Regulating Energy and Emissions in Existing Buildings: A Primer for Canadian Municipalities

Efficiency Canada

Carleton University

low carbon cities canada

This guide offers municipalities and policymakers insights into the role existing buildings are expected to play in meeting Canada's decarbonization goals. It highlights two unique tools to regulate retrofit activity in existing buildings: the Alterations to Existing Buildings code (AEB) and Mandatory Building Performance Standards (MBPS).

Development of the AEB is now underway as a national model code to regulate retrofit activities in existing buildings. The first half of this guide explores the principles and mechanics driving the development of the AEB. AEB requirements will be based on the voluntary actions of the building owner to 'alter' their building. While the AEB is expected to incrementally increase the energy efficiency of existing buildings, it is not likely to provide the volume, scale, or depth of building retrofits needed to reach Canada's net zero commitments. Nor will it consider GHG emissions as a primary objective until after requirements addressing emissions in new construction have been added to the 2025 national model codes.

To fill this critical gap, MBPS have emerged as a leading policy tool to drive deeper and more certain energy and emissions reductions. The second half of this guide highlights MBPS as an innovative policy tool that can be set at a federal, provincial/territorial, or municipal level. MBPS set predefined minimum energy and emissions performance standards for specific building types, to be met by a specific date. By signaling both the required end-state, and a series of interim requirements, MBPS provide the certainty needed for property-owners to plan a managed transition to near-zero emissions. It will also give policymakers the flexibility to target specific segments, building types, and/or specific objectives.

Municipalities are seeking regulatory tools that can help them quickly cut energy waste and emissions from the built environment, particularly from existing buildings. This guide sets out an innovative policy framework to help achieve this. In concert with the AEB, MBPS are essential tools providing municipalities with a framework for regulating energy and emissions in Canada's existing buildings and a path to ensure existing buildings are a core component in reaching our net zero commitments.

How to navigate this guide

Thanks

This report was funded by the LC3 network. We would like to thank the LC3 network's advisory group and other building practitioners and policymakers who provided insights and perspectives on what Canadian municipalities need to know to ensure it is best tailored to municipal needs and they are better prepared for regulations such as the Alterations to Existing Building code and Mandatory Building Performance Standards.

About Low Carbon Cities Canada (LC3)

Low Carbon Cities Canada (LC3) supports cities in reaching their carbon emissions reduction potential. LC3 is a collaboration among seven local Centres in Canada's largest urban areas and the Federation of Canadian Municipalities (FCM).

LC3 helps demonstrate, de-risk and scale up local solutions to climate change, while embedding equity principles to ensure members of all communities receive access to resources and skills. LC3 was established thanks to an endowment from the Government of Canada.

About Efficiency Canada

Efficiency Canada is the national voice for an energy efficient economy. Our mission is to create a sustainable environment and better life for all Canadians by making our country a global leader in energy efficiency policy, technology, and jobs. Efficiency Canada is housed at Carleton University's Sustainable Energy Research Centre, which is located on the traditional unceded territories of the Algonquin nation.

The views expressed, as well as any errors or omissions, are the sole responsibility of the authors.

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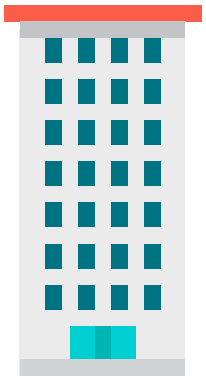
Buildings sector decarbonization runs through existing buildings

New and existing buildings account for approximately 18 per cent of Canada's greenhouse gas (GHG) emissions.[1] New buildings regulated under provincial and territorial building and energy codes are expected to reach net zero energy-ready standards by 2030. But there is currently no national building code to advance the energy and emissions performance of Canada's existing building stock.

Canada's existing building stock[2]

Residential Buildings

- Number of buildings: 16 million
- Floor area: 2,176 million m^2
- Secondary energy use: 1536 PJ
- GHG emissions: 63.3 Mt CO_{2e}



Commercial and Institutional Buildings

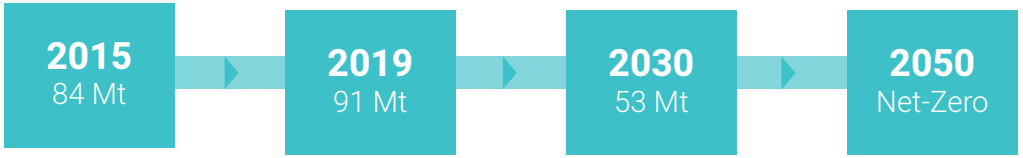
- Number of buildings: 556,000
- Floor area: 709 million m^2
- Secondary energy use: 1204 PJ
- GHG emissions: 58.8 Mt CO_{2e}

[1] The IEA's 2022 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector estimates embodied emissions represent an additional 9 per cent of buildings sector emissions.
[2] Statistics taken from Natural Resources Canada (2019), Comprehensive Energy Use Database for 2019 and Statistics Canada, (2014) Survey of Commercial and Institutional Energy Use Database: Commercial and institutional building, The GHG emissions include electricity-related emissions.

Most buildings standing today will continue to be in service in 2050. This means we need to retrofit nearly every building currently in use. And to do so, Canada needs a practical regulatory framework to encourage faster, deeper energy and emissions reductions in its existing building stock.

This framework can underpin Canada's climate commitments to reach net-zero emission by 2050 and reduce direct building sector emissions by 37 per cent or 53 Mt by 2030.

Figure 1. Canada's Buildings Sector Emissions and Goals



Adapted from Canada's Natural Resources Canada's Green Buildings Strategy, June 2022.

Today, 80 per cent of Canadians live in municipalities.[3] The buildings that enable our daily activities account for up to half of a municipality's emissions and energy. To meet the demands of our growing population, vast numbers of buildings will need to be retrofitted.

Retrofits must focus on reducing emissions and energy use, while maximizing the benefits for building owners, occupants, and residents. For municipalities, it's an opportunity to strengthen existing energy systems, build resilience against extreme heat or other weather events, and protect building and homeowners against rising energy costs.

[3] Statistics Canada, Population Growth in Canada's Rural Areas, 2016 to 2021. Accessed September 28, 2022.

Regulating existing buildings reaps broad benefits

To reach its climate commitments, Canada must move far beyond today's relatively modest pace and scale of retrofits. We have to lift the national rate of building retrofits to at least 2.5 per cent each year by 2030, up from less than one per cent today. Each year we delay will require deeper interventions in the coming decades.

To decarbonize our buildings sector, we need to ensure all buildings — new and existing — are on a path to net-zero energy and emissions. Based on a building's age and condition, this target is best achieved through whole building electrification, or deeper energy retrofits that combine electrification with other measures. As defined in Canada's Green Buildings Strategy, deep retrofits can target reductions in energy use by 70 per cent, and emissions by 80 per cent or greater.[4]

This will mean deeper retrofits at a greater scale, thereby straining all facets of the retrofit economy from workforce capacity to enabling financing.[5] Instead, early action can place municipalities as catalysts in the retrofit economy, ready to capture the benefits. Beyond climate commitments, renewing our building stock will meet the needs of those who live, work, play, and gather in them for decades to come.

[4] Natural Resources Canada, The Canada Green Building Strategy. July 2022.
[5] International Energy Agency, Net Zero by 2050. October 2021.

The benefits of regulating existing buildings

Existing buildings significantly outnumber newly constructed buildings and are a core component in cutting energy use and emissions in the clean economy.

Retrofit activity stays in the local economy. Sixty per cent of retrofit expenditures go toward labour. According to the Canadian Homebuilders Association, home retrofits and repairs create nearly 850,162 jobs, $56.5 billion dollars in wages and $102.4 billion in investments each year.[6]

Retrofits are an opportunity to improve the health and comfort of occupants through reduced noise, comfortable indoor temperatures and better indoor air quality.

Energy and emissions retrofits can reduce dependence on conventional energy supplies and, in some areas, occupants and building owners benefit from reduced energy costs. This can also reduce exposure to future increases in carbon pricing and sustainability compliance requirements.

Occupants benefit from increased hours of safety in the event of power outages through renewable energy sources, battery storage, and electric vehicle charging.[7]

Weatherization improvements, adequate ventilation and air filtration, can reduce the vulnerability of occupants to extreme weather events, including forest fires.

By addressing deferred maintenance issues, and preparing the building for future use, the longevity and performance of buildings can be secured.

[6] Canadian Homebuilders Association, Residential Construction in Canada: Economic Performance Review 2021 with 2022 Outlook.
[7] Urban Land Institute, Resilient Retrofits: Climate Upgrades for Existing Buildings. Washington, DC: Urban Land Institute, 2022.

Existing building retrofits present unique barriers

Building energy retrofits can advance multiple objectives including housing affordability, climate mitigation and adaptation, poverty reduction, and public health. But there are significant barriers that limit the volume of energy and emissions retrofits.

Retrofits can:

- Be disruptive for occupants who may need to find alternative accommodation.
- Be complex and confusing to navigate and execute.
- Require high upfront investment costs.
- Be difficult to sequence without creating additional burdens for building owners. For example, while most existing natural gas heating and hot water systems will be replaced with high-efficiency electric heat pumps, these systems tend to only get replaced once every 10 to 15 years for water heaters and 20 to 25 for boilers.
- Place energy efficiency upgrades against other building owner priorities.
- Create split incentives, which occur when those responsible for paying for energy efficiency measures, typically the building owners, are not the same as those paying the energy bill, i.e. the tenant.
- Drive unpermitted retrofit activity to avoid code compliance and associated costs.
- Present challenges for contractors and design professionals unfamiliar with designing and implementing energy retrofit measures, as well as budgeting costs and allocating risks. This is particularly the case for deep retrofits.
- Present challenges for authorities having jurisdiction related to administrative, training, and enforcement burdens.

A bigger challenge in reaching our 2050 climate commitments may be increasing the long-standing retrofit rates in Canada, and ensuring those retrofits are carried out at a deeper scale.[8] Deep energy retrofits are expected to play an important role in the decarbonization of the buildings sector.[9] To play this role, the regulatory environment — building codes and related standards — must enable innovative paths to mandate, support, and incentivize ambitious retrofit rates.

[8] Haley, Brendan and Torrie, Ralph (2021), Canada's Climate Retrofit Mission – Why the climate emergency demands an innovation-oriented policy for building retrofits.
[9] Canada Green Building Strategy. 2022.

The current regulatory environment for existing buildings

Canada's national model codes, including the AEB, are developed at the federal level by the Canadian Board for Harmonized Construction Codes (CBHCC). National model codes are adopted by provinces and territories, and select municipalities. Municipalities, acting as authorities having jurisdiction (AHJ), are then tasked with the implementation and enforcement of the building code.

Increasingly, municipalities are turning to building codes and standards to address their most urgent policy goals. Examples include building sector decarbonization and climate change resilience, particularly when quick and effective action is required. New construction code improvements are expected to impact about 25 per cent of 2030s building stock. Unfortunately, 75 per cent of the anticipated building stock in 2030 is already built. And, we do not currently have a harmonized regulatory framework governing retrofit work in existing buildings in Canada.[10]

Federal Government

- CBHCC develops a model code (AEB)
- Develops supportive technical tools
- Supports implementation via knowledge/training moduls

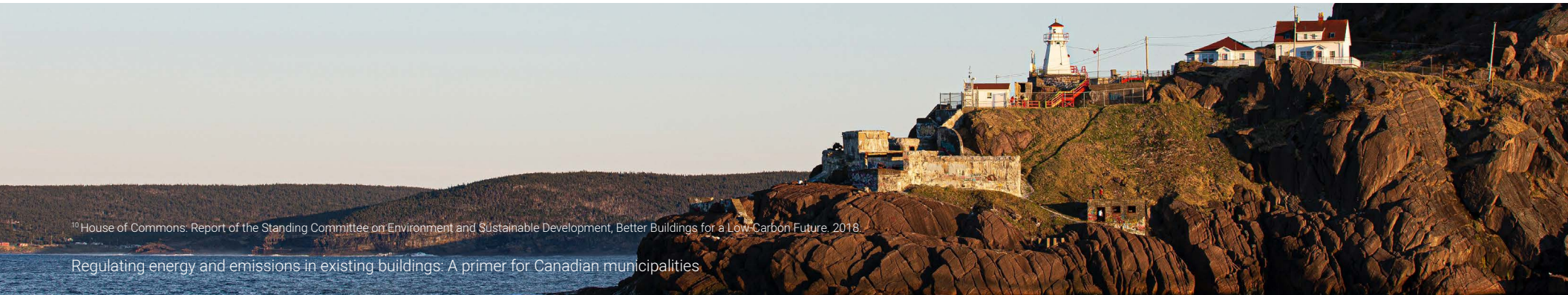
Provincial Government

- Adopts model code as per Construction Codes Harmonization Agreement
- Sets implementation schedule for provincial building code

Municipalities (AHJ)

- Responsible for code compliance enforcement
- Sets additional standards, bylaws, and requirements

Without the guidance of a harmonized, Pan-Canadian framework, a fragmented approach to regulating existing buildings has unfolded. To fill this gap, some provinces, territories, and municipalities have adapted building codes intended for new construction. They typically have no or few requirements to address emissions or energy efficiency when applied to existing buildings. They also aren't well-suited to address the unique conditions and considerations of existing buildings. This has forced code officials and code users to apply incomplete and difficult to understand code requirements related to existing buildings.



[10] House of Commons: Report of the Standing Committee on Environment and Sustainable Development, Better Buildings for a Low-Carbon Future. 2018.

Code	Coverage	Building code applies to	Metric/triggers	Compliance
National Energy Code for Buildings (NECB)	NECB is intended to regulate new construction and additions. It can also apply to alterations to buildings that were built in compliance with the NECB.	Typically, Part 3 buildings classified as Group A, B or F-1, or exceeding 600 m^2 in building area or exceeding three storeys in building height and have major occupancies.	Some energy metrics may be triggered by a permit for the alteration, renovation, change of use or occupancy of an existing building.	Prescriptive and performance.
National Building Code (NBC)	Part 8 of the NBC (Safety Measures at Construction and Demolition Sites) outlines safety provisions related to the alteration and repair of existing buildings.	Part 9 buildings are three storeys or less, have a building area less than 600m^2 and have major occupancies classified as Group C (residential), D (office/service), E (retail), or F-2, F-3 (medium- and low-hazard industrial).	Some energy metrics may be triggered by a permit for the alteration, renovation, change of use or occupancy of an existing building.	Prescriptive and performance.
Vancouver Building Bylaw (VBBL), Part 11 (Existing Buildings)	Ensures work on an existing building is upgraded to an acceptable level.	Residential (other than one and two family residential) and non-residential.	Energy and emissions metric triggered by repair/small suite, renovation, reconstruction, change of occupancy classification or addition.	Prescriptive with performance components (e.g., lighting, power density).
BC Building Code (BCBC)	Regulates new construction, alterations, repairs and demolitions including energy and water efficiency requirements.	Simple buildings and complex buildings (Part 3 and Part 9). Requirements are based on the differences in building size and use.	TEUI and TEDI triggered by alteration, renovation, change to its use or occupancy, has components replaced.	Prescriptive and performance.

Code	Coverage	Building code applies to	Metric/triggers	Compliance
Quebec Construction Code Part 10 "Existing Buildings under Alteration, Maintenance or Repair"	Requirements apply to existing buildings where provided in the regulations.	Alterations of an existing building or part of a building.	Based on the scope of renovations energy metrics may be triggered. Includes change in occupancy (where there is no alteration work and an increase in the number of occupants), a building becoming a high building, or major alteration.	Prescriptive and performance.
Ontario Building Code incl. SB10 "Energy Efficiency Supplement"	Minimum requirements for new buildings, change of occupancy (Part 10), and renovations (Part 11).	Commercial and residential with exemptions.	Based on the scope of renovations energy and emissions metrics may be triggered.	Prescriptive and performance.
ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings	Referenced in provincial and municipal building codes in Canada. ASHRAE has committed to a net zero carbon 90.1 model code by its 2031 version.	Applies to both new and existing buildings (Part 3). Outlines specific compliance conditions for existing buildings.	Typically applies to "above code" programs or as an alternate compliance path to the IECC	Prescriptive and performance.
ASHRAE 100 - 2015 -- Energy Efficiency in Existing Buildings	Residential and non-residential.	Performance-based standard for energy efficiency in existing buildings.	EUI based on the measured data from 53 building types. Buildings that meet the target EUI are in compliance.	Performance.

A national model code for existing building alterations

The absence of requirements that drive the energy efficiency and emissions performance of existing buildings was recognized in Canada's Pan-Canadian Framework on Clean Growth and Climate Change (PCF). The PCF laid out a new future for the Canadian buildings sector. In addition to action on new buildings in the development of net-zero energy codes, it includes a commitment that will see federal, provincial and territorial governments work together to, "Develop a model code for existing buildings to help guide energy efficiency improvements during renovations."[11]

Canada's strengthened climate plan, A Healthy Environment and a Healthy Economy, commits to building on the PCF by continuing work with provincial and territorial governments to develop and publish a new model code for alterations to existing buildings by 2025.[12] This model energy code is now under development. It is expected to guide energy efficiency improvements in Canada's approximately 16.5 million existing residential, commercial, and industrial buildings. While standard building codes are expected to cut emissions from new construction, the remaining reductions must be met through activities that address existing buildings.

The AEB will be based on the most recent National Building Code (NBC 2020) and National Energy Code for Buildings (NECB 2020). As outlined in the foundational CCBFC/PTPACC Final Report - Alterations to Existing Buildings, it will be defined by eight principles (see table below). These principles recognize the challenge in applying current code requirements intended for new construction to existing buildings, particularly when based on the voluntary renovation actions of the building owner. They are intended to balance affordability and the need to "optimize the opportunity for improvement"[13] with a number of other considerations including maintaining life safety and building integrity, and avoiding unnecessary burdens on the building owner.

[11] Pan-Canadian Framework on Clean Growth and Climate Change.
[12] Government of Canada, A Healthy Environment and a Healthy Economy. 2021. Accessed March 28th, 2023.
[13] Canadian Commission on Building and Fire Codes, Final Report - Alterations to Existing Buildings Joint CCBFC/PTPACC Task Group on Alterations to Existing Buildings. April 2020.

The eight overarching principles of the AEB

Close the performance gap between the new and existing building stock.

Maintain or increase life safety and overall building performance level. Don't make the building worse.

Avoiding negative unintended consequences or unrealistic expectations.

Ensure that any retrofit work does not leave the building in an unsafe state.

Require flexibility to encourage alterations to existing buildings rather than placing an undue burden on owners, which could lead them to avoid planned alterations or turn to the "underground economy."

All regulatory measures should be reasonable, pragmatic and effective.

Requiring flexibility so as to preserve officially recognized heritage elements.

Regulatory measures and voluntary programs should complement each other.

Adapted from Canadian Commission on Building and Fire Codes, Final Report - Alterations to Existing Buildings Joint CCBFC/PTPACC Task Group on Alterations to Existing Buildings April 2020.

A core component of the AEB will be the 'buildings-as-a-system' approach. It recognizes the combination of materials, components or assemblies that make up the building's systems — the HVAC system, building envelope assemblies, or air barrier system, and the interactions of those systems.[14] Each interacts with one another and must be considered as a dynamic system to avoid disrupting the performance of another system, or the building as a whole.

[14] Ibid.

Renovation actions trigger mandatory requirements

The AEB will be triggered by renovation action(s) taken at the owners behest — upgrades, repairs or replacements to a given system or component of a system. It applies to the portion of the building that is being altered or any new additions to the existing building. How code requirements are triggered is one of the core challenges inherent in a retrofit code such as the AEB. How can the voluntary action of the building owner be leveraged to trigger AEB requirements while balancing the concerns of the project proponent as they relate to cost, scope, or the complexity of planned alterations beyond the owners original intent?[15] More importantly, how can these voluntary triggers spur the uptake of energy efficiency measures and provisions to cut emissions in existing buildings.

Trigger points are the "critical decision points that determine whether or not a building requires mandatory upgrades." These decision points help define the scope of renovation activity, whether or not specific renovation activity warrants building codes intervention, and how extensive the technical requirements applied will be.[16]

The concept of trigger points was laid out by the CCBFC in its 2020 Final Report - Alterations to Existing Buildings[17] and include:

1. The maintenance, repair or replacement with a similar system or component. This can include, for example, a single component of a system or a component in that system, or replacement with a component that is similar in function to the one already in use.
2. Change of occupancy type.
3. A new addition.
4. The reconfiguration of the existing space.
5. A system(s) upgrade.
6. Other, a term used to define triggers for potential project types that have yet to be identified.

Notably, costs are not considered a trigger for AEB requirements. As experienced in the rollout of the Vancouver Bylaw 10908, triggers based on project cost tend to encourage the tailoring of such costs to fall below the threshold set by the city, thereby skirting AEB requirements. The absence of costs also reflects the significant variation in costs in markets across Canada, and the potential to drive renovation/retrofit activity underground. These factors could undermine energy and emissions objectives,[18] not to mention create unsafe conditions within a given building.

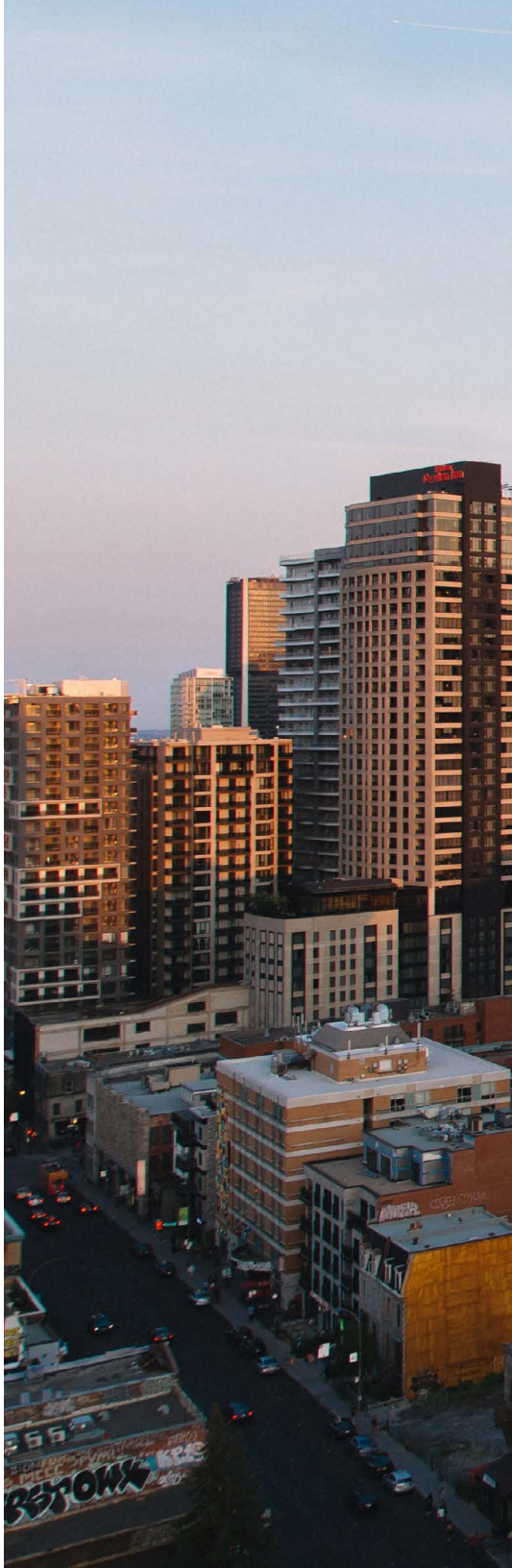
[15] Ibid.
[16] Canadian Commission on Building and Fire Codes, Final Report - Alterations to Existing Buildings Joint CCBFC/PTPACC Task Group on Alterations to Existing Buildings. April 2020.
[17] Ibid.
[18] Ibid.

Mechanics of the AEB

Once triggered, renovation activity under the AEB falls into one of three categories (see below) to determine if the activity is exempt from AEB requirements. Projects that maintain, repair, or replace an assembly or systems in a like-for-like manner can be expected to be exempt as long as the performance of the building is no worse than before the intervention took place. On the other hand, projects may be required to follow AEB provisions based on the building type, project size, and complexity of the proposed project. Based on the level of activity, these requirements are considered minor or major alterations. For example, if a systems upgrade, space reconfiguration, change of occupancy, or addition is planned by the building owner, the scope of the project will determine if it is a minor or major alteration.

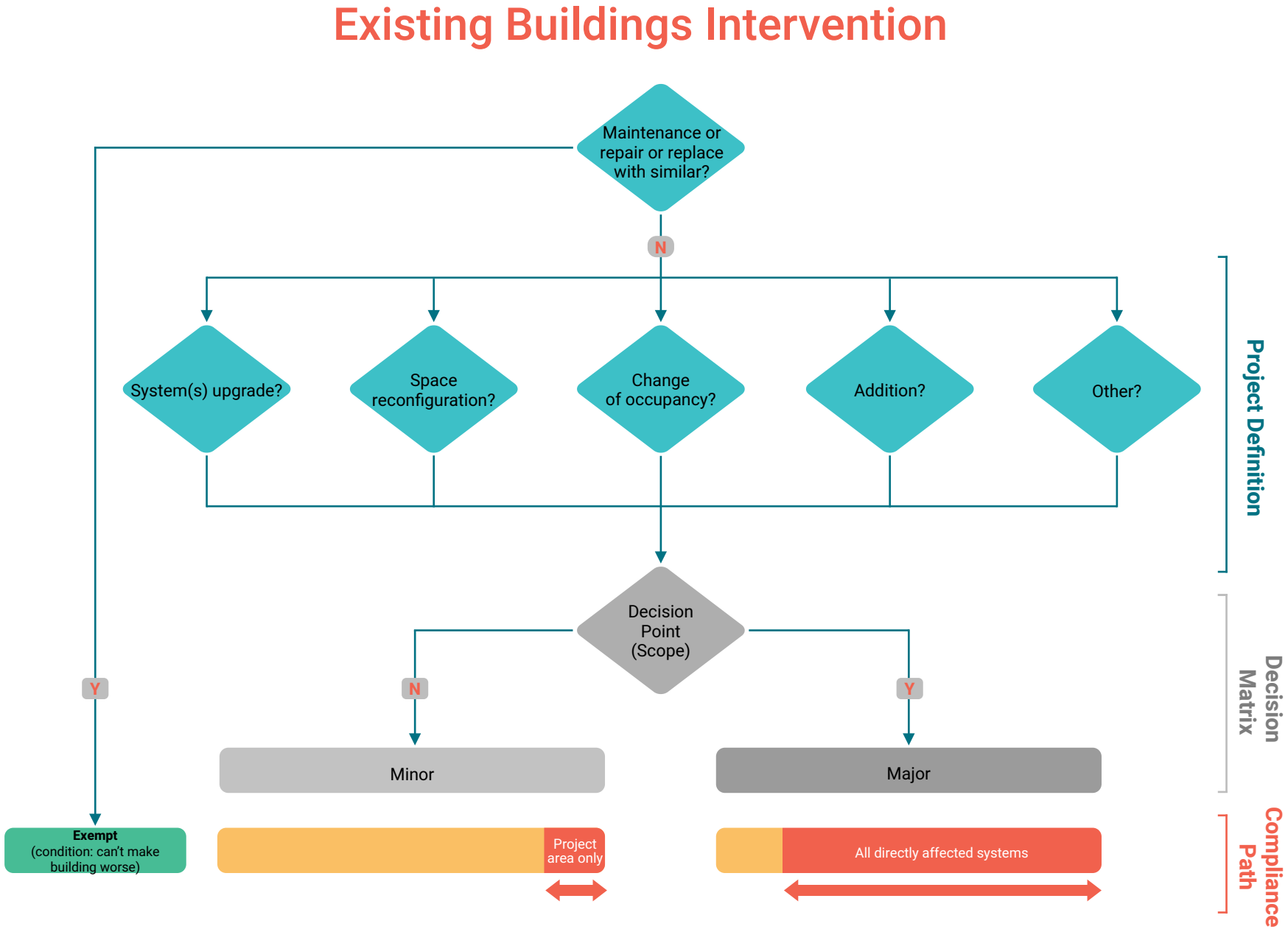
Intervention level[19]	AEB requirements
Exempt	Building renovations or interventions that do not leave the building in a worse state (in relation to code objectives). This can include maintenance, repair, or replacement.
Minor alteration	These are typically stand-alone projects and alterations, limited to the project area, and default to the current code requirement barring any potential exemptions.
Major alteration	Major alterations apply to everything outside the scope of a minor alteration. It includes all affected systems in the area of work which must be brought up to current code requirements, other areas impacted by the alteration, or where the alteration provides an opportunity to raise the performance of other systems and elements.

How the AEB is triggered, and the scope of work proposed, define whether a project is considered minor, major or exempt. A conceptual diagram of this interplay was presented in the Final Report - Alterations to Existing Buildings Joint CCBFC/PTPACC Task Group on Alterations to Existing Buildings.



[19] Ibid.

How trigger points and the scope of work determines a project's compliance path.



Adapted from the CCBFC Final Report - Alterations to Existing Buildings Joint CCBFC/PTPACC Task Group on Alterations to Existing Buildings

Enforcing compliance with AEB requirements

Similar to code compliance in new construction, AEB requirements will be enforced by the AHJ. Compliance continues to challenge AHJs across Canada. Achieving high levels of compliance with the AEB will require education, training, tools and incentives for renovators, municipalities and industries.[20]

One of the core challenges for municipalities will be how concessions and exemptions are provided in situations where it is not technically feasible to meet the required provisions. For example, in heritage buildings where requirements may threaten, degrade or destroy the historic form, fabric, or function of the buildings, or where it will result in undue hardship for the building owner. AHJs will need to evaluate and address exemptions on a case-by-case basis to ensure requirements are technically possible, and avoid placing additional burdens on the building owner.

To prepare for implementation of the AEB, municipalities acting in the role of AHJ can begin developing pre-compliance materials. This could include guidelines and definitions, resources to support code compliance enforcement for industry, building officials, and building owners. Municipalities can also consider penalties for non-compliance in the form of stop work and compliance orders as is the case with the Ontario Building Code's Part 10, or financial penalties.[21]

[20] Dunsky Energy + Climate. Alterations to Existing Building Codes. Jurisdictional Scan. Prepared for Natural Resources Canada.
[21] Ibid.

The AEB is limited in reach

Reaching our climate commitments, namely our net-zero by 2050 objectives, demands a marked increase in the pace and scale[22] of how we retrofit our existing buildings. The AEB has a fundamental role in this transition. It will deliver to municipalities, acting in the role of AHJ, a much-needed regulatory backstop for an expected increase in retrofit activity in the coming years. Nonetheless, there are limitations to how effective an AEB code based on voluntary renovation work can be in driving the energy and emissions performance of existing buildings.

As development of the AEB has begun to take shape over the last several years, it has become clear that there are inherent limits related to the use of energy codes applied to existing buildings. These include:

Triggers: The basic trigger for existing building retrofit activity is a one-time requirement to improve the energy efficiency of the building. Because these triggers are based on the scale and scope of the retrofit intervention, there is a risk that bad actors could tailor or manipulate interventions to avoid triggering code requirements.[23]

Lower volume of activity triggered: Due to its voluntary triggers, only a small percentage of the existing building stock is subject to AEB requirements. And, an even smaller portion of the building is subject to AEB requirements. This approach recognizes that highly stringent requirements will push retrofit activity to be put off or to be conducted without proper permits. Applying it to the AEB will not be enough to reach the pace and scale of energy and emissions retrofits needed to meet Canada's climate commitments.[24]

Sequencing: Financing for building alterations is often secured before permitting is sought. In some cases, particularly as the AEB is first adopted by provinces and territories, adding additional requirements has the potential to trigger a cascade of additional costs. This includes amendments to approved designs, architectural and technical documentation, and energy and emissions modelling.[25]

[22] The Global Alliance for Buildings and Construction Roadmap for Buildings and Construction (Global ABC/UNEP/IEA 2020) identified increasing deep energy renovations that reduce energy consumption of existing buildings by 50 per cent or more in developed economies and increasing annual renovation rates globally to 4 per cent by 2050 from a current rate of less than one per cent are needed to achieve global 2050 net zero commitments.
[23] Hinge, Adam and Brocklehurst, Fiona.IEA-EBC Building Energy Codes Working Group, Building Energy Codes and Other Mandatory Policies Applied to Existing Buildings. June 2021.
[24] Dunsky Energy + Climate. Alterations to Existing Building Codes. Jurisdictional Scan. Prepared for Natural Resources Canada.
[25] Hinge and Brocklehurst. 2021.

Compliance: Enforcing code compliance in existing buildings raises new challenges related to the scope of work considered. And, critically for municipalities, careful interpretation of exemptions and concessions and increased demands on building officials. Compliance with the AEB may vary from jurisdiction to jurisdiction as the priorities of each are emphasized in the compliance framework.

Systems: The AEB is based on a buildings-as-a-system approach. It must take into account the challenges presented by introducing newer code requirements in buildings that were built to less stringent building codes, or were built before building codes were in place. One of the core principles of the AEB is to maintain life safety and ensure the building's conditions are not worse off than before alteration work began. As such, it demands careful attention to the interaction between the building's major systems such as HVAC, building envelope, etc.

Emissions: Emissions will not be an immediate requirement for the AEB, but will be considered after requirements for new construction have been added to the 2025 national model codes. Until that time, there is no emissions objective within the national model codes that will see demands for the carbon or emissions performance of buildings subject to AEB requirements. Nor are there incentives to encourage fuel switching or the use of low-carbon heating systems. While this can be expected to change in coming code cycles, municipalities and some provinces/territories are urgently focused on reducing emissions arising from existing buildings.

The AEB has the potential to be an important lever in how Canadian provinces, territories, and municipalities regulate construction activity in existing buildings. Nonetheless, it is unlikely to drive the energy and emissions reductions necessary to achieve Canada's climate commitments. Any delays in accelerating the depth and scale of retrofits have the potential to force a steep increase in retrofit activity needed to meet our climate commitments by 2050. This can then be expected to result in a sharp increase in thermal energy and electricity demands, thereby putting further strains on our electricity grid. Without complementary policies, namely MBPS, this risk becomes clear and present.[26]

Building code requirements, including those under consideration for the AEB, typically apply only to those buildings undergoing significant voluntary renovation activities. However, the worst performing buildings are often the least likely to undertake major renovations. MBPS, on the other hand, can be designed to target the worst-performing buildings using building performance benchmarks that identify those with below-average performance.

[26] International Energy Agency, Net Zero by 2050 - A Roadmap for the Global Energy Sector, 2022.

The power of MBPS

Mandatory Building Performance Standards (MBPS) are also often referred to as Minimum Energy Performance Standards (MEPS) or Minimum Energy Efficiency Standards (MEES). They set performance limits for existing buildings that need to be met by a specified date or upon the occurrence of a triggering event, such as during major renovations or building transactions. MBPS are legally binding with the risk of liability and financial penalties for non-compliance.

These mandatory policies act as a "stick", alongside a supportive framework of financial assistance, practical support, and social safeguards for disadvantaged populations. Beyond providing information to the market, MBPS guarantee the renovation of the worst-performing buildings towards a desired end goal.

MBPS build on voluntary measures and programs, such as benchmarking, labeling, financing, subsidizing, and incentivizing energy efficiency. These voluntary measures have been effective in raising awareness about building energy use and emissions but have been largely ineffective in triggering the scale of retrofit activity required to meet our climate commitments in a way that MBPS can.

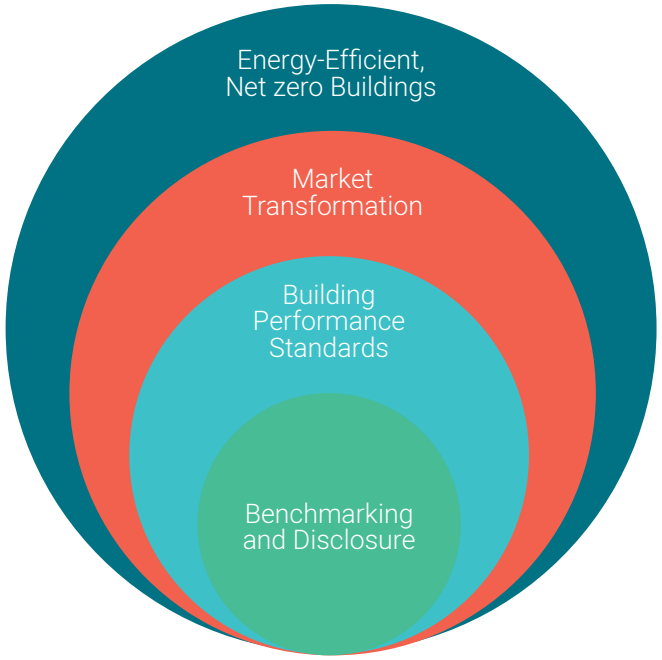
This guide explores the effectiveness of MBPS to trigger retrofit activity in Canada's existing buildings. Given that MBPS typically apply to commercial buildings, topics including the application of MBPS to single-family homes, specific technologies such as heat pumps to drive decarbonization, and life-cycle perspectives including embodied carbon are not covered.

Benchmarking and transparency are the foundation of MBPS

Benchmarking is one of the core precursor activities to MBPS. It measures the operational performance of a building over time and compares it to similar building types and sizes. It is used to establish a building's baseline energy performance, set performance goals, track and improve ongoing energy use, and identify buildings that are ripe for efficiency investments. Although benchmarking policies do not mandate energy improvements or emissions reductions, consistent benchmarking can result in an average annual energy savings of 2.4 per cent.

MBPS build on existing or planned benchmarking programs to identify the building type and size to target for improvement. Informed by benchmarking data, policymakers can align building sector decarbonization goals with local priorities such as the impact on their community (e.g., building owners, landlords, renters, and higher-risk populations). Benchmarking data can also be used to develop ambitious, but achievable, performance targets and identify the levels of support needed for program outreach, support, and investment.

Benchmarking and disclosure are the bedrock of MBPS. Unlike benchmarking and disclosure, MBPS triggers market activity by requiring building owners to take action to meet the performance targets.



Benchmarking in Canada

- In 2013, Canada adopted a national energy benchmarking system for commercial and institutional buildings. Since then, ~26,000 buildings representing 318.5 million m^2 floor area are currently using ENERGY STAR Portfolio Manager to understand the energy performance of their buildings and the effectiveness of targeted energy efficiency initiatives. Throughout the program, participation steadily increased by 2,000 to 3,000 buildings per year as municipalities have adopted mandatory and voluntary benchmarking programs.
- In 2018, Ontario became the first Canadian province to implement a mandatory energy and water reporting and benchmarking program for large buildings greater than 50,000 ft^2 of gross floor area.
- The Cities of Vancouver and Montreal have adopted energy and/or carbon reporting for large commercial and multifamily buildings.
- Twenty-two municipalities in British Columbia, the cities of Calgary, Edmonton, Winnipeg, and Ottawa, and the Province of Nova Scotia have implemented voluntary programs.

Larger buildings continue to be overrepresented in most benchmarking programs, including the ENERGY STAR® Portfolio Manager® program, largely due to the high recruitment cost and energy savings potential these buildings represent.[27] To ensure there is ample data to develop an effective MBPS for small and medium size buildings (e.g., Class B and C buildings), municipalities and other levels of government need to encourage or mandate greater uptake of benchmarking in that market segment.

[27] Krukowski, Andrea, Creating Value from Benchmarking: A Utility Perspective, Institute for Market Transformation. August 2014.

Early adopters inform our approach to MBPS

MBPS, and variations like MEPS and MEES, have already been adopted by various Member States of the European Union, the United Kingdom, and several cities and states across the globe (see table below). While each jurisdiction shares similar long-term goals of decarbonizing their existing buildings, alleviating energy poverty, and extending social and economic benefits, the design of these policies differs in three main ways:

- **Building types and sizes:** Most North American MBPS focus on commercial and multifamily buildings over 25,000 ft^2, whereas European MEPS primarily focus on residential or rental properties.

- **Targeting energy or emissions**: Jurisdictions use MBPS to regulate GHG emissions or energy consumption. This leads to different outcomes as emissions-based MBPS do not incentivize owners to reduce energy consumption, while energy-based MBPS do not directly link to a jurisdiction's climate goals and different fuel mixes significantly affect the carbon intensity of a building.

- **Trigger points:** These can include a range of different trigger events, including a specific future date and/or transactional triggers such as a change of tenancy or ownership. European MEPS tend to be triggered by real estate transactions and during planned construction work; however, set timelines are also used to require renovations of specific building types. North American MBPS uses a set schedule that determines the compliance window.

Jurisdiction and building type	Objective(s)[28]	Metric	Target	Trigger
France (2013) Private and rented homes, and tertiary sector buildings	Reduce energy use by 41 per cent by 2050 and emissions by 75 per cent by 2050	EPC score;[29] energy performance; final energy consumption	EPC E for homes (2033); <450 kWh/m^2 for rented homes (2023); improvement 60 per cent of tertiary buildings (2050)	Change in tenancy; point of sale; set timeline
Sweden (2014) Apartment buildings, schools, and offices	Climate neutral economy by 2045; 100 per cent renewable energy by 2040	EPC score; prescriptive measures	Meet the energy performance of a new building or prescriptive measures municipal governments	During alteration or renovation
The Netherlands (2018) Office buildings and residential rental sector	Cut GHG emissions by 37 per cent by 2030 and 95 per cent by 2050	EPC score	EPC C for office buildings by 2023; EPC B for rental sector by 2021	Change in tenancy; point of sale; set timeline
Flanders, Belgium (2019) Residential and non-residential buildings	Reduce residential/ non-residential energy usage by 70 per cent and 33 per cent by 2050	EPC score; prescriptive measures	Minimum roof insulation and glazing targets by 2023; EPC A for homes by 2050	Change in lease; set timeline
England and Wales (2018) Privately rented residential and nondomestic properties	Improve the efficiency of privately rented residential and non-domestic properties	EPC score	EPC E for domestic properties by 2020 and non-domestic by 2023	Change of tenancy; point of sale; major renovation; set timeline

[28] Some jurisdictions do not have set objectives for the decarbonization of the building sector (e.g., Sweden and the Netherlands). In such cases, the general climate goals are presented. BPIE, 2020, "A Review of EU Member States' 2020 Long-Term Renovation Strategies".
[29] European Member States define EPC based on the calculated energy consumption (or asset rating), actual energy consumption (or operational rating), or a combination of both. In the revised EPBD, improving the quality, accessibility, and the harmonization of EPCs are prioritized to reduce the lack of consistency between Member States. European Commission, 2021, "Minimum Energy Performance Standards (MEPS) in the Residential Sector".

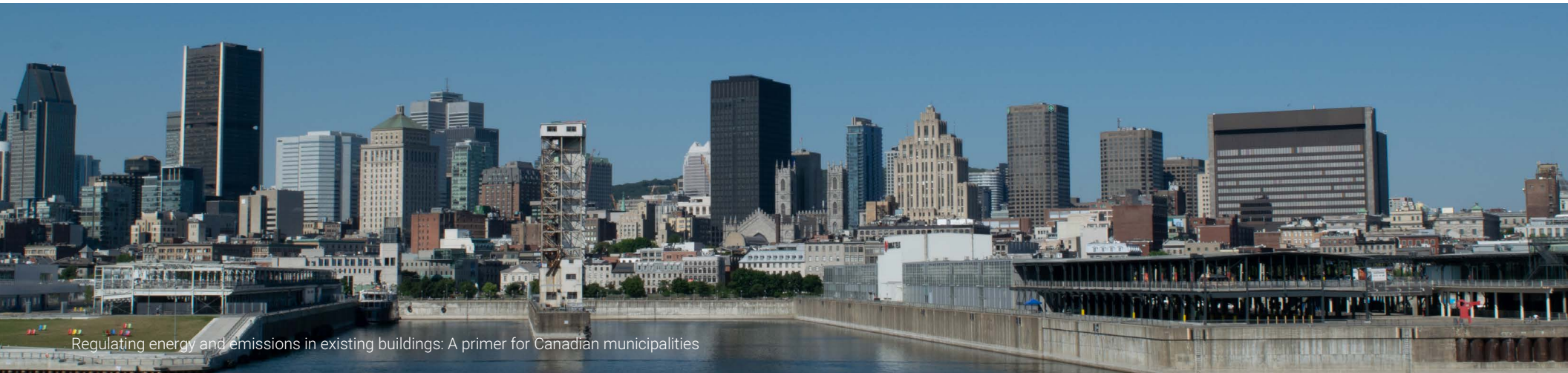
Jurisdiction and building type	Objective(s)	Metric	Target	Trigger
Boston, MA (2021) Non-residential buildings ≥20,000 ft^2 and any parcel ≥20,000 ft^2 or ≥15 units	Reduce emissions gradually to net zero by 2050	Annual greenhouse gas emissions intensity ($kgCO_{2e}/ft^2$)	Performance targets depend on building type/use starting in 2025	Set schedule; building-specific schedule
Denver, CO (2021) Commercial and multifamily buildings ≥25,000 ft^2	Achieve 30 per cent energy improvement by 2030	Weather-normalized Site Energy Use Intensity (EUI)	Unique target for each building depending on the trajectory from the baseline year to 2030	Set schedule
New York City, NY (2019) Commercial and multifamily buildings ≥25,000 ft^2	Reduce emissions by 40 per cent by 2030 and an 80 per cent reduction by 2050	Annual greenhouse gas emissions (tCO_{2e}/ft^2)	Performance targets depend on occupancy type	Set schedule
Washington, DC (2018) Private buildings ≥50,000 ft^2; district-owned buildings ≥10,000 ft^2	Reduce emissions by 50 per cent by 2032; carbon neutrality by 2050	ENERGY STAR score or Weather-normalized Site EUI	Per cent improvement targets or prescriptive measures	Set schedule
City of Vancouver, BC (2022) Commercial office and retail buildings ≥9,290 m^2	Reduce carbon pollution by 50 per cent by 2030	Annual greenhouse gas emissions intensity(tCO_{2e}/ft^2)	Office building: 25 kg CO_{2e}/m^2/year; retail buildings: 14 kg CO_{2e}/m^2/year by 2027	Set schedule
Victoria, Australia (2021) Privately rented homes	To improve performance of privately rented homes	System and appliance efficiency standards	Efficiency standards for heating, cooling and appliances	Change in tenancy

Jurisdiction and building type	Objective(s)	Metric	Target	Trigger
New Zealand (2019) Government office buildings; rented homes	To lower the emissions intensity from building stock	NABERS rating; prescriptive measures	Office buildings: 4-star (2021); minimum ceiling and floor insulation; fixed heating systems	Change in tenancy
Tokyo, Japan (2010) Large facilities (≥15000 kl of annual crude oil equivalent)	To reduce GHG emissions in the most energy intensive building sector	Annual greenhouse gas emissions (tCO_{2e})	Percent improvement from baseline	Set schedule

Table: Select examples of leading MBPS/MEPS programs worldwide.

MBPS in the Canadian context

Three Canadian municipalities have identified MBPS as a leading policy to decarbonize existing buildings. The City of Vancouver is the only municipality that has adopted an MBPS program by implementing carbon pollution limits for commercial and retail buildings, starting in 2027. Toronto and Montreal have also signaled plans to implement an energy and emissions-based MBPS in upcoming years based on current enabling precursor activities. These cases draw on the experience of other US-based MBPS programs due to similarities in jurisdictional authority, climate, and building types and codes.



MBPS models

Based on the local context and jurisdictional needs, seven MBPS models have emerged. Each has variations in the covered building types, performance targets, and compliance timeframe (see table below). MBPS models can be considered to be either prescriptive, performance or as standards for specific building types or stock and each can be used independently or in combination.

Models and description	Considerations	Example
Single: the worst-performing buildings are targeted for improvement to a specific standard by a set date.	Promotes shallow retrofits of low-hanging fruits. Inconsistent retrofit activity from year to year.	Netherlands: Offices must be EPC 'C' by 2023.
Progressive: similar to the Single model but standards become more stringent over time to a set date.	Sets a long-term trajectory for buildings, aligned to climate goals and guarantees consistent annual retrofit activity.	Scotland: Rented homes must be EPC 'E' by 2021 and 'D' by 2025. Most North American MBPS fall under this category, such as: Chula Vista, CA; Boston, MA; Denver, CO; New York City, NY; State of Washington; and Vancouver, BC.
Deep renovations: buildings are renovated once to a specific performance level (e.g., 2030 or 2050 levels) which results in the highest energy savings and avoids lock-in of suboptimal renovations.	DER targets fewer buildings to achieve similar energy/GHG savings as standards targeting wider segments as building owners can incorporate it into their capital investment plans. Uses a building-specific retrofit plan with a legal commitment tied to the property.	French CCC: 'F' and 'G' homes must be EPC 'B' by 2030, followed by 'D' and 'E' by 2040.
Trigger-point-only: standards only apply at natural (e.g., sale, rent, and renovation) or market (e.g., licensing or inspection) trigger points.	Retrofit activity will fluctuate yearly. Can result in a class of substandard buildings. Similar limitations as the AEB code.	Under Article 7 of the Energy Performance of Buildings Directive (EPBD), the efficiency of select EU buildings must be upgraded when undergoing a major renovation.

Models and description	Considerations	Example
Measures-based: buildings required to implement specific measures or meet set requirements, for example, to require 100 per cent efficient HVAC equipment.	Highly applicable to residential and affordable housing as it eliminates the need for onerous data collection. Easy to communicate and requires less technical and financial support, but relies on cost-intensive inspections.	Flanders, Belgium: minimum roof insulation and glazing measures.
Stock average: the average or median energy or GHG performance of a specific archetype is used to set the performance target which is recalculated at the end of each cycle.	Little incentive to retrofit buildings beyond the standard as a clear trajectory is not provided ahead of time. Multiple compliance routes are available. Requires significant reporting of benchmarking data.	St. Louis, Missouri targets large buildings >50,000 ft^2. Using benchmarking data, it requires 65 per cent of the worst-performing buildings to make improvements by 2025.
Renovation target: requires a certain proportion of the stock to be renovated to a prescribed standard annually.	Does not require every building in the portfolio to be renovated. Suitable for stock portfolios held by a single owner.	Article 5 of the Energy Efficiency Directive requires 3 per cent of the floor area of government buildings to be renovated to the minimum standards.

Adapted from Sunderland & Santini, 2020, "Next steps for MEPS: Designing minimum energy performance standards of European buildings"

What it takes to design an effective MBPS

An effective MBPS tackles a specific segment of the building sector, for example commercial buildings under 25,000 ft^2, and uses well-defined metrics to achieve specific policy outcomes. It is ambitious but pragmatic in its goals and offers practical compliance pathways for building owners to meet the short, medium, and long-term goals of the policy. In the following sections, current best practices are identified from existing MBPS programs that are applicable to Canadian jurisdictions. North American examples are prioritized due to the similarity in governance structure and climatic conditions.

Target specific segments of the building stock

Understanding the existing building stock - the building types, floor area, energy sources used, and emissions generated - is fundamental to MBPS design and implementation. Municipalities can use information gathered from their voluntary or mandatory benchmarking programs, tax assessor and permitting data, community-scale GHG emissions inventories, and other public sources to define the MBPS. This should reflect technical, financial, equity, and societal priorities of the jurisdiction.

A hallmark of effective MBPS programs has been a focus on commercial and multifamily buildings. This is due to their large floor areas, considerable energy consumption, and higher potential for energy savings compared to smaller buildings and single-family homes. The former are typically well-represented in existing benchmarking programs and have access to financial and technical resources. Smaller buildings and single-family homes, on the other hand, are typically excluded due to the array of archetypes and diverse energy usage represented, as well as owners with limited access to capital.

Craft careful exceptions

Leading MBPS make use of exemptions in cases where the building is historically valuable, its current state or usage will be disrupted by retrofit activity, or where there is the potential to introduce or exacerbate financial hardship or capacity constraints. To avoid the overuse of exemptions, the AHJ can provide special accommodations for under-resourced building owners, including additional support and compliance flexibility.

Jurisdictions	Exemptions
Chula Vista, CA	County, state, and federal buildings, including transportation depots and schools.
	Properties occupied less than five years, in financial distress, have an open permit for demolition, or have not previously been benchmarked.
New York City, NY	Industrial facility used for generating electric power or steam.
	Dwellings less than three stories, city and NYC Housing Authority buildings, and not-for-profit housing.
	Places of public worship.
Washington State	Historic buildings do not need to meet any requirement that would compromise their historical integrity.
	Buildings recently occupied, those with an average occupancy of less than 50 per cent or where there is financial hardship.
	Primary use of building is industrial or agricultural.

Table: Common exemptions used by North American jurisdictions

In Boston, building owners can apply for a Hardship Compliance Plan that includes an alternative emissions standard and timeline based on the building's characteristics or circumstances (e.g., historic building designations, or affordable housing refinancing timelines).

In St. Louis, MO, qualified affordable buildings and houses of worship have six years (instead of four years) to comply with the targets.

Desired outcomes drive building performance metrics

The Environmental Protection Agency has defined seven key guiding principles for selecting appropriate metrics. These include the use of simple metrics to send clear signals, encouraging efficient electrification, focusing on actions within the control of building owners, and equity. Although achieving these criteria simultaneously is challenging,[30,31] leading MBPS programs prioritize accessibility to the majority of stakeholders (rather than the specialized few) and the resulting outcome of widespread adoption.

Various metrics can be used to quantitatively describe a building's performance. These include:

- **Energy efficiency metrics** (e.g., site and source energy use intensity, EPC, and ENERGY STAR score)
- **Electrification metrics** (e.g., per cent of energy use that is from electricity and onsite greenhouse gas emissions intensity)
- **Renewable electricity metrics** (e.g., per cent of onsite green power and total green power)
- **GHG emissions metrics** (e.g., total greenhouse gas emissions intensity, onsite greenhouse gas emissions intensity, and time of use emissions)
- **Grid-balancing metrics** (e.g., peak demand and coincident peak demand intensities)

Metrics are typically expressed using a numerator with the unit of measure (e.g., site or source building energy use and emissions) and a denominator which acts as a normalizing factor (e.g., floor area and occupant density).[32] For the denominator, floor area is commonly used as it is easy to audit (and is usually fixed unless there is significant space reconfiguration) compared with a more flexible denominator such as the number of occupants. The table below shows the most commonly used building performance metrics.

[30] O'Brien et al., 2017, "On occupant-centric building performance metrics", Building and Environment, 122, 373-385.
[31] Fawcett & Topouzi, 2020, "Residential retrofit in the climate emergency: the role of metrics", Buildings and Cities, 1(1), 475–490.
[32] Bordass, 2020, "Metrics for energy performance in operation: the fallacy of single indicators", Buildings and Cities, 1(1), 260–276.

Metric	Strengths	Weaknesses
Site Energy Use Intensity (EUI)	Easy to understand, directly measured from utility bills.	Does not account for occupancy and requires weather normalization to account for yearly changes.
	Favours electrification as it does not include generation and transmission losses.	Overall energy consumption and GHG emissions are not necessarily correlated.
Source Energy Use Intensity (EUI)	Traces heat and electricity requirements of the building back to the raw fuel input, accounting for any losses.	Does not account for occupancy (requires weather normalization to account for yearly changes) or regional source conversion factors.
	Enables equitable comparison of buildings in the same region.	Challenging to compare buildings in different regions due to high source variability and perceived as outside of the control of building owners.
Energy performance certificates (EPC)	Asset rating based on a building model generated by an energy assessor.	Disparity between the modeled and actual energy usage since occupancy isn't accounted for. Difficult to translate EPC into energy efficiency and requires building data that is not easily accessible.
	Includes current and potential energy and emissions impact ratings (if cost-effective measures are installed).	EPC is valid for five or 10 years.

Metric	Strengths	Weaknesses
ENERGY STAR 1-100 Score	Relatively simple and stakeholders are familiar with Portfolio Manager and understand the benefits of capturing a higher score.	Requires multiple inputs that are difficult to verify/validate. Need to be normalized for weather and business characteristics (e.g., number of workers).
	Good for long-term performance improvements since scores can be recalculated to reflect city progress.	Does not represent carbon emissions or absolute performance. Energy Star scores are only available for certain building types and scores are relative to other buildings.
GHG Intensity	Linked to carbon neutrality targets. Favours electrification in the long term.	Annual carbon emissions do not factor in the time of use fuel mix for electricity and may require adjustments to emissions factors based on forecasts to minimize building owners concerns.
	Normalized by floor area; no standard currently available to normalize by weather or business characteristics.	Individual building performance is difficult to compare year-on-year as the grid's fuel mix changes. Emissions from electricity generation are outside of the control of building owners.

Table: Metrics commonly used by jurisdictions.
Adapted from U.S. Environmental Protection Agency, 2022, "Understanding and Choosing Metrics for Building Performance Standards"

In Canada, efforts to advance clean electricity grids by 2035 are underway. The GHG intensity metric can help accelerate grid decarbonization, in part because it encourages low-carbon heating options like district energy or heat pumps. However, while GHGI ensures emissions reductions, it may not be as effective in encouraging energy efficiency measures. This can be resolved either by combining it with an energy efficiency metric (e.g. EUI), or relying on complementary policies and programs to ensure end-use efficiency.

Set ambitious but achievable performance targets

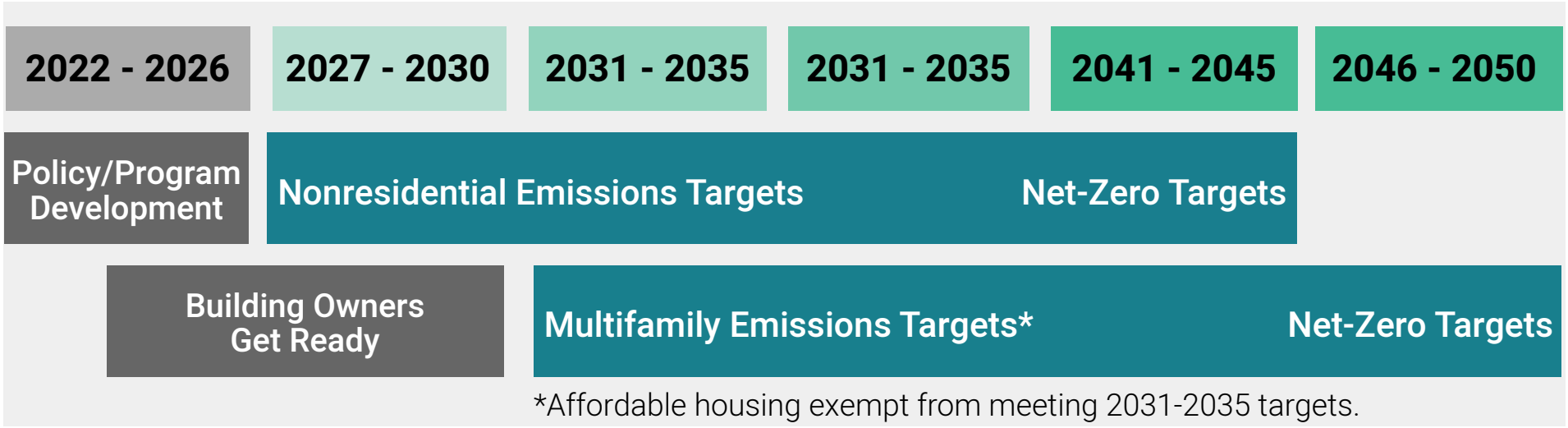
Similar to performance metrics, targets need to be clearly defined and measurable. In most MBPS programs, policymakers define short and long-term targets (also referred to as interim and final targets) that align with the jurisdiction's goals. Interim targets can be fixed in advance or recalculated at the beginning of the next compliance cycle. Fixed targets are generally preferred by building owners as they provide certainty and adequate lead time to incorporate into their capital plans. Recalculated targets are adjusted based on market feedback (e.g., lower compliance rate or major changes in the electricity grid) at the end of each compliance cycle.

Targets are generated based on benchmarking data that represent the actual performance of the covered buildings within the jurisdiction for at least one ordinary year (i.e., a year without unusual business activity/inactivity or extreme weather events). Data must be representative, with a complete distribution of both high- and low-performing buildings. If the data lacks high-performing buildings, the targets can be too lax. Conversely, if low-performing buildings are missing, targets can be too stringent and impractical as these buildings will need an unreasonable amount of investment to meet the target.

Compliance timeframe

The hallmark of an effective MBPS is the use of advanced timelines to signal and prepare building owners well before the standard comes into effect. By signaling requirements well in advance, policymakers can help reduce potential conflicts around compliance, and ensure building owners know what their obligations may be.

Example of MBPS development and implementation in Seattle, W.A.



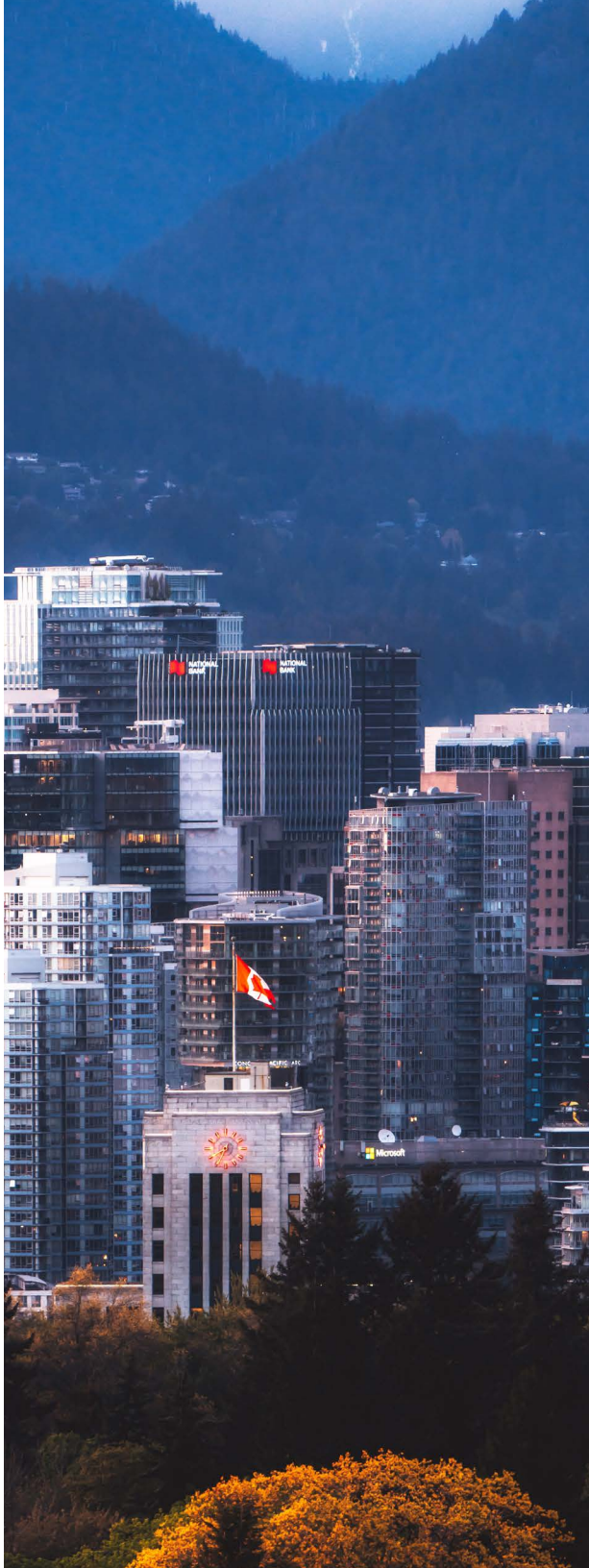
Source: Office of Sustainability & Environment, 2022, "Seattle Building Emissions Performance Standards Policy Development".

In existing MBPS programs, building owners are given four to six years to comply with the performance standards (also referred to as a compliance cycle) annual reporting requirements. Alongside a fixed compliance timeline, some jurisdictions have incorporated trigger events such as during real estate transactions and major renovations. While a fixed schedule provides predictability—all covered buildings must adhere to the same schedule—it does not consider the lifespan of major equipment such as HVAC systems and major envelope components, or the capital planning of those systems and their repair and replacement. On the other hand, planned construction work and change in building use triggers are less predictable from year to year.

Options for compliance often reflect the diversity of barriers and challenges facing the covered buildings. Three pathways are offered: Performance, Standard, and Action-based (Prescriptive) compliance pathways (see table below). In some cases, a fourth option is offered when buildings with specific limiting circumstances (e.g., unique logistic or financial constraints) can present a customized retrofit plan that meets the final goal of the MBPS.

	Performance pathway	Standard Target pathway	Prescriptive pathway
Eligibility	All property types but best suited for low-performing buildings	High-performing buildings that are more efficient than the national median	All property types
Evaluation	Performance-based	Performance-based	Action-based
Target	Improve performance by a set percentage	Reach the target for the covered building type	Implement measures with extensive reporting

Table: Common compliance pathways offered by leading jurisdictions to accommodate the diverse needs of building owners.



Ensuring success through supportive programs

Financial, technical, and other supportive resources that account for the varied needs of stakeholders are notable attributes of effective MBPS programs. Jurisdictions can use a market assessment of existing resources and incentives available from utility, municipal, provincial, and federal programs to map existing gaps before developing additional supports.

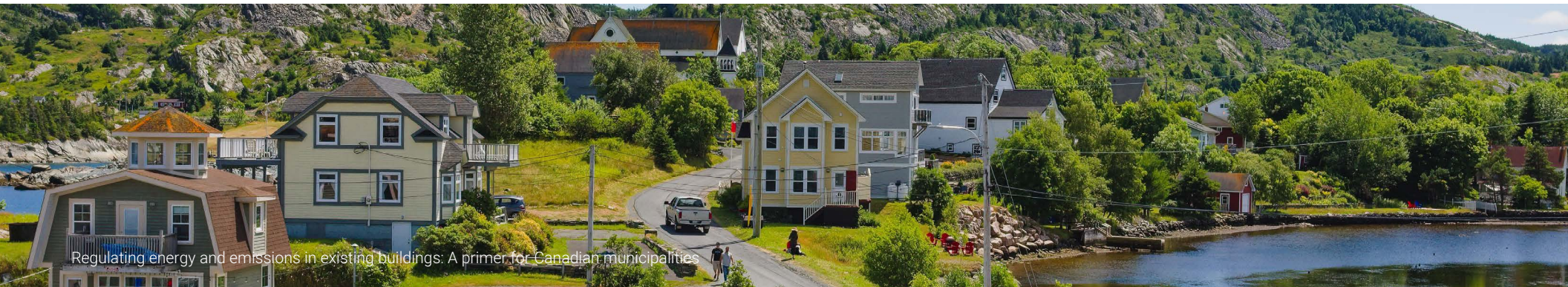
Financing and funding options

Well-resourced buildings have access to capital funds required for compliance with the MBPS requirements. However, other property types such as Class B and C commercial real estate, condominiums, affordable multifamily housing, and schools may have limited capital budgets which affect their ability to comply with the MBPS. Given these financial barriers (see image), jurisdictions should ensure that a tailored, comprehensive suite of public subsidies, (non)financial incentives, and private finance solutions are available to building owners (see table below).

To maximize returns from these investments, leading jurisdictions should reward early adoption when buildings meet or exceed the performance criteria. Alternatively, a cost cap approach (e.g., using a spending limit or payback threshold) can be used to limit the amount of money owners need to invest during each compliance cycle. Unfortunately, some buildings may require greater investment to meet the performance target.

Financial barriers impeding the uptake of building retrofits

Adapted from D'Oca et al., 2018, "Technical, Financial, and Social Barriers and Challenges in Deep Building Renovation: Integration of Lessons Learned from the H2020 Cluster Projects", Buildings 8, no. 12: 174.



In Washington State, a $75 million incentive fund was set aside for an Early Adopter Incentive Program. Eligible building owners that meet the performance target early will receive a one-time incentive payment of $0.85 per square footage. To ensure that the funds are equitably distributed, for the first three years, half of the fund is earmarked for buildings with the highest energy users, those present in rural communities, and multifamily affordable housing.

In St Louis, building owners that meet the property type EUI target and achieve a 20 or 50 per cent EUI reduction at the end of the first cycle, will be considered to be in compliance for the next two or three cycles.

In the United Kingdom, domestic building owners are required to spend no more than $4,500 per dwelling unit every five years. For non-domestic buildings, a cost threshold is used where owners make investments that pay back within seven years.

Incentives types		Weaknesses
Financial incentives	Grants and rebates	Building owners receive upfront grants or cash rebates for implementing energy-efficient measures from a utility or government, usually within a set period of time, or until the fund is exhausted.
	Tax incentives	Municipalities can offer a reduction in property taxes for a number of years to cover the cost of certain energy-efficient measures or the labour component of the retrofit.
Non-financial incentives	Expedited building permits	Municipalities can simplify and reduce the cost of acquiring permits and planning approval for building performance upgrades.
	Bulk purchasing programs	Municipalities can negotiate a lower price from vendors for common energy-efficient measures or equipment by taking advantage of aggregate purchasing power.
Financial mechanisms	Third-party financing	Owners obtain a secured loan from a private lending institution to cover cost-efficiency upgrades. Repayments are not tied to energy efficiency savings and are subject to market interest rates.
	Local improvement charges (LICs)	Owners finance their retrofits through the municipality and repay the loan through their property taxes. The LICs are tied to the property and can be repaid prior to the sale or by the new owner.
	Green mortgages	Owners can borrow money for energy-efficient features as part of their mortgage and repay them gradually on a monthly basis.
	Green leases	A lease that incorporates clauses whereby the owner and occupier undertake specific responsibilities with regard to the sustainable operation/occupation of a building. To overcome split incentives, owners can pass on the cost of the retrofits to tenants if the tenants benefit from energy savings.
	Energy service companies (ESCO)	A type of 'pay-for-performance' financing mechanism where energy service companies pay for project development, construction, and maintenance costs. The building owner pays the ESCO from the operational energy savings over an extended period of time.
	On-bill financing	Owners receive upfront capital from a utility to cover the cost of the retrofit and/or energy system, including design, equipment, and installation (labour, insurance, and permits). The utility company recovers the costs through repayment on the billing system by the owner or occupant.

Table: Types of incentive options for retrofit projects.

Adapted from City Energy, 2018, "Energy Efficiency Financing Primer"

Technical support

Bridging the knowledge gap and increasing the capacity of building owners/industry to identify, develop, and implement efficiency measures can be achieved through a range of technical resources. These can include a resource hub outlining the MBPS requirements and timelines, more advanced consultative supports (e.g., energy audits, technical inspections, and legal assistance) and training for building owners and the workforce.

Similar to building codes, MBPS deliver the regulatory certainty needed to direct investments toward building energy and emissions retrofits, including the development of a highly skilled workforce. As AHJs, municipalities can proactively identify the size and skill matrix of the workforce. Low-cost training can be designed to target disadvantaged groups (e.g., low-income, unemployed/underemployed, underrepresented, and women) or upskill current workers through local colleges and training institutions. In addition, jurisdictions can promote credentialing that is transparent, meaningful to the labour market, embedded in a pathway to future employment, and recognized in other regions or cities. For example, building owners can be provided with a pre-approved list of contractors who have evidence of the right skills, credentials and/or a demonstrated history of quality workmanship.

Noncompliance penalties

Although MBPS provides technical and financial support to boost compliance, jurisdictions can levy penalties to discourage noncompliance through administrative enforcement mechanisms. Building owners can be penalized for knowingly withholding information, submitting inaccurate information or failing to meet the benchmarking and performance requirements.

In Colorado, a building owner is subjected to a civil penalty of up to $2,000 for the first violation and up to $5,000 for each subsequent violation.

In New York City, building owners pay $268 per metric ton of emissions that exceed the emission limit.

In Denver, Colorado, building owners pay up to $0.70 per year for each required kBtu reduction that the owner's building failed to achieve in that year. If the fine is unpaid within 180 days, the penalty becomes a lien on the property.

In Flanders, Belgium, rental homes that do not meet the minimum insulation standard, can accrue penalty points; if they receive more than 14 points, the property cannot be legally rented.

In the Netherlands, enforcement bodies can undertake various preventive and corrective actions, which ultimately can lead to fines or the closure of the building, if owners fail to comply.

Key considerations for success

A variety of factors influence the jurisdiction's ability to enforce performance targets. Improperly designed and inadequately supported MBPS programs can undermine the potential of future programs. In the following sections, equity and affordability, workforce development, and the role of utilities are considered, based on their influence on the design and implementation of the MBPS.

Equity and affordability

The intent of a MBPS policy is not to create new or perpetuate existing inequities. By mandating performance standards, jurisdictions risk exacerbating the affordability crisis by imposing additional costs on building owners. This could impact the economic viability of these buildings, leading to higher rents and increased rates of displacement for low-income communities. However, simply exempting properties where equity-seeking populations reside misses the opportunity to improve housing quality. Improved housing quality can deliver important tenant rights, such as the right to cool temperatures during extreme events and other improvements to health and safety.

Potential equity risks of MBPS

Equity Risks	
	• Housing cost increases • Tenant harassment and displacement • Long-term gentrification and displacement • Pushing smaller landlords out of business • Energy bill increases • Lack of community trust and buy-in • Lack of opportunities for minority contractors or workers

Adapted from Building Electrification Institute, 2021, "Enabling Equity Through Building Performance Standards"

Considering these consequences, a priority should be one of doing no harm by taking preemptive measures. These include:

- Conducting a gap assessment to understand the affordable housing market, including the energy efficiency needs, existing supporting resources/programs, funding gaps, and specific obstacles that could prevent action.
- Co-creating policies or programs with stakeholders to ensure their concerns are addressed in the policy.
- Partnering with local and national equity partners to lead difficult discussions.
- Providing financial, staffing, and technical assistance for affordable and under-resourced buildings.[33]
- Providing compliance flexibility through extended deadlines and alternative pathways.
- Tying the compliance penalties to the appraised value of the property.

Workforce development

The implementation of MBPS creates predictable demand for a workforce with the right skills, knowledge, and resources to provide materials, equipment, and technical services. To meet this demand, leading jurisdictions create supply by facilitating activities that expand the pool of skilled workers.[34]

Jurisdictions can conduct local labour market studies and engage stakeholders to determine the types and quantities of jobs that would be required, including the barriers and policy changes needed. Jurisdictions can engage stakeholders in advance to develop approaches to support the local market.

[33] Haley, Brendan and Abilash, Kantamneni. Energy Efficiency for Low-Income Tenants. How the Federal Government can Improve Energy Efficiency While Protecting and Enhancing Tenant Rights. March 2023.
[34] Truitt et al., 2020, "Building the Efficiency Workforce".

These include:

- Building interest and awareness of energy efficiency careers, especially for underemployed, low-income or disadvantaged groups.
- Clarifying the career pathways available and needed in the building energy efficiency sector.
- Supporting the update or development of technical, sales, and marketing training offered through local institutions.
- Incentivizing participation in relevant training by requiring certain qualifications or giving preference through pre-approved vendor lists.

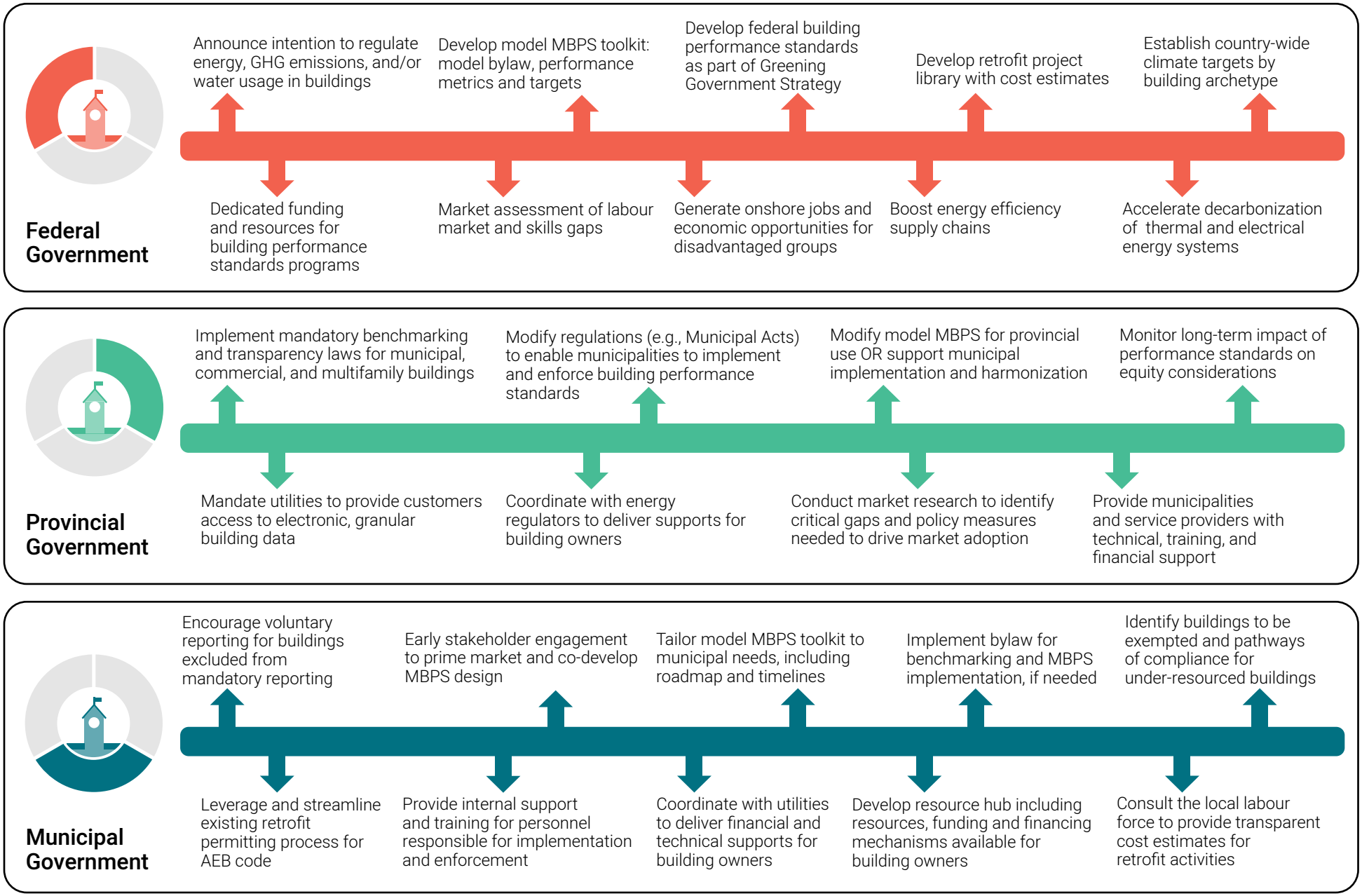
Working with utilities

Utilities play an important role in delivering many MBPS programs and should be engaged early and often as their business operation will be impacted (e.g., increasing demand for electrification and reducing demand for natural gas and other fuels). Utilities can provide access to granular performance data in an appropriate format, especially when benchmarking programs need to be developed.[35,36] Utilities can also administer energy efficiency programs to assist their customers through conventional rebates, financial incentives, and technical assistance. Jurisdictions should be aware of these programs as they will determine where new supports are needed.

Utilities benefit from advanced engagement as they can incorporate the impact of MBPS policies into their resource and distribution plans to meet future demand. This will ensure that adequate investment and distribution infrastructure are in place, especially as demand for electrification increases.

[35] IMT, 2022, "Building Performance Policies are a Gateway to Utility Reform".
[36] City Energy Project, 2016, "Engage With Utilities To Implement Energy Performance Policies".

The role of government in enabling MBPS



How municipalities can prepare for the AEB and MBPS

What	How municipalities can act	Leading by example
Continue to leverage existing powers	Before the AEB or MBPS are adopted, municipalities may be limited in how they drive retrofit activity. However, as has been done with voluntary incentives in new construction, municipalities can use existing powers such as density bonuses or site concessions in exchange for energy and emissions reduction measures, as well as offering low cost and/or convenient building energy performance services — such as energy modelling verification or compliance checklists — boosting the technical feasibility of deeper energy retrofits.	The District of Saanich, BC offers the Home Energy Navigator program to guide homeowners through their retrofit journey. Saanich aims to reduce barriers to completing a home energy retrofit by providing free support from local energy experts, including rebate navigation, virtual home energy consultation, quote reviews, and a customized retrofit roadmap. A number of municipalities, including Victoria, BC also offer municipal top-up rebates to make heat pump installations more accessible. A number of jurisdictions, including 22 municipalities in British Columbia, Calgary, Edmonton, Winnipeg, Ottawa, Nova Scotia, and Montreal have implemented benchmarking programs (mostly voluntary) to gain a better understanding of their existing buildings.
Education and training	The success of the AEB codes and MBPS in other jurisdictions highlights the critical role of information sharing and awareness building. An important aspect of this training and education will be the sharing of both digital and physical case studies that allow all those with an interest in building retrofits to explore, understand, and get motivated about residential and commercial retrofits. As well as de-mystifying building retrofits for energy and emissions performances, these real-world examples can be used by industry to help building capacity for building owners, trades, and other industry professionals.	Kingston, ON offers retrofit training and guidance for building owners and contractors to encourage energy retrofits. The Better Building Ottawa program provides free training for building operators on strategic energy management and organizational net-zero planning when participants publicly disclose their buildings' energy, emissions, and water performance data. The Region is also partnering with the Canadian Home Builders' Association (CHBA) to launch the Towards Net Zero Renovations Project.

What	How municipalities can act	Leading by example
Engage early and often	Engaging stakeholders early and often through consultations and collaboration is crucial to building meaningful relationships and soliciting regular feedback that can be used to inform policy creation.	Using two phases, the Province of British Columbia engaged over 300 stakeholders, representing 108 organizations during the development of the CleanBC Roadmap to 2030. Feedback was solicited on the regulatory approach and support measures needed to increase energy efficiency in existing buildings.
Provide supportive financing	Building retrofits require high upfront capital outlays. Municipalities can support the burgeoning retrofit economy by promoting existing provincial and utility rebates, or by offering incentives through existing municipal programs. Through Property Assessed Clean Energy (PACE) or Local Improvement Charges (LIC), municipalities can top-up existing rebates or offer unique rebates or tax exemptions for building retrofits. Such incentives should scale to meet the advanced demands of buildings requiring deeper retrofits.	Through the Building Retrofits Initiative, Canada Infrastructure Bank provides financing to the public and private sector for energy retrofits projects. Efficiency Capital and Johnson Controls-CIB Aggregator program develop, invest, and manage efficiency retrofit in commercial, industrial, and multi-residential buildings. Sofiac energy performance helps to eliminate financial, technical, and operational barriers facing commercial and multi-residential building owners as they seek to reduce energy use and emissions.
Provide a supportive retrofit ecosystem	Municipalities can build on the EnergieSprong initiative, a retrofit mission approach that sees retrofits carried out at infrastructure scale. The innovative technologies and approaches that result from these initiatives have the potential to drive larger GHG and energy savings, faster, and at lower cost while increasing the services buildings provide to occupants.[37]	Through Better Homes Ottawa, over $10M in zero-interest loans have been provided to residents to help them increase their energy efficiency and remove fossil fuels from their homes. This program offers a full suite of services.

[37] Haley, Brendan & Ralph Torrie. 2021. Canada's Climate Retrofit Mission. Ottawa: Efficiency Canada.

AEB specific action

Get involved in comment periods	The AEB is expected to be available for provincial and territorial adoption by the end of 2024. During that time, there will be two public consultation periods. These consultations are an opportunity for stakeholders, including municipalities, to provide their perspectives and inform the AEB's development, as well as ensure it meets their needs.
Manage AEB expectations and prepare for BPS	The AEB will be limited in how deeply it can drive energy and emissions reductions in existing buildings. Moreover, the AEB is not expected to incorporate emissions at this time, a measure that would be highly desirable to municipalities and others. AHJs can prepare for the AEB's implementation by managing stakeholder expectations and exploring the use of innovative MBPS frameworks that meet the needs and ambitions of their local markets.

MBPS specific actions

Let municipalities lead	Municipalities have thus far been the key champions of MBPS in North America, yet some municipalities face barriers to exercising this leadership due to unclear authority.	In 2022, the City of Vancouver implemented mandatory annual energy/emissions reporting for commercial and multi-family buildings. In 2027, GHGI limits for large commercial office and retail buildings will come into effect. In 2021, the City of Toronto outlined its intent to develop an emission-based MBPS in the Net Zero Existing Buildings Strategy. Building owners will be required to report and disclose GHG emissions from their buildings of all sizes. This data will underpin future performance targets. In 2021, Montreal developed a by-law mandating emission disclosures/ratings of large buildings. Starting in 2022, owners of commercial, institutional, and multi-unit residential buildings > 2,000 m^2 or > 25 dwelling units will be required to disclose building emissions, a precursor for an MBPS program.

MBPS specific actions		
Explore jurisdiction's resources and streamline processes	The design and implementation of MBPS requires extensive data collection, ongoing stakeholder engagement, and technical experience. Municipalities can reduce their resource burden by adjusting the number of covered buildings included in the policy, outsourcing certain aspects of the design process, or streamlining permitting process.	In collaboration with utilities and other funding sources, including the NRCAN Deep Retrofit Accelerator Initiative, municipalities can set up resource and engagement Hubs[38] to support building owners and inclusively engage stakeholders. One-stop shops or concierge service providers are highly recommended. They provide impartial expert advice, make complicated technical information accessible and understandable, and oversee the quality of the work provided. Vancouver offers a range of resources to help owners reduce their building emissions. Alongside their Home Retrofit Navigator and heat pump incentives, instructional videos and case studies, the city highlights incoming regulations. The City will also remove certain permitting requirements for heat pumps as well as remove the energy upgrade requirements in Part 11 (Existing Building Alterations) of the Vancouver Building Bylaw. CleanBC Better Homes is an online Hub that provides BC homeowners access to incentives and support to reduce energy use and carbon pollution in new and existing homes.
Explore gaps between new and existing construction	New construction is considered existing once occupied (in some cases for at least one year) and may be subject to MBPS. This creates both a dilemma and an opportunity as buildings constructed to subpar building codes may be subject to more stringent MBPS.	Leading municipalities are increasing the performance of newly constructed buildings through local building codes, such as Vancouver's Building By-law or Zero Emissions Building Plan, and Montreal's and and the Victoria's Zero emissions building standard for new construction. To help close the gap between new and existing buildings, Edmonton launched the voluntary Building Energy Benchmarking Program, a rebate for large commercial, institutional, industrial, and multi-family buildings to submit their energy performance data to the City for benchmarking and disclosure purposes.

[38] Market supports such as high-performance hubs or "one-stop shops" are emerging as a crucial asset for leading NA jurisdictions as they offer technical assistance and compliance support to stakeholders. Hubs have been launched in Washington, DC, New York City, St. Louis, Seattle, and Kansas City.

Glossary

Airtightness: A building's resistance to air leakage through areas of the building enclosure not intended to allow airflow.

Authority having jurisdiction: A municipality—or the province or territory—responsible for enforcing compliance with the building code.

Building code: A law or regulation that establishes requirements for the design and construction of new buildings. Building codes ensure new construction meets minimum health, safety, and performance standards.

Building energy performance: Defined using an "asset rating" (i.e., the theoretical or simulated energy use in a building under a set of defined conditions) or an "operational rating" (i.e., the building's actual energy use, typically measured from energy bills and consumption).

Building envelope: The building's physical separation between the conditioned and unconditioned environment, including walls, floors, ceilings, windows, doors, etc.

Compliance: Applies to covered buildings and demonstrates that requirements of a building code or BPS are met, either through the performance threshold or standard or through other paths as defined by the policy.

Electrification: As a decarbonization strategy, electrification shifts heating and cooking loads to electricity. Energy efficiency is a core component of electrification, as a well-insulated building envelope and low-energy equipment and appliances reduce thermal and electrical energy demands. As a result, low-carbon heating and mechanical equipment can be used in place of fossil-fuel alternatives.

Energy performance certificate (EPC): A record of a building's energy efficiency using an A to G rating scale (i.e., A is the most efficient and G is the least efficient). The certificate also lists a building's potential rating if all cost-effective measures are installed.

ENERGY STAR Portfolio Manager: An online resource management tool that enables energy benchmarking of any type of building.

ENERGY STAR 1-100 score: Score compares a building's energy performance to other similar building types, normalized for weather and operating characteristics. A score of 50 represents median performance. A higher score is better than average; a lower one is worse.

Greenhouse gas intensity (GHGI): A measure of the greenhouse gas emissions associated with the use of all the energy required to operate a building. It is measured on an annual basis, and emissions are divided by the building's floor area. It is expressed as 2kgCO2e/m .

Metric: The unit of measurement (energy, carbon or other) that will be used to report data and compliance. A BPS can have multiple metrics which, taken together, define the areas the city deems most important in achieving its goals.

Model code: Canada's national model codes set out minimum requirements and form the basis of most building design in the country. It is a model set of requirements which provide for the health and safety of the public in buildings. These are produced nationally and published for adoption by authorities having jurisdiction (i.e., provinces and municipalities).

Net-zero emissions building: One that avoids or greatly reduces greenhouse gas emissions arising from the building's operations or construction materials. Residual emissions can be offset to achieve net zero.

Metric normalization: Adjusting metrics to a common scale or unit, such as building floor area.

Performance target normalization: Adjusting the performance targets for a building based on specific factors that may influence its performance, such as weather, occupancy, and high-energy applications.

Operational emissions: Those emitted during the building's operations or use.

Site emissions: All the energy used directly by the building. Site energy does not account for energy losses incurred during the production, transmission, and delivery of energy.

Site Energy Use Intensity (site EUI): A mixture of what is called primary energy (i.e., a raw fuel like natural gas) and secondary energy (i.e., a converted product like electricity or district steam).

Source Energy Use Intensity (source EUI): Similar to Site EUI, except secondary energy types are converted into a unit that is comparable to primary energy which considers all transmission, delivery and production losses.