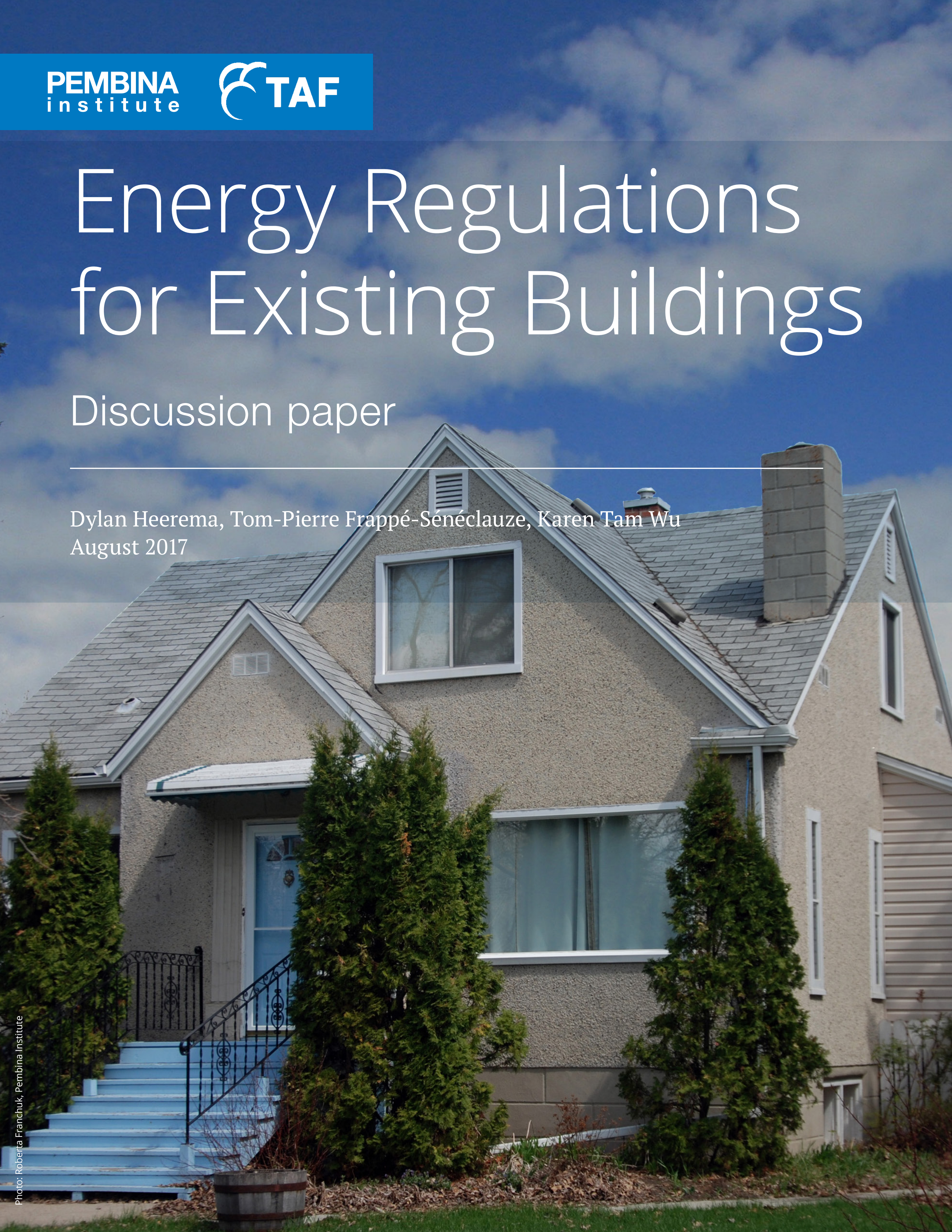

Energy Regulations for Existing Buildings

Discussion paper

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Photo: Roberta Franchuk, Pembina Institute

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In order for Canada to achieve its climate targets and mid-century decarbonization goals, emissions from existing buildings must be significantly reduced and construction practices must rapidly evolve to reach net-zero ready standards for new buildings. The International Energy Agency estimates that energy efficiency, including emissions reductions from buildings, accounts for 47% of the total energy supply investment required to limit long-term global temperature rise to less than 2°C.[1]

Current policy direction among all levels of government in Canada assumes a shift toward net-zero energy ready construction for new buildings by around 2030. For example, the *Pan-Canadian Framework on Clean Growth and Climate Change* calls for the adoption of a net-zero energy ready model building code by 2030. The provinces of Ontario and British Columbia have committed to adopting similar requirements by 2030 and 2032, respectively, and the City of Vancouver is requiring new construction to be zero carbon emissions by 2030.

Shifting new construction to net-zero ready by around 2030 will lead to a significant reduction in emissions from new buildings, but will not be sufficient to achieve deep emissions reductions in the building stock as a whole. In B.C., for example, it is estimated that code requirements for new buildings will result in less than a third of the reductions needed in the building sector by 2050.[2] Therefore, the federal government will need to work with the provinces to create and implement a comprehensive strategy for existing buildings, resulting in emissions reductions needed to meet overall climate targets.

While the federal government has set economy-wide emission targets, it has not defined how much reduction should be expected from each sector of the economy, including the building sector. This is also the case for most provinces in Canada. Sector-specific targets are needed to guide appropriate levels of retrofit activity for buildings.

[1] IEA, *World Energy Outlook* (2016), 82. http://www.iea.org/newsroom/news/2016/november/world-energy-outlook-2016.html

[2] T.-P. Frappé-Sénéclauze, D. Heerema and K. Tam Wu, *Deep emissions reduction in the existing building stock: Key elements of a retrofit strategy for B.C.* (Pembina Institute, 2017). http://www.pembina.org/pub/building-retrofits

Cost-optimization exercises for reductions within Canada have been conducted by various teams of economists, many of which have been reviewed in the Federal *Mid-Century Long-Term Low-Greenhouse Gas Development Strategy*. In these modelling studies, the emissions reductions expected in the building sector are greater than the percentage target for economy-wide reductions, and range from 76% to 99% by 2050.[3]

Setting an vision for a decarbonized building sector by 2050 offers a clear guiding principle and a consistent approach for sub-national governments to follow. A vision for Canada's building stock that delivers on climate commitments is one that sees an evolution to ultra-energy-efficient construction, deep energy retrofits and switching to low-carbon fuel sources.

1.1 The need for code requirements for existing buildings

While supporting measures such as financing, incentives, energy labelling and voluntary programs are critical measures for market transformation in the building sector (see Section 4), deep emissions reductions in the building stock by mid-century are not likely to be possible without an ambitious and clear pathway set through codes and regulations.

The *Pan-Canadian Framework* committed to the development of a national model code for existing buildings by 2022. Improving the performance of existing buildings through codes has several benefits, including:

- Improving the longevity and performance of buildings, and addressing deferred maintenance issues
- Improving occupant health and comfort
- Creating economic benefits by stimulating retrofit activity and investment in the building stock
- The opportunity to consider a range of triggers, including time of equipment replacement, time of renovation, and time of sale
- The opportunity to consider the house as a system, and determine the optimal path to lowering energy and emissions

[3] Government of Canada, *Canada's Mid-Century Long-Term Low-Greenhouse Gas Development Strategy* (2016), 85-87. http://unfccc.int/files/focus/long-term_strategies/application/pdf/canadas_mid-century_long-term_strategy.pdf

- The possibility of requiring, measuring and/or verifying energy and emissions reductions — providing a more reliable path to meeting targets
- Reducing operating costs to homeowners through reduced energy and/or maintenance costs

On the other hand, there are some inherent challenges surrounding the regulation and enforcement of existing building performance, including:

- Introducing new capital spending requirements for home and building owners
- Disturbance to tenants and residents during renovation activity
- The potential for unpermitted retrofit activity in order to avoid code compliance
- Increasing the administrative and enforcement burden on local governments and authorities having jurisdiction

These issues can be addressed through careful code design and implementation, and are discussed in more detail below.

2. Model and reference codes

Provincial and municipal building energy codes in Canada typically make reference to one or more external standards, with modifications as necessary to meet the unique needs and goals of each jurisdiction. The most commonly referenced whole-building standard in Canada is the National Energy Code for Buildings (NECB), published by the National Research Council and intended as a *model code*, meaning that it is intended to be adopted by provinces and other authorities having jurisdiction (AHJs), but has no legal authority in its own right.

The other commonly referenced whole-building standard in Canada is ASHRAE 90.1, a long-running standard intended for new and existing buildings, except for low-rise residential buildings. ASHRAE standards for low-rise residential buildings (ASHRAE 90.2) and existing larger buildings (ASHRAE 100) also exist, but are not in common use in Canada. Energy efficiency requirements for smaller buildings are not defined in a separate energy code but rather are integrated directly in the National Building Code (Section 9.36).

NECB

The National Energy Code for Buildings (the most recent iteration being NECB-2015) currently sets out technical requirements for the energy efficient design and construction of new buildings. NECB provides both prescriptive and performance-based compliance paths, with the performance pathway being based on modelled energy use compared to a reference building (see Section 2.4, below). NECB is not designed to apply to alterations to existing buildings. While such an amendment to NECB-2015 has been considered as an interim measure, a national model existing building code tailored to Canada's buildings and climate, and as committed to in the *Pan-Canadian Framework,* will require a significant amount of new development. This model code could, theoretically, take the form of an addition to NECB, or it could be developed as a separate document.

ASHRAE 90.1

ASHRAE 90.1 is referenced in provincial and municipal building codes in Canada and applies to both new and existing buildings. It outlines specific compliance conditions for existing buildings. These elements apply to individual building systems including building envelopes, HVAC systems and lighting. ASHRAE 90.1 provides both prescriptive and performance-based compliance paths, but the performance pathway is energy-cost based, which may result in lowest-cost fuel choices rather than choices that reduce overall emissions.[4] ASHRAE 90.1 is designed for use in larger buildings above three stories and does not apply to low-rise residential buildings.

ASHRAE 100

In contrast to ASHRAE 90.1, which is mostly prescriptive-based, ASHRAE 100 is a performance-based standard for energy efficiency in existing buildings. It provides energy use intensity (EUI) targets based on the measured data from the existing building stock for 53 building types (residential and non-residential) in each of the ASHRAE climate zones. Buildings that can show (e.g. through ENERGY STAR® Portfolio Manager) that they already meet the target EUI are deemed in compliance and require no further action. Otherwise, they must engage a professional to perform energy audits and to implement energy conservation measures to improve building performance, starting with retro-commissioning.[5]

2.1 Model code development process

The development of model codes in Canada, including the NECB, is undertaken by the Canadian Commission on Building and Fire Codes (CCBFC), a committee established by the National Research Council. The CCBFC is made up of volunteers from a variety of jurisdictions and technical backgrounds, and includes a Standing Committee on Energy Efficiency in Buildings, among other standing committees and working groups. The CCBFC also receives support from the Canadian Codes Centre.

Model codes developed by the CCBFC are modified as necessary by provinces, territories, and other authorities having jurisdiction, and become enforceable building codes in those jurisdictions. There is typically a delay of several years between the release of a new version of the model code, and the adoption of those revisions by AHJs. Figure 1 shows the roles of different levels of government in code development.

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[4] Government of B.C., *New Energy Requirements*, Information Bulletin (2013). http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/construction-industry/building-codes-and-standards/bulletins/b13-05_new_energy_requirements.pdf

[5] For more information on these three standards, and how they apply in the Canadian context, see RDH Building Science Inc., *White Paper: Review of Potential Energy Efficiency Standards for Existing Buildings in BC.* (2016). http://rdh.com/wp-content/uploads/2017/01/Energy-Code-for-Existing-Building-Whitepaper-Final.pdf

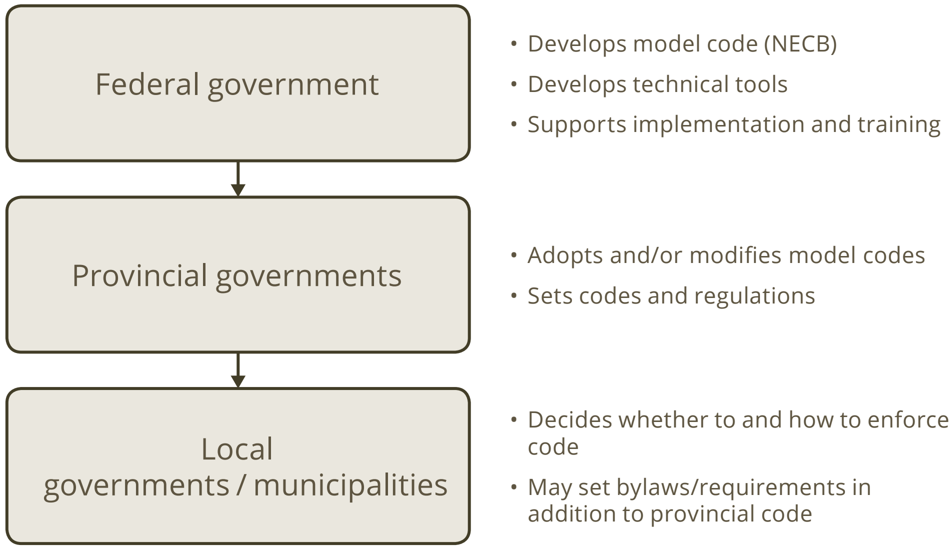

Figure 1. Roles and jurisdiction of different levels of government

A unique approach for existing buildings

Although annual CCBFC Standing Committee meetings are open to the public, the process of model code development in Canada has historically been done largely behind closed doors and with limited engagement of stakeholders from diverse backgrounds in the building sector. However, the development of requirements for existing buildings, as committed to in the *Pan-Canadian Framework*, is unique in many respects and demands a unique approach. For example, as one of the primary objectives of the requirements is to help Canada meet its climate targets, they should consider trade-offs in the carbon intensity of different fuels, a departure from the historically fuel-agnostic approach to building codes.

Alongside emissions reductions, other objectives may call for upgrades in existing buildings, such as seismic resilience, fire protection, climate adaptation, and accessibility. An integrated retrofit code could be created to address several of these objectives. This would increase the complexity of retrofit requirements and the cost of compliance, but would ensure a holistic conversation on whole-building performance and resilience. The landscape of regulations for these other goals is complex, however, and they may already be addressed in some jurisdictions during major building alterations.

The development of requirements for existing buildings will be a complex task that will cut across the mandate of several of CCBFC's Standing Committees, and retrofit technologies may by unfamiliar to some of the technical experts in these groups. An existing building energy code will need to consider a “whole-building”, holistic approach to energy efficiency and carbon reductions, and should be developed with the expertise of a broader group of stakeholders.

Expanding the model code development process to consult a wider group, including NGOs, academics, local governments and industry will promote a robust dialogue on the unique challenges of existing buildings and ensure that the new requirements are effective and enforceable.

Understanding the existing building stock

The development of a model code for existing buildings will further shift the purpose of codes away from defining minimum standards and towards defining a roadmap to the desired end state of Canada’s built environment. Comprehensive modelling of Canada’s building stock will be required to inform the pace and scale of effort required to meet proposed sectoral targets. This, in turn, will inform the level of stringency that must be required by codes in order to ensure that these targets can be met or exceeded.

At a minimum, this modelling must capture:

- A snapshot of emissions and energy use from Canada’s currently existing buildings, including information on the vintage and type of building as well as how these buildings are heated, cooled and insulated
- Current and projected growth rates and emissions from new construction, as well as rates of demolition and replacement of existing buildings from now to 2050
- Assumed ‘business-as-usual’ improvements in the building stock as a result of envelope efficiency improvements, smart metering and controls, and equipment replacement (e.g. replacement of furnaces with electric heat pumps)
- Assumed rates of decarbonization of grid-supplied electricity in each of the provinces and assumed uptake of on-site generation (e.g. from PV panels)

Preliminary modelling of this nature was completed for the province of B.C. in 2016,[6] and is currently being completed for the rest of Canada by the Canadian Energy Systems Analysis Research (CESAR) Initiative. This data may need to be further refined or supported; for example, by federal research funded and/or performed by Natural Resources Canada.

[6] Navius Research, *Modelling the Impact of the Climate Leadership Plan & Federal Carbon Price on British Columbia’s Greenhouse Gas Emissions* (Pacific Institute for Climate Solutions, Pembina Institute, and Clean Energy Canada, 2016). http://www.pembina.org/pub/bc-climate-modelling

2.2 Adoption

Current provincial and territorial building codes are based on the model National Building Code, with additions and modifications where appropriate. Adoption of the National *Energy* Code for Buildings (NECB), on the other hand, has been less widespread. Currently only two provinces (Nova Scotia and Ontario) reference the most recent 2015 revision of NECB, with B.C., Alberta, and Manitoba referencing the 2011 version.[7,8]

The development of code requirements for existing buildings by 2022 will set the stage for provinces, territories and municipalities to adopt the model code as part of their building regulations. However, work needs to be done to ensure widespread and timely adoption of these requirements.

Some conditions for success of code requirements for existing buildings include:

- Building the capacity of local permitting offices, very few of which currently enforce energy codes for new buildings beyond asking for letters of assurance
- Low-barrier financing and/or incentives to make compliance possible and non-punitive for owners
- Communicating the performance and health benefits of buildings that are brought up to the model code standard
- Targeted funding to support training, increased code compliance and enforcement in those jurisdictions that commit to being early adopters of the model retrofit code

2.3 Triggers

Retrofit requirements could be triggered at time of renovation, time of sale, or based on performance; there are advantages and disadvantages to each. The triggering pathway need not be prescribed by a national model code, instead leaving the decision of which pathway to choose to individual provinces, municipalities, or authorities having jurisdiction. However, a predictable trigger mechanism is necessary to provide clarity

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[7] National Research Council Canada, "Model code adoption across Canada." http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/codes_centre/code_adoption.html

[8] Ontario Ministry of Municipal Affairs, *Supplementary Standard SB-10 "Energy Efficiency Requirements"* (2016). http://www.mah.gov.on.ca/Page15255.aspx

and confidence to owners and industry, who can prepare and invest for bringing buildings into compliance.

Time of renovation

Energy code compliance can be required when specific building components will be affected by a planned alteration. This ‘time of renovation’ approach offers the advantage of leveraging work already being done, and reducing the incremental cost of compliance with the energy code.

However, time of renovation requirements may encourage building owners to defer capital investment, or to conduct upgrades without permits in order to avoid the additional requirements. They also do not ensure compliance within a certain timeframe, and therefore provide no certainty that overall emissions reduction targets will be met. Requirements at time of renovation should be embedded in a long-term retrofit strategy to ensure that each intervention is consistent with the long-term goal for the building to become low- or zero-carbon.

Building Energy Performance Standard (BEPS)

Triggering enforcement of energy code compliance based on the relative performance of a building is often referred to as a Building Energy Performance Standard (BEPS), and requires pre-existing information on the energy performance of the building stock. Therefore, a benchmarking requirement is a prerequisite for enforcing a retrofit code based on BEPS. Under such a system, the worst-performing buildings would be targeted first, and compliance could be required periodically, rather than depending on the initiation of retrofit activity.

BEPS promises smart regulations that achieve significant carbon reductions by targeting the worst performers. This is also, in a sense, the main weakness of the approach; the very reason why targeted buildings underperform might be because owners lack the means or the knowledge to invest in these buildings. To mitigate costs, BEPS sometimes allows for less stringent ‘recommissioning’ as an alternative compliance route. This reduces costs, but also the depth of energy savings expected. Thus, to be effective, BEPS must both require a high level of performance, and provide support for owners to meet these requirements.

Given that the *Pan-Canadian Framework* calls for building energy labelling and benchmarking as a mandatory requirement (“as early as 2019”), the development of BEPS for existing buildings in Canada could become a realistic objective within the next five years, assuming that one or two years of energy use data would be required to establish a baseline level of performance.

Time of sale

Efficiency requirements for existing buildings that are triggered at time of sale would tie code compliance to a transfer of ownership. Such an event provides a clear opportunity to require compliance, just as time of listing is used in some jurisdictions (e.g. Chicago) to require energy use labelling and disclosure. However, unlike energy labelling, energy code compliance may require substantial alterations, placing a financial burden on the buyer that would need to be considered as a part of the overall valuation of the property.

This could be integrated with a buyer's acquisition process and investment plan, and align with any renovations conducted as part of their other capital improvement plans. However, some buyers do not plan to conduct any renovations and would prefer not to disturb tenants, therefore an exit clause could be considered, ranging from the purchase of green power to the commitment to a phased-in deep retrofit.

2.4 Compliance and enforcement

Several compliance pathways are possible for existing buildings to meet code requirements, each with their own advantages.

Prescriptive-based

Traditional building codes are prescriptive; that is, they define the minimum standard that each building component must meet. An example would be a requirement that a wall assembly meet a certain R-value for insulation. When all building components meet the minimum standard, the building is assumed to meet or exceed the desired performance level.

While prescriptive codes have the advantage of being relatively easy to implement and enforce, they do not incorporate models of how the entire building performs as a *system*, and therefore do not always prescribe the most efficient, cost-effective or flexible solutions.

Performance-based

Performance-based codes differ from prescriptive codes in that they do not mandate the use of certain materials, assemblies or methods, but rather define the desired overall performance level of the building. Performance-based codes are rising in popularity as computer-aided energy modelling becomes more widespread. A prescriptive code relies on a pre-construction energy model of the building that estimates how it will perform as a system, and whether the proposed design will meet the objective defined by the code. This is usually determined either by comparing building performance to a specified target, or by comparing it to a similar building that meets the objectives (often referred to as a *reference* building).

Performance-based codes can be more complex to implement and verify due to the need for energy modelling, and sometimes for post-construction verification tests (e.g. a blower door test for airtightness). However, they offer the advantage of greater flexibility and efficient use of materials, sometimes leading to significant cost savings when compared to prescriptive pathways. Performance-based retrofit codes for larger buildings (such as ASHRAE 100-2015) could be considered as models for a national retrofit code, as they provide both clarity of desired outcomes and the flexibility to select measures that minimize costs and maximize benefits.

Other systems

Some standards, such as NECB 2011, provide multiple options for compliance including a prescriptive and performance-based pathway, as well as a *trade-off* pathway, which allows for flexibility in the prescriptive pathway by allowing for substitutions in certain building components as long as the overall objective is met.

Outcome-based codes also exist, and are designed to measure the *as-built* rather than the as-designed or as-modelled performance of a building. Outcome-based approaches rely on measurement of a building's actual energy performance over a certain period of time after construction, and also take into account energy use that is *unregulated* by other codes, such as plug and process loads. These codes are therefore the only standards that verify that the performance objectives of a building have actually been met.

An outcome-based approach to codes offers many advantages in terms of flexibility and a guarantee that objectives are met. However, such codes are currently difficult to enforce as the authority to enforce building codes generally does not extend past construction and occupancy. However, since a model energy code for existing buildings already requires a unique triggering mechanism (including one based on actual measured energy use: BEPS), the opportunity exists to adopt a non-conventional compliance pathway as well.

3. Further questions and barriers

3.1 Addressing unpermitted activity

One of the most discussed barriers in implementing an existing building code is the challenge of deferred or informal retrofit activity. Building owners may choose to defer planned investments in their buildings due to a fear of triggering extensive requirements under the building code. They may also choose to proceed with unpermitted, informal, or otherwise “underground” retrofits in order to avoid code compliance.

The financial impact of unplanned alterations, as well as the disruption to owners and tenants that results, should not be underestimated. Disturbances can be mitigated by adopting new integrated retrofit strategies, such as those developed under the Energiesprong program in the Netherlands. This program delivered deep (net-zero energy) retrofits, installed in less than 10 days without relocating tenants.[9]

Given the right regulatory constraints, a long-term policy commitment from government, and incentives for innovation, the industry will find solutions that minimize disturbance and costs. Research and communication efforts to analyze the health, comfort and productivity benefits of energy efficiency retrofits could also help build a better business case for retrofits.

As the building sector transforms and minimum standards become more stringent, adequate support must also be given to the industry in the form of training, capacity building and the sharing of best practices and lessons learned. Only with this support will ultra-energy-efficient construction and the use of low-carbon fuels become entrenched within the industry as the “new normal”, thus making compliance with more stringent codes feasible and acceptable.

[9] S. Cole, *Keep calm and learn Dutch: Energiesprong the future of sustainable homes?* (UK Green Building Council, 2014). http://www.ukgbc.org/resources/blog/keep-calm-and-learn-dutch-energiesprong-future-sustainable-homes

3.2 Improving enforcement

Although many provincial buildings codes (for example, the 2012 B.C. Building Code, which references both ASHRAE 90.1-2010 and NECB-2011) technically apply during alteration of buildings, enforcement of codes is often not observed for retrofit projects.

A 2016 white paper by RDH[10] identified three main reasons for this:

1. NECB-2011 was not developed to apply to existing buildings.
2. ASHRAE 90.1-2011 contains numerous exemptions, particularly for the building envelope.
3. Enforcement of these requirements by local AHJs is minimal.

The current lack of enforcement by AHJs in both new construction and retrofits is partially due to a systemic lack of adequate resourcing for those jurisdictions. Therefore, a national retrofit strategy must begin to address the funding and capacity-building needs of cash-strapped municipalities that have limited capacity to enforce codes.

Some jurisdictions have started to require compliance with an existing building code at time of renovation, providing early experience and lessons learned in enforcing these regulations. For example, in 2015 the City of Vancouver began enforcing compliance with energy efficiency requirements as part of major building alterations or renovations. The compliance pathway is largely based on meeting either ASHRAE 90.1-2010 or BOMA BESt standards for larger buildings, and meeting a list of prescriptive requirements for homes.[11]

3.3 Sequencing and evolution over time

Energy codes for new buildings, including NECB, provincial and other codes, generally become more stringent with each revision, with the planned evolution of the code being communicated in a roadmap for the next several revision cycles. However, given that windows, cladding and heating equipment in a given building will likely be replaced only once between now and 2050, retrofit requirements should be defined to meet the long-term goal of decarbonizing all existing buildings.

[10] *White Paper: Review of Potential Energy Efficiency Standards for Existing Buildings in BC.*

[11] City Green Solutions, “About EnerGuide Reports for Vancouver Renovation Permits.” http://www.citygreen.ca/about-energuide-reports-vancouver-renovation-permits

Requirements should be as stringent as feasible and capture much of the energy upgrade potential for the building when a retrofit is planned. This will be necessary to achieve a near-decarbonized building stock by mid-century without redoing work. Programs such as EuroPHit, which introduced phased-in, Passive House-level retrofits, should be studied to understand how such an approach can be supported by regulations.

While the *Pan-Canadian Framework* committed to developing a model code for existing buildings by 2022, the desired end state or level of stringency has not been defined. The federal government should work to define and establish targets for Canada's existing buildings stock so that mid-century decarbonization goals and climate targets can be reached.

4. Other components of a retrofit strategy

Although the development of codes by federal and provincial governments is a critical step in ensuring that the building sector meets decarbonization goals, codes are only one part of a holistic strategy. A comprehensive retrofit strategy for Canada is one that encourages market transformation and offers consumers and industry the tools and support needed to make regulations successful. Some of the key elements necessary for a comprehensive retrofit strategy, and how they interact with regulations such as model energy codes, are described below.[12]

4.1 Appliance and equipment minimum performance standards

The *Pan-Canadian Framework* commits to improving energy efficiency standards for appliances and equipment. While an important element of a comprehensive strategy for existing buildings as a whole, these requirements also have potential synergies with an existing building code. Several building components that might be covered under appliance and equipment standards (e.g. windows, heating systems, and plug loads) have a large impact on the overall energy performance of a building.

Other building components, such as boilers, heat pumps and light fixtures, can also be covered under equipment regulations, ensuring that only those components that comply with the model code are permitted to be sold in Canada. Provinces, territories and municipalities may already have authority and experience with such regulations, and established compliance mechanisms.

Fully utilizing this pathway and strengthening the stringency and coverage of equipment standards may ease the administrative burden of code enforcement by ensuring that key components are already mandated to be highly efficient under separate regulations.

[12] Adapted from *Deep emissions reduction in the existing building stock: Key elements of a retrofit strategy for B.C.*

4.2 Energy labelling, benchmarking and disclosure

Benchmarking, labelling and disclosure policies are foundational tools in enabling an energy code for existing buildings — particularly in the case of BEPS, which relies on performance data from a wide range of building types in order to establish a baseline minimum standard. Voluntary programs have existed for a number of years, and have allowed industry capacity to develop. However, to advance market transformation and collect data for regulatory design, the reporting and disclosure of energy information must become mandatory.

Benchmarking for larger buildings

Building energy benchmarking is a key tool for enabling informed and sound decision-making in energy management. Requiring reporting enables governments to prioritize and evaluate policies including regulation and incentives, while public disclosure enables the real estate sector to measure and value high performance buildings. A growing number of municipalities in North America now require benchmarking and disclosure, along with two U.S. states and, recently, the Province of Ontario.

Home energy labelling with EnerGuide

Home energy labelling provides customers and the real estate industry with the basic information they need to make informed decisions regarding home energy efficiency. Home energy labelling using EnerGuide provides a simple point of reference to compare buildings to each other, and allows homebuyers to factor energy costs and greenhouse gas emissions into their decisions when evaluating different properties. Several cities, such as Vancouver, already require some level of home energy labelling, and others such as Chicago require public disclosure as part of a home's MLS® listing.

4.3 Public financing

Although previous federal incentive programs such as the ecoENERGY Retrofit program have been successful, maintaining the level of effort required to decarbonize Canada's buildings stock by mid-century will require a sustained effort and long-lasting programs.

The repeated introduction and removal of incentives has been detrimental to the establishment of a mature retrofit industry. It creates instability in markets, with demand dropping both before the introduction of incentives (as clients await the rebates) and after their withdrawal. This instability discourages investment in training and in the development of new products and services, particularly within companies that have experienced contraction at the end of incentives.

Public investments in retrofit incentives and programming often more than pay for themselves through new tax revenues; in Germany, for example, KfW's retrofit grants and loans return $4 to $5 to public coffers per $1 invested by the national bank.[13]

Incentive programs can also encourage the successful implementation of retrofit regulations and codes, by covering some of the capital outlay required by building owners and therefore easing the cost of compliance while preserving the benefits of energy bill savings.

Infrastructure banks, green banks and bonds

There are multiple ways in which publicly raised capital could be used to accelerate retrofits, including the creation of a centralized public financing authority (or 'green bank') focused on energy efficiency and building renewal. The use of public funds to leverage private capital allows for a much larger and more sustained effort, and is therefore a key supporting mechanism for regulations that will drive significant investment in the building stock.

Leveraging funds to create provincial and/or federal green banks would enable the establishment of institutions with capacity to raise capital on an ongoing basis, a necessity if Canada is to maintain retrofit efforts between now and 2050. Ontario has taken a step in this direction with its proposed Ontario Climate Change Solutions Deployment Corporation.

The Canada Infrastructure Bank (CIB) could play such a role, but given the distributed nature of building investments and their unique challenges, it would require a dedicated department to aggregate projects and design programs suited for different market segments. Provincial institutions in charge of market transformation and aggregation of loans could also be created, with the CIB or treasury bonds providing bulk capital.

[13] KfW Bankengruppe, *Impact on Public Budgets of KfW Promotional Programmes in the Field of 'Energy-Efficient Building and Rehabilitation'* (2011), 8. https://www.kfw.de/migration/Weiterleitung-zur-Startseite/Homepage/KfW-Group/Research/PDF-Files/Energy-efficient-building-and-rehabilitation.pdf

Repayment mechanisms

Repayment mechanisms aim to encourage longer-term financing and increase loan security by tying financing to the property, utility bill, or operational budgets. Repayment mechanisms include local improvement charges (LICs), utility on-bill financing (pay-as you-save or PAYS), energy service agreements, equipment leases and soft loans.[14]

Providing financing options that are tied to the property, rather than the owner, helps to cover some of the initial capital outlay required to upgrade a building or bring it into compliance, while ensuring that building owners are not left paying for these improvements after they no longer own the building and are not receiving the benefits of reduced energy bills.

Credit enhancements

Credit enhancements are typically offered by a government and aim to encourage lenders to provide long-term financing or lower interest rates. They may also enable lenders to offer financing to customers who would not otherwise be eligible for credit. Credit enhancements include loan loss reserves, loan guarantees and interest rate buy-downs.[15]

Such measures can be important tools in ensuring that more stringent regulations for building performance are not regressive, and that all home and building owners have access to low-cost financing for the purpose of energy upgrades.

[14] For more detail on these tools, see The Atmospheric Fund, *Energy Efficiency Financing Tools for the Canadian Context* (2017). http://taf.ca/wp-content/uploads/2017/03/Public-Financing-Tools-Guidance-Note-Mar-2017.pdf

[15] ibid.

5. Conclusion

Developing and implementing code requirements for existing building will require a significant effort and collaboration across a wide range of industry stakeholders. These requirements must be ambitious and present a clear pathway to deep emissions reductions in Canada's building stock by mid-century. At the same time, they must be fair and enforceable, and supported by programs to minimize financial and administrative burdens on building owners and municipalities. A model code itself has no authority unless adopted by a sub-national jurisdiction, therefore policymakers at all levels of government must collaborate in order for these requirements to be successful.

Code requirements for existing buildings are only one part of a holistic strategy for transforming Canada's built environment. Code development at the federal level must fit into an overall strategy for existing buildings, one that addresses equipment performance standards, financing, training and capacity building, and the valuation of non-energy benefits. Figure 2 shows how some of these elements interact as part of a larger strategy for deep emissions reductions in existing buildings.

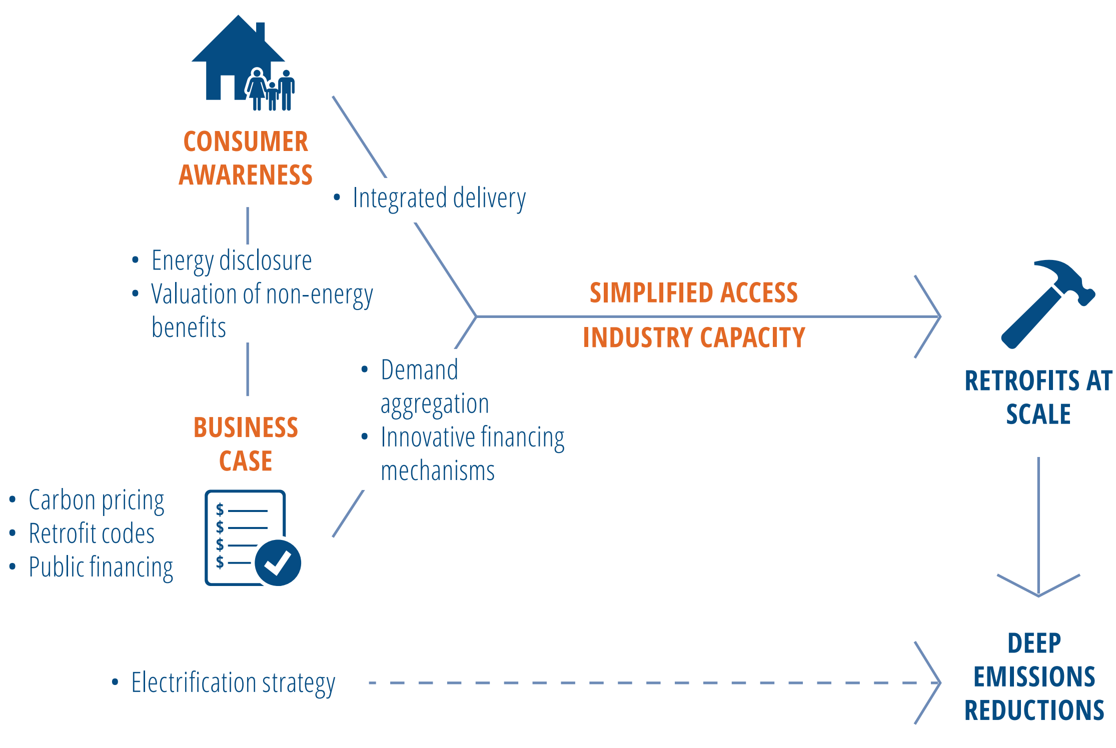

Figure 2. Necessary conditions and systemic interventions for deep emissions reductions

5.1 Key issues

Key issues that must be considered in the development of code requirements for existing buildings are:

1. Engaging with stakeholders early in the process, and determining whether to expand the current engagement structure to include a wider range of participants
2. Establishing the overall level of carbon reductions needed for Canada's building sector, and setting targets for reductions from existing buildings
3. Determining how the model code might be triggered, and whether the compliance pathway will be based on performance, prescriptive, and/or other requirements
4. Determining which, if any, existing standards the requirements will reference, and if the model code will take a holistic approach and include non-energy elements, e.g. seismic or fire requirements
5. Ensuring that the code is equitable, is not unduly punitive to building owners or industry, and is adequately supported, for example by robust financing structures and access to energy use data
6. Encouraging adoption of a model code by provinces and other AHJs, including through incentives and access to funding
7. Considering the ability of local and municipal governments to enforce an existing building code, and supporting capacity-building efforts, including those that discourage unpermitted retrofit activity