing the principal-agent problem

The architects and builders making technology and design choices for a building are typically not the ones that will occupy it or pay the bills. Up-front technology and energy-source choices — such as whether to install natural gas heating or an electric heat pump — have major effects on the operational emissions of a building over its lifetime. Yet, the incentives for the builder do not necessarily align with the best interests of the occupant or society more broadly; this is known as the principal-agent problem.

The federal benchmark emissions price (set to rise to $170 per tonne CO_2e in 2030) will continue to make high-emitting fuels more expensive. This price is designed to make low-carbon technologies more appealing, while disincentivizing the use of high-emitting fuels. However, builders will not face the burden of this policy during operation of the building and therefore have no incentive to install low-emitting technologies from the outset, particularly if high-emitting choices have higher installation costs and lifetime costs appear less expensive initially. This leads to myopic investment decisions that minimize costs for the builders, and imposes greater costs on future occupants (who also remain susceptible to fossil fuel price fluctuations) and society which faces the cost of climate and air pollution damages.

This challenge is particularly salient for renters with the increase in construction of purpose-built rental properties. The proportion of households that own their home declined from 2011 to 2021 and the proportion of households renting increased to almost one third in 2021 (Statistics Canada 2022). Newly constructed buildings are increasingly likely to be occupied by renters, with more than 40 percent of new builds in the last five years tenant-occupied, the highest rate since the 1960s (Statistics Canada 2022). Correcting the principal-agent problem can help prevent builders from making myopic choices at the outset that force higher energy and policy costs onto future renters. Moreover, the principal-agent problem is exacerbated by the fact that renters are one step further removed from the builder's decision and that landlords do not have the necessary incentives to retrofit their rental properties to reduce energy use or emissions. Many of the abatement support policies in place to help reduce emissions from existing buildings take the form of consumption subsidies to install new technologies such as heat pumps. Often renters are ineligible for these incentives and unable to make decisions about the building they rent.

While many policies have been implemented to reduce energy source emissions or to provide financial support for homeowners and businesses to install lower-emitting technologies in existing buildings, comparatively few seek to correct this market failure at the point of construction. Examples include energy efficiency standards in buildings and for appliances, and targeted subsidy programs such as New Brunswick's New Home Energy Savings Program which subsidizes energy saving measures in new buildings.

Building codes have an important role in addressing these misaligned incentives through energy efficiency and insulation standards and emissions standards. Stringent energy efficiency and insulation standards minimize operational energy use, with near-term benefits in reductions in fossil-fuel and electricity use. The misalignment of incentives is likely to impede decarbonization and make the net-zero transition longer and costlier; a strong GHG standard in the building codes can also help correct this. Ensuring incentives are aligned for the building sector can help avoid the need for occupants to retrofit emissions reduction technologies and help accelerate decarbonization.

Filling policy coverage gaps

As we discuss above, policy coverage and density varies widely across jurisdictions in Canada. Moreover, the majority of building-sector policies are to incent voluntary action, which could limit their effectiveness in achieving widespread emissions reductions. Similarly, many of the policies have narrow scope, meaning they target a small share of Canada's emissions. This highlights a potential role for GHG standards in building codes to fill policy gaps and incent or require emissions reductions from unregulated activities. In particular, policies targeting new buildings are comparatively rare and represent a policy gap that building performance standards can address. Over the last five years, annual investment in new residential construction represented 3.1 percent of the residential building capital stock on average (Statistics Canada 2023a). This demonstrates that new buildings represent a relatively small fraction of the entire building stock in a given year. However, over the lifetime of the buildings, reducing operational emissions can be significant.

Additionally, investment in residential renovation added approximately 2.4 percent of the total residential building capital stock annually on average over the last five years (Statistics Canada 2023a). Therefore, expanding the scope of building performance standards to major retrofits and renovations could represent an opportunity to reach a greater proportion of the overall building stock that merits further evaluation.

Important for this discussion is how policies in addition to emissions pricing and the building codes interact with the design of emissions pricing schemes. Specifically, with a carbon tax, complementary policies and action layer on top of the existing price, and will result in further emissions reductions. In contrast, with a cap and trade system, the effect of complementary policies depends on whether or not these actions overlap with the emissions covered by the cap and trade system (Ragan et al. 2017).[17] Therefore, the relative effectiveness of policies targeting the building sector and the building codes themselves requires understanding the broader policy environment. This is scope for future work.

Other emissions sources are unlikely to be significantly affected by building performance standards. For example, energy source emissions (i.e., emissions from electricity generation) can have a major effect on the emissions profile of buildings in a jurisdiction (Figure 3 and Figure 4). However, the implementation of building performance standards are unlikely to affect the energy source decisions made by utilities. In such cases, alternative policies such as a clean electricity

[17] Ragan et al. (2017) cover the mechanism in detail. Briefly, when complementary policies change behaviour and cause emissions mitigation actions, demand for emissions permits within the cap-and-trade system falls. This reduces the market price for permits, lowering the incentive for emissions reductions and eliminating the incentive for actions that cost more than the permit price. The end result is mitigation from the complementary actions displaces mitigation actions incented by the cap-and-trade system, with no net effect on emissions.

standard, phase-out of coal-fired electricity, or performance standard applied to generators will have a much larger role in driving decarbonization.

At the same time, it is important to avoid unnecessary duplication of policy effort that places an undue burden on the building sector. For example, This is particularly important as many regions in Canada face challenges with housing affordability related to insufficient home stocks (Moffat, Dudu, and Hosseini 2022). Complying with new building performance standards could add significant time and cost to the development of new housing projects in order to demonstrate and verify the expected emissions of the building. The design and implementation of building performance standards must seek to avoid exacerbating Canada's housing crisis whilst addressing the climate crisis.

Ratcheting policy stringency

Emissions profiles of the building sector also vary across jurisdictions (Figure 3 and Figure 4). For this reason, a single building performance standard is unlikely to be able to both incent additional emissions reductions and be attainable in every jurisdiction in Canada. Following the tiered standard approach can allow for individual jurisdictions to adopt the standard that is both ambitious and attainable.

However, since the adoption of national model codes is optional within jurisdictions, there remains a risk that provinces lagging in climate policy effort may be similarly uninterested in adopting building performance standards. This is partially offset by FPT desires to harmonize the policy environment to minimize costs on businesses and consumers. Further, weak building performance standards adopted by jurisdictions with many other stringent climate policies have the potential to add duplicative regulation without contributing to additional emissions reductions.

Therefore, careful consideration of building performance standard design in the context of local and regional emissions profiles and policy environments will be necessary to ensure standards are set at an appropriate level. This is particularly important as a large number of policies (high policy density) does not necessarily mean a stringent policy environment that will incent significant emissions reductions. True stringency relies on the strength of the emissions-reduction incentive (including whether it is mandatory or voluntary) and the emissions subject to the policy (the breadth of emissions covered by the policy). Moreover, as we explain above, the additionality of emissions reductions from any interventions (whether via policy or building codes) depends on the main mandatory pricing lever (Ragan et al. 2017). Additionally, incorporating sufficient flexibility to adjust standards in response to changes in emissions factors across sectors (see the next subsection on electricity decarbonization) can help ensure standards motivate additional abatement.

Synergies through electrification

Canada has set a clear target to decarbonize the electricity generation across the country (Environment and Climate Change Canada 2022a). Policies targeting energy source decarbonization have contributed significantly to current emissions reductions. For example, Harris, Beck and Gerasimchuk (2015) credit Ontario's coal phase-out as "the single largest GHG reduction policy in North America". Building emissions performance standards have the potential to work in synergy with on-going electricity decarbonization policy through encouraging electrification. By helping to shift residential and commercial energy use toward a decarbonizing electricity sector, the effect of both policies can be enhanced. This will require regular updates to provincial emissions factors for energy sources such as electricity and sufficiently stringent standards to reflect this anticipated trajectory.

However, meeting Canada's increasing electricity demand with clean sources and ensuring its electricity grids are resilient to the negative effects of a changing climate remains a challenge. Therefore, energy efficiency and demand management policies all have an important role to play in addressing building energy use in the long-term and building emissions in the short-term.

Improved data and evaluation

Effectively designing and implementing building performance standards will require additional data and evaluation approaches. For example, data on heterogeneous energy use and emissions across the new and existing building stock would allow for a more nuanced understanding of opportunities to reduce building sector emissions. Additionally, detailed data on the state of the building stock and building technology adoption would help governments to better understand the effectiveness of different policy types and voluntary programs. This would include before and after energy use, and ensuring data is usable for and available to researchers for independent analysis. Data on the embodied emissions in buildings is also needed to better evaluate the potential of expanding building performance standards to include embodied emissions in the future.

Additionally, it is critical to ensure that standards are set in line with what is both measurable and achievable in practice. Evidence suggests that estimates for potential energy savings tend to overestimate observed energy savings in retrofit programs (Giandomenico, Papineau, and Rivers 2022). Ensuring methods are available and usable to accurately estimate building emissions *ex ante* to inform the design choices of builders and ensure compliance with the standards is imperative to a well-functioning policy.

Finally, consideration of the effect of building performance standards within the broader policy landscape requires improved metrics for evaluating a policy mix. In this report, we primarily discuss the quantity of emission reduction policies in a given jurisdiction. However, policy density is not necessarily reflective of policy stringency and coverage. Improved metrics for evaluating the coverage and stringency of policy mixes is a priority area for future research. Additionally, as more policies are implemented across Canada, further research measuring effectiveness of alternative policy interventions (e.g., emissions reductions associated with subsidies relative to regulations) can help inform design of the policy mix.

Barriers from Stakeholder Perspectives

Here, we provide a more detailed overview of the barriers to achieve decarbonization of new and existing buildings in Canada, the prospects of the National Model Codes for partly alleviating those barriers through adopting a new objective of limiting greenhouse gas emissions, and the remaining barriers that would need to be addressed by complementary (i.e., non-Codes) policy measures. The barriers fall broadly into five categories, depending on the key influencer party they affect.

There are barriers to <u>owners, investors and developers</u> to invest in design solutions that minimize GHG emissions. A common aspect is the perception of a lack of willingness-to-pay for low-carbon buildings by buyers and tenants, covered in the next paragraph. This leads the owner to seek the least-cost solution to comply with codes. As we note above, it also creates a principal-agent problem given that the owner doesn't pay energy bills or carbon pricing and thus will not benefit from reduced GHG emissions in operations. Builders may also perceive risk with specifying new technologies and designs and be concerned that their reputation could be compromised if the designs do not perform as expected. There are uncertainties on the cost of utility interconnection for electrified buildings. Performance gaps could manifest in complaints and warranty claims, higher maintenance costs, or non-compliance with standards of governments and utility incentive programs. Each sub-sector has different investment drivers, varying for purpose-built rentals (market), social housing, custom homes, speculation homes, condominiums, commercial and institutional buildings. National Model Codes can significantly address these barriers, provided they achieve widespread acceptance by the broader development community, reduce performance risk, facilitate competition, and are adequately enforced to ensure a level playing field to allow costs to be transferred to buyers (thereby mitigating the principal-agent problem). However, the current building code does not include a sector-specific approach to address the unique investment drivers. For example, purpose-built rentals are subject to rent control in some provinces and thus need predictability and cost minimization in solutions. Codes can be enhanced with cross references to professional practice guidelines and trades certification in emerging areas such as energy modelling, residential refrigeration contractor for heat pumps, airtightness detailing and testing, among others.

The second type barriers are those for building buyers and occupants. The lack of willingness-to-pay highlighted in the previous paragraph is a result of additional barriers. Information barriers are common, including technical complexity and apparent contradictions of information between competing utilities, multiple levels of government, manufacturers, nonprofits and contractors. Addressing this issue requires standardization and simplified labelling, referenced by Codes, including GHG emission performance. Buyers and occupants would benefit from having Model National Building Codes include use issues such as certification and labelling, common in equipment standards under the *Energy Efficiency Act*. Buyers and occupants may also have a perception of technical and financial risk due to underperforming equipment, both in terms of not achieving the manufacturer specs for energy performance, and also in terms of implications on comfort, maintenance costs and durability. This is particularly an issue when ex post energy use is higher than predicted by engineering models (Giandomenico, Papineau, and Rivers 2022). National Model Codes can address this by using verification studies that document performance based on measured data. Other orders of government can support this process by collecting detailed programmatic data and enabling independent research with said data.

There is also uncertainty about the future pricing of energy and the carbon tax, both of which contribute to the cost-effectiveness of owners and occupants' investment or the magnitude of their energy bills. Addressing this would require an independent forecast of costs and benefits, currently completed by utilities, but better published by a PT agency. These risks and uncertainties collectively contribute toward a perceived lack of resale value and lead to high discount rates that make capital-intensive designs less desirable. Finally, buyers and occupants may oppose full electrification and favour a dual fuel system for flexibility to respond to shifting rates, higher heating value and associated comfort, and reliability. The latter is a factor with increasingly common extreme weather events and other natural hazards leading to power outages. A full suite of utility regulatory system measures could help address these aspects, summarized below.

The third set of barriers apply to the different orders of government in Canada that share an interest in decarbonizing the building stock, but face competing political drivers such as addressing affordability for low- and middle-income constituents, funding healthcare and education, and other pressures of the day. Different orders of government also have different responsibilities and imperatives that result in policy differences across jurisdictions. Governments need to collectively avoid fragmentation that can confuse the market and lead to excessive costs (both taxpayer costs for administration and industry costs for compliance). National Model Codes can provide a foundation for consistency, provided that PTs and local authorities adopt those national standards in a timely fashion, the subject of the Construction Codes Reconciliation Agreement. However, the challenge with Codes is that the building stock turnover rate is low, given extensive technical lifetimes in the decades. As we note above, annual investment in new residential construction averaged 3.1 percent of the residential building capital stock between 2018 and 2022 (Statistics Canada 2023a), and the average remaining lifetime of commercial buildings in Canada is more than 55 years (Statistics Canada 2023b). Given the low building stock turnover rate it is imperative that governments deploy complementary measures to catalyse investments in existing buildings, keeping in mind these complementary measures should fill policy gaps. These investments have an important role in ensuring existing buildings achieve some or all of the emission reductions that the building code for new construction can achieve. Moreover, retrofits occur on a more frequent basis than the existing building code triggers for building replacement or comprehensive alterations to existing buildings. These measures, such as equipment standards or investment support for more frequent turnover of building assets such as heating equipment, can be supported by a harmonized building code for existing buildings, potentially with multiple tiers of performance standards.

As part of the harmonization process, and ensuring the Codes integrate with and complement current policy, the Codes could set future targets that voluntary policy measures support today and could be mandated as the minimum standard for Codes in the future. Codes and the complementary policy measures would be enhanced by preparing the building sector for more stringent standards in the future. This prevents technology lock-in.

A key gap in government policy relates to carbon accounting. Scope 1 emissions can be fully addressed by Codes. Scope 2 emissions can be tracked by utility regulation (we discuss further below). Scope 3 emissions such as renewable natural gas (methane) from biological waste (or biomethane) provide an opportunity for the building sector as a fuel replacement for natural gas (British Columbia Utilities Commission 2022).[18] Capturing such emission reductions requires a credible accounting system to track Scope 3 emission reductions from the production of biomethane for use in new and existing buildings. While contracts between a biomethane producer and a natural gas utility that sells to consumers is sufficient for tracking, a national accounting or certification system could increase stakeholder acceptance of the quality and persistence of the emission reductions, and that the emission reductions aren't double counted. Existing federal and provincial offset markets are a starting place, though consistency in offset protocols will be important (Dobson, Goodday, and Winter 2023). An alternative is low-carbon fuel standard certifications.

[18] As the global warming potential of non-fossil methane is 27 times that of carbon dioxide (IPCC 2021), capturing and combusting this source provides significant emission-reduction potential.

The fourth set of barriers relate to the government institutions that are delegated to implement legislation. These agencies, boards and commissions operate in a way that reflects the scope of their legislation and a particular slice of the building stock. The National Model Codes are implemented by PT ministries or agencies such as Régie du bâtiment du Québec. They are responsible for regulations based on the Codes that support objectives of safety, health, structural and fire protection, accessibility, and energy efficiency of building design. Additional PT standards apply to repairs, alterations and demolition of existing buildings. Separate institutional structures include:

- Electrical, gas, refrigeration and pressure vessel equipment safety requirements, led by third parties such as Technical Safety BC, applying at the time of installation until retirement.
- Equipment energy efficiency standards, led by Natural Resources Canada and some provincial ministries, applying at the time of installation and replacement.
- Public utility regulation, led by PT public utility commissions (PUC), responsible for approving utility resource planning, infrastructure, rate design, pricing of fuels and ensuring adequacy of community and Indigenous consultation.
- Emissions pricing, led by FPT finance ministries.
- Enforcement of codes, land use and airshed planning and zoning, led by municipalities, regional governments and PTs.
- Professional governance, led by PT professional regulators, responsible for professional practice guidelines.
- Builders and trades training, certification, governance, led by PT agencies

A key barrier for institutions is the legislative limitations to respond to emerging issues such as decarbonization of buildings and the slow process to amend legislation (including due to competing policy priorities). For example, equipment safety regulators do not have a specific mandate for climate action, but are a key influencer given their responsibility for electric and gas equipment. These regulators can enhance National Model Codes, but operate in a separate structure with PT ministries and local authorities. Another barrier may exist in the siloed strategic planning frameworks for each institution, focusing on their own mandates, potentially missing key opportunities for economy-wide optimization of policies and associated institutional actions to achieve decarbonization of buildings. A potential solution is to support development of individual PT frameworks for optimizing decarbonization of buildings across all regulatory structures and institutions, building types and ownership structures, and energy fuels. This could include a buildings "pathway" for decarbonization that considers all legislation and market structures, and which prioritizes legislative amendments collectively.

The final set of barriers apply to energy utilities (electricity, natural gas and district energy utilities). In addition to public interest decisions around energy infrastructure and prices, these utilities are responsible for demand-side measures that promote energy conservation, efficiency and peak-load management, and more recently fuel switching measures to promote zero-carbon (scope 1) fuels. Very few of the barriers for utilities can be addressed with building codes. The first barrier is that utilities do not have an explicit mandate to address climate change, and that public interest decisions rely primarily on cost and system reliability (Goodday, Winter, and

Westwood 2020). Relatedly, electrification of buildings generally causes increased demand in existing winter peak periods across Canada due to space heating. This means that high-capacity resources are required, including storage hydroelectric and peaking gas. Energy efficiency requirements in the building code are a potential preventative measure (via avoided demand). A possible solution is the establishment of a dynamic or time-of-use pricing system with supportive demand-side measures (DSM) that minimize that peak and ensure that revenues reflect the time-specific costs of providing capacity. Dynamic prices, as with high capital cost renewable investments, could introduce equity issues (Dolter and Winter 2022). The barrier of peak demand with electrification could be further addressed by providing utilities with control of loads that have minimal consequence if interrupted for short periods. The smart grid, smart meters, appliance hubs and smart appliances could enable this, and DSM could grant permission to the utility to turn-off water heaters and EV charging for short periods so that utilities can reduce their peaks. National Model Codes could support this by standardizing “smart” components in buildings that are ready for smart grid deployment. The Canadian Electrical Code could play a significant role as well. Collectively, data sharing and control-ready building design and components at the time of construction would prevent expensive retrofits of existing thermostats, water heater controls, EV chargers and electrical panels by occupants of existing buildings in the future.

In many instances, the National Model Codes are a key option for mitigation of the barriers we describe above. Current National Model Codes focus on new building construction, though Codes Canada is also developing a building code for alterations to existing buildings (the Alterations Code). The expansion of National Model Codes to apply to existing buildings will expand the barrier mitigation benefits. For owners and investors, it could provide certainty of the performance that will be sought at the time of major building renewal in the future, thereby legitimizing investments at opportune times for capital stock turnover. Furthermore, it could de-risk investments in design solutions and technologies that are also referenced by the Alterations Code, and increase the likelihood of industry and labour capacity to install those solutions, particularly with harmonization across Canada. For building buyers and occupants, it will define the standard performance that could be sought at the time of building purchase or occupancy. For governments and institutions it could be easily referenced in law and regulatory processes, minimizing the need for additional PT investment in policy development. Finally, for energy utilities it would provide a target for DSM that could aim to encourage early adoption of the standards associated with the Alterations Code. As Pape-Salmon (2016) outlines, the emission-reduction benefits of an alterations code are substantial — up to half a million tonnes of GHG reductions in BC by 2030 — with energy and carbon tax saving benefits exceeding incremental capital costs of building renewals by up to $439 million over the study timeframe.

Conclusions

In this report, we explore the interactions and complementarities between extant Canadian emissions-mitigation policy that affects the building sector and building codes. We provide a summary of federal, provincial, territorial (FPT) climate mitigation legislation, regulation, policies, programs, and targets — collectively, policies — that are relevant for Canadian building codes. We provide a comprehensive enumeration of relevant policies; classify these policies by instrument type, abatement channel, scope, and jurisdiction, among other characteristics; and describe their interactions. Our purpose is to identify which policies affect operational and embodied emissions in buildings, how these policies may affect these sources of emissions, and inform potential building code regulations related to emissions. With this report, we provide a surface view of potential interactions. Truly understanding interactions will require policy design details and implementation approaches. Further research will be required to evaluate the potential impact of such policies within each policy jurisdiction.

We can, however, draw some broad conclusions based on the results of our policy inventory. First, the majority of policies target existing buildings, and the majority of policies are voluntary. These facts mean that building codes have an important role in preventing future emissions by avoiding technology lock-in and by mandating performance requirements. Second, policy gaps remain — there are additional market failures other than that posed by emissions (e.g., misaligned incentives, information barriers, myopia in decision-making) and many building-sector policies have narrow scope, limiting their ability to address these additional market failures. Building codes, by mandating performance requirements, can partially or fully address these issues (depending on the stringency of the performance requirements). Third, by providing a signal with its tiered standards, the National Model Codes can allow for individual jurisdictions to adopt the standard that is both ambitious and attainable, supporting gradual stringency increases. Fourth, building emissions performance standards have the potential enhance emissions reductions from on-going electricity decarbonization policy. By helping to shift residential and commercial buildings' energy use toward a decarbonizing electricity sector, building codes supports additional societal benefits.

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Appendix I: Additional Coding Categories

Policy characteristic	Coding Categories
Jurisdiction	Federal, BC, AB, SK, MB, ON, QC, NB, NS, PU, NL, YK, NT, NU
Building emissions targeted	Embodied Operational Both
Building sub-sector	Commercial Residential Both C&R Public Indigenous All building sub-sectors
Building stock	Existing New Both existing and new (explicit targeting) Both existing and new (not explicit targeting)
Instrument Type	Abatement support Framework Information Mandatory Voluntary
Instrument	Emissions price Command and control Consumption subsidy (subsidizes consumption or uptake of a technology) Production subsidy (subsidizes production of a technology) Information Allowing activity: Enabling legislation or regulation to permit emissions reducing alternatives Financing (loan) Framework Procurement Information Performance standard (tradeable/non-tradeable) R&D Target Voluntary TBD: Policy Instrument has not been defined
Implementing Agency	Description of the organization in charge of implementation, if other than the initiating government.

Appendix II: NIR Canadian Economic Sector Definitions

Economic Sector	Description
OIL AND GAS	
Upstream Oil and Gas	Stationary combustion, onsite transportation, electricity and steam production, fugitive and process emissions from:
Natural Gas Production and Processing	natural gas production and processing
Conventional Oil Production	Emissions resulting from:
Conventional Light Oil Production	conventional light crude oil production
Conventional Heavy Oil Production	conventional heavy crude oil production
Frontier Oil Production	offshore and arctic production of crude oil
Oil Sands (Mining, In-situ, Upgrading)	Stationary combustion, onsite transportation, electricity and steam production, fugitive and process emissions from:
Mining and Extraction	crude bitumen mining and extraction
In-situ	in-situ extraction of crude bitumen including primary extraction, cyclic steam stimulation (CSS), steam-assisted gravity drainage (SAGD) and other experimental techniques
Upgrading	crude bitumen and heavy oil upgrading to synthetic crude oil
Oil, Natural Gas and CO_2 Transmission	Combustion and fugitive emissions from the transport and storage of crude oil and natural gas
Downstream Oil and Gas	Emissions resulting from:
Petroleum Refining	Stationary combustion, onsite transportation, electricity and steam production, fugitive and process emissions from petroleum refining industries
Natural Gas Distribution	Combustion and fugitive emissions from local distribution of natural gas
ELECTRICITY	Combustion and process emissions from utility electricity generation, steam production (for sale) and transmission. Excludes utility owned cogeneration at industrial sites.
TRANSPORT	Mobile related emissions including all fossil fuels and non-CO_2 emission from biofuels.
Passenger Transport	Mobile related combustion, process and refrigerant emissions from the vehicles that primarily move people around.
Cars, Light Trucks and Motorcycles	Light duty cars and trucks up to 3856 kilogram GVWR and motorcycles
Bus, Rail and Aviation	All buses and the passenger component of rail and aviation
Freight Transport	Mobile related combustion, process and refrigerant emissions from the vehicles that primarily move cargo or freight around.
Heavy Duty Trucks, Rail	Vehicles above 3856 kilogram GVWR and the freight component of rail
Aviation and Marine	Cargo component of aviation and all domestic navigation (inclusive of all fishing and military operations)
Other: Recreational, Commercial and Residential	Combustion emissions from the non-industrial use of off-road engines (e.g., ATVs, snowmobiles, personal watercraft), including portable engines (e.g., generators, lawn mowers, chain saws).
HEAVY INDUSTRY	Stationary combustion, onsite transportation, electricity and steam production, and process emissions from:

Mining	metal and non-metal mines, stone quarries, and gravel pits
Smelting and Refining (Non-Ferrous Metals)	Non-ferrous Metals (aluminium, magnesium and other production)
Pulp and Paper	Pulp and Paper (primarily pulp, paper, and paper product manufacturers)
Iron and Steel	Iron and Steel (steel foundries, casting, rolling mills and iron making)
Cement	Cement and other non-metallic mineral production
Lime and Gypsum	Lime and Gypsum product manufacturing
Chemicals and Fertilizers	Chemical (fertilizer manufacturing, organic and inorganic chemical manufacturing)
BUILDINGS	Stationary combustion and process (i.e., air conditioning) emissions from:
Service Industry	service industries related to mining, communication, wholesale and retail trade, finance and insurance, real estate, education, etc.; offices, health, arts, accommodation, food, information & cultural; Federal, provincial and municipal establishments; National Defence and Canadian Coast Guard; Train stations, airports and warehouses
Residential	personal residences (homes, apartment hotels, condominiums and farm houses)
AGRICULTURE	Emissions resulting from:
On Farm Fuel Use	stationary combustion, onsite transportation and process emissions from the agricultural, hunting and trapping industry (excluding food processing, farm machinery manufacturing, and repair)
Crop Production	application of biosolids and inorganic nitrogen fertilizers, decomposition of crop residues, loss of soil organic carbon, cultivation of organic soils, indirect emissions from leaching and volatilization, field burning of agricultural residues, liming, and urea application
Animal Production	animal housing, manure storage, manure deposited by grazing animals, and application of manure to managed soils
WASTE	Non-CO_2 Emissions from biomass resulting from:
Solid Waste	municipal solid waste management sites (landfills), dedicated wood waste landfills, and other treatment of municipal solid waste
Wastewater	municipal and industrial wastewater treatment
Waste Incineration	municipal solid, hazardous and clinical waste, and sewage sludge incineration
COAL PRODUCTION	Stationary combustion, onsite transportation and fugitive emissions from underground and surface coal mines
LIGHT MANUFACTURING, CONSTRUCTION AND FOREST RESOURCES	Stationary combustion, onsite transportation, electricity and steam production, and process emissions from (excluding LULUCF):
Light Manufacturing	all other manufacturing industries not included in the Heavy Industry category above
Construction	construction of buildings, highways etc.
Forest Resources	forestry and logging service industry

Source: Table A12-1 in Environment and Climate Change Canada (2022d).

Appendix III: Policy Inventory

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