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Long-Term Strategy for Developing and Implementing More Ambitious Energy Codes

A Position Paper

Canadian Commission on Building and Fire Codes

National Research Council Canada
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Canada

CCBFC Position Paper on a Long-Term Strategy for Developing and Implementing More Ambitious Energy Codes

Introduction

This paper identifies and examines policy issues related to developing and implementing a long-term strategy for more ambitious energy codes. For each issue, the CCBFC's policy position is presented.

The document's purpose is to set the direction of energy codes developed through the CCBFC and with the support of Natural Resources Canada (NRCan) for new and existing houses and buildings in Canada - at this time.

Cognisant of the fact that federal and provincial/territorial governments may dictate national energy performance goals for Canadian houses and buildings, the CCBFC wishes to describe the pathway to enable future directions in energy codes and identify potential barriers.

As government policies are set and new information and technologies develop, it is expected that this document and the CCBFC's position may be adjusted to reflect appropriate and relevant policy directions.

Background

Before energy efficiency requirements were introduced into National Model Codes in 2011 and 2012, the CCBFC commissioned an analysis to look into whether regulation is an appropriate approach to improve the energy efficiency of houses and buildings. The analysis compared the effectiveness of regulation to other measures such as voluntary labelling, incentives/disincentives, product standards and mandatory labelling in meeting the following four key policy objectives:

- the reduction of greenhouse gas (GHG) emissions;
- increased energy efficiency;
- harmonization of building practices; and
- long-term reductions to the operational costs of houses and buildings.

The report concluded that energy efficiency requirements in building codes are appropriate and effective. Energy code requirements address all four policy objectives, affect up to 81% of energy use in houses and up to 68% of energy use in buildings, and could bring about significant long-term reductions in energy use and GHG emissions.

Given that the analysis determined that regulation is an effective tool to support the policy direction of increased energy efficiency in houses and buildings, a logical next step is to decide the extent to which the energy performance of houses and buildings should be regulated through codes. It is widely understood that the building sector will play a major role in the transition to a low-carbon economy.

Globally and nationally, energy codes are making major contributions to solving our energy and climate problems. Houses and buildings are typically built to last several decades so investments at the time of construction can have significant impacts over the lifetime of the house or building. These impacts apply directly to the owner of the house or building in terms of energy cost savings (and higher initial construction cost) and also to the broader society in terms of energy security and lowering the environmental impact of excessive energy consumption.

Voluntary incentive programs have made significant contributions in setting the direction of high performance houses and buildings and in supporting industry developing new capacity. With growing momentum, the housing and building industry together with Canada's incentive programs are identifying suitable new technologies and designs while driving down cost premiums. For example, the Canadian Home Builders' Association (CHBA) is in the process of developing a Net Zero Energy Housing Standard for its builders, renewing Canadian leadership in high performance housing. Likewise, through NRCan's awareness and incentive programs the construction industry has achieved considerable energy efficiency improvements and emissions reduction in thousands of institutional, commercial and industrial and large, multi-unit residential buildings across Canada. These types of initiatives and developments will contribute to developing effective regulation for high performance houses and buildings while lowering its impact on industry.

Recent developments

In January of 2016, the Executive Committee (EC) of the CCBFC asked the Standing Committees on Energy Efficiency of Buildings and Housing and Small Buildings to analyze the feasibility of implementing more ambitious energy codes. The two committees explored an approach of pre-determined performance levels towards an end goal of net-zero energy ready or net-zero energy. For the purpose of this paper, a *net-zero energy building* is defined as a high performance building that combines superior standards in energy efficiency with renewable energy production to offset all of the building's annual energy consumption. A *net-zero energy **ready** building* is defined as a high performance building that is built to the same level of energy efficiency as a net-zero energy building but does not include renewable energy production[1].

The EC recognized that there are significant policy issues that need to be examined and solicited the input on these policy issues from the provincial/territorial partners and NRCan, which have collaborated with the National Research Council (NRC) on developing energy performance requirements for houses and buildings[2].

Question 1:
Is a predetermined pathway for building energy performance a suitable approach for building codes?

Pre-determined increases in energy performance levels for buildings can create a pathway that leads to an ultimate performance goal (e.g. net-zero energy ready houses and buildings). Each performance level would represent a tier on this energy code pathway. A tier could include prescriptive requirements (i.e. an itemized list of building requirements), a performance requirement (i.e. a reference building approach or an energy use intensity approach), or both[3]. Refer to Appendix 1 for an example of what an energy code pathway could look like (in this case for housing).

The tiered approach introduces a couple of key policy considerations:

Building codes that set the pathway rather than follow the industry

Traditionally building codes set minimum acceptable requirements, which often follow already established accepted good practices in the industry.

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[1] If suitable, renewable energy system(s) can be added by owners to offset some or all of the building's annual energy consumption.

[2] Energy requirements for houses and buildings are covered in the National Building Code (NBC) Section 9.36. and the National Energy Code for Buildings (NECB). The NBC describes the energy requirements for housing and small buildings that are no more than three stories in building height and 600 m^2 in building area. The NECB covers the energy requirements for all other buildings.

[3] In general, prescriptive requirements are considered to be user-friendly whereas performance-based requirements involve the use of energy modelling software. Performance-based requirements allow more flexibility in meeting Code requirements, often resulting in innovative solutions.

The regulation of energy performance requirements in buildings (i.e. energy codes) overcomes market barriers to include energy efficiency measures with higher upfront cost that arise because of limited consumer demand. The development of these minimum requirements is highly dependent on stakeholder input to ensure that regulators and practitioners have the capacity to implement code changes.

The development of an energy code pathway (with pre-determined tiers leading to an ultimate goal) changes the regulatory dynamic from codes that follow the industry to codes that set the direction for the industry. While a desirable energy performance goal might be established by governments, a well-planned energy code pathway will show the industry where it needs to go while providing the necessary time and support to meet the code requirements. Until the tiers are regulated, they would represent voluntary stretch codes[4] or voluntary standards that would help prepare code users for upcoming code changes. A phased-in approach would permit the industry to become familiar with the more stringent stretch codes in the near term and would allow authorities having jurisdiction (AHJs) to adopt the stretch codes earlier. In essence, the stretch codes (tiers) would help 'prime' the market for upcoming code cycles.

It is recognized that builders, designers and owners who already fulfill consumer demand for higher energy performance standards might be concerned with losing their market advantage when more ambitious energy codes become mandatory. On the other hand, industry practitioners who design and build beyond the current energy codes would be well-positioned to respond to the increased requirements for high energy performance construction.

The CCBFC expects therefore that setting up tiers of progressively higher energy performance requirements would increase the capacity in the market for builders, designers and manufacturers to construct higher energy performance buildings.

Moving from minimum codes to leading the industry on a pathway towards pre-determined future performance levels will require investment in substantial training and education to prepare the industry and regulators for future changes (i.e. higher tiers). This is discussed in more detail in Question 3.

Policy Position: The CCBFC will develop an energy code road map that lays out how energy codes should evolve to reduce the energy impact and carbon footprint of buildings. The CCBFC has the framework and the technical expertise to develop progressive energy performance requirements that are science-backed and evidence-based.

Harmonization

A key policy goal of the CCBFC has been to harmonize the design, construction and maintenance of buildings. Harmonized codes increase productivity by reducing the regulatory burden and by removing barriers to internal trade.

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[4] The energy efficiency movement has coined this term and describes a stretch code as more aggressive than the minimum code, resulting in buildings that achieve higher energy savings. When 'base' codes are not keeping up with advances in technology and design practices, stretch codes provide an opportunity to train the building and development communities in advanced practices before the 'base' energy code is improved. Stretch codes help accelerate market acceptance and adoption of more stringent energy efficiency codes in the future. BC is planning to explore this concept for energy and other code subjects. The NECB Adaptation Guideline is a tool similar to stretch codes.
Also known as 'reach codes', stretch codes often work in tandem with incentive programs. In many cases, energy efficiency programs, incentives and jurisdictional stretch code programs can be aligned. An example of this is the seamless integration of calculation and simulation models that serve both NRCan incentive programs and NECB and 9.36. compliance calculations. A stretch code often has pre-scheduled performance targets that intend to lead the industry and its practice into achieving these goals. It can be locally mandated or act as an alternative compliance path allowing a more energy efficient option than minimum codes and offering a streamlined and cost effective route to achieving better energy efficiency than required by the minimum energy code.

At first glance it might seem that a tiered approach counteracts harmonization because it introduces a number of acceptable solutions at various performance levels. However, there would be harmony within each of the different tiers. Any province, territory or municipality deciding to adopt the same tier will use the same set of solutions. This would likely be an improvement over the current disharmonious situation of various "better than code" policies and programs, which can be difficult for industry, regulators and the public to navigate.

Indeed, there are several advantages to this approach in that some jurisdictions will likely be ready to adopt higher tiers before others as they move more ambitiously towards a low-carbon economy. They will act as the early adopters and their experience with the implementation of higher performance requirements will help to move the entire industry forward.

This framework allows some flexibility for the provinces and territories as the country moves forward on a united and coherent path to meet its ultimate performance target. This national approach towards a common end goal would assure Canadians and the international community that Canada is serious about its climate change commitments. A greater degree of harmonization will be reached when the energy code requirements that regulate the final performance goal are adopted in all provinces and territories.

Policy Position: The CCBFC recognizes that a tiered approach supports harmonization; it provides a flexible framework for the provinces and territories while leading the entire country to an ultimate performance target.

Question 2:
What should the performance goal be?

A tiered approach would be illustrated by a pathway that describes how to reach a desired goal in increments (e.g. net-zero energy, net-zero energy ready, passive house, carbon neutral). When determining the end goal, there are some important considerations:

Should the performance goal focus on reducing energy demand or should it also include renewable energy production?

Internationally, several jurisdictions are setting ambitious performance goals for buildings as an important component of their transition to a carbon-free economy. Some countries are focusing on maximizing the energy efficiency of buildings (e.g. passive house) while others are focusing on the combination of energy efficiency and renewable energy production (e.g. net-zero energy).

The National Building Code Section 9.36. and the National Energy Code for Buildings set an acceptable level of energy efficiency in houses and buildings respectively. The introduction of renewable energy production as a requirement for houses and buildings (e.g. net-zero energy) brings up many policy questions and may require considerable investment in infrastructure to ensure sufficient grid capacity and efficient management of distributed and intermittent renewable energy production (e.g. smart grid). The suitability of renewable energy systems is also context specific. For example, some buildings will not have proper solar access or enough space for renewable energy systems. (This is discussed in more detail under Question 4, Energy Source.)

World energy leaders are currently prioritizing investments in energy efficiency over other energy action priorities. For example, the World Energy Issues Monitor, which samples the views of CEOs, Ministers and international experts, reported four priority areas for energy leaders: energy efficiency, renewable energies, energy subsidies and regional interconnection. Of these four priorities, energy efficiency measures is reported to achieve the highest impact with the least uncertainty about the measures' outcome (World Energy Council, 2016).

For many of the reasons mentioned above, both Standing Committees on Energy Efficiency of Buildings and Housing and Small Buildings recommend that net-zero energy ready houses and buildings would be a reasonable end goal for the CCBFC's long-term strategy.

Policy Position: The CCBFC will continue to focus its efforts on reducing the energy demand of houses and buildings through improved energy efficiency. This will enable the provinces and territories to prepare for and transition to an ultimate net-zero energy ready performance target and to implement renewable energy or net-zero energy incentive programs to meet their specific policy objectives should they desire to do so[5].

Should the tiers include metrics for carbon intensity?

The carbon emissions of houses and buildings are currently not addressed in the energy efficiency requirements of the NBC and NECB. All else being equal, increasing the energy efficiency of a house or building will reduce the greenhouse gas (carbon) emissions produced by that building. Once all houses and buildings achieve a net-zero energy ready performance level and consume a very small amount of energy, the type of the energy used by the house or building and the types of materials used in its construction would have the next biggest impact on the overall carbon footprint of these buildings.

For jurisdictions that want to adopt net-zero-carbon (carbon neutral) targets, the energy type used to meet the energy demand of buildings will determine the carbon intensity of buildings. For example, oil is more carbon intensive than natural gas whereas renewable energy systems have no carbon emissions related to their operation.

A net-zero energy house or building ceases to be carbon neutral if the house or building uses fossil fuels to meet its energy demand. Where net-zero energy houses or buildings are grid connected, decarbonizing the electrical grid would play an important role in moving towards carbon neutrality. However, the carbon intensity of the electrical grid is highly dependent on the region. For example, regions whose electricity supply comes predominately from hydro power will have an easier time in achieving net-zero energy buildings that are carbon neutral and grid-connected.

If all levels of government agree to implement a national carbon-free economy, there will be more of an incentive to decarbonize the electrical grid and develop renewable energy storage solutions. A plan for a national carbon-free economy will also create a push to account for the embodied greenhouse gas emissions associated with construction materials.

Policy Position: The CCBFC recognizes that implementing a national carbon-free economy will provide a more comprehensive assessment of the broad impact of energy efficiency measures. However, until all levels of government agree on an approach for a national carbon-free economy, the long-term performance goal for buildings should focus on energy – not carbon.

What about existing houses and buildings?

The NECB and NBC sections on energy efficiency were primarily developed with new construction in mind. The modeling and analysis leading to the development of the requirements did not address the impact of making existing houses and buildings more energy efficient. Achieving even small energy use

[5] It is generally considered good practice to achieve high levels of energy efficiency in houses or buildings before considering renewable energy systems.

reductions in existing houses and buildings may however create overall savings that are orders of magnitude larger than energy use reductions in new houses and buildings.

Specific energy performance improvement of existing houses or buildings may be achieved at the time of planned alterations or renovations. Requiring the retroactive updating of existing stock would need the support from the provinces and territories.

In 2011, Canada had 13 million occupied housing units in high-rise and low-rise residential buildings and over 9 million houses (CMHC 2016). According to CHBA, "Half of Canada's housing stock was built before 1985. That half uses twice as much energy as the stock built since 1985." (CHBA, 2016), because the energy performance of houses has improved significantly since then.

Similarly, data from NRCan indicates that 57% of Canadian commercial and institutional (C&I) buildings were built before 1980, which use 54% of the energy consumed by all C&I buildings. The same data show that nearly half (46 %) of all C&I buildings had some type of renovation done in the five years before 2012. More than half (55 %) of all C&I buildings used some form of energy efficiency feature in 2009, such as awareness programs or control systems.

There are significant challenges to improving the energy efficiency of existing houses and buildings besides the cost and disruption to occupants. Houses and buildings are typically regarded as complex systems with various interacting components. For example, improving the building envelope of a house or building can lower the thermal demand significantly, possibly requiring the heating system to be replaced. A house or building with less air leakage may also require a ventilation system to achieve appropriate interior air quality.

Incentive programs have played a large role in overcoming those challenges for housing and buildings. For example, almost one million households participated in NRCan's ecoEnergy Retrofit Program. As the housing renovation market currently makes up about half of the residential construction industry (CMHC), incentive programs will likely continue to play a big role in the years to come.

The CCBFC, in collaboration with the Provincial/Territorial Policy Advisory Committee on Codes (PTPACC) and with support from NRCan, is exploring how to best address the energy efficiency of the existing building stock through a regulatory framework. Potential energy efficiency requirements for existing houses and buildings would support renovations and alterations of existing houses and buildings but not mandatory retrofits.

Policy Position: The CCBFC recognizes that improving the energy performance of existing houses and buildings is a critical component to achieving meaningful energy reductions. The CCBFC will work with PTPACC and the Federal Government (NRCan) to develop technical guidance on energy efficiency improvements during alterations and renovations for existing houses and buildings.

Is it reasonable to have the same performance goal for all of Canada?

Canada is the world's second largest country with large variations in climate, from temperate Vancouver Island to the Arctic North. This variation in climate and thus heating demand makes it considerably more demanding for Canada's northern regions to meet net-zero energy ready performance than its southern counterparts. Construction in the North also requires building materials that can withstand extreme temperatures as well as unique construction strategies (e.g. buildings are often raised above the ground).

Building to a net-zero energy ready performance level in the North requires higher levels of insulation, better performing windows, superior airtightness, higher efficiency mechanical systems, and a higher overall cost of houses and buildings. When building to such high levels of energy efficiency, the issue of cost optimization becomes progressively more relevant – that is, as houses and buildings become more and more efficient, it becomes increasingly difficult and expensive to achieve additional gains in efficiency (i.e. the law of diminishing returns).

Although not directly related to the energy performance of houses and buildings, there are other construction challenges in the North, which include issues that affect the durability of houses and buildings. For example, climate change has already started to alter permafrost levels. The consequent freezing and thawing can cause serious settlement problems and structural damage to houses and buildings.

Given the small population[6], climatic challenges and high cost of construction in the North, it begs the question whether the performance goal should be the same for all of Canada or whether the goal should be regionally specific (e.g. adapted to climate zone). For example, the US-based Passive House Alliance (PHIUS) is in the process of adapting the German Passive House Standard to reflect the regionally-specific climatic demands of houses and buildings.

Policy Position: The CCBFC recognizes that Canada has large climatic variations which affect the energy demand of houses and buildings. The CCBFC will analyze the impact of a uniform performance goal for all of Canada compared to regionally-specific performance goals and pay particular attention to constraints in Canada's North.

Question 3:
How should the energy code roadmap be implemented?

Tiers of progressively advanced energy performance requirements for houses and buildings would represent science-backed and evidence-based voluntary standards that could be supported with incentives offered by governments. Until they are included in National Model Codes and adopted in regulation, the tiers would represent stretch codes or aspirational codes that governments can use to achieve their specific energy or greenhouse gas reduction objectives. The successful transition from voluntary standards/tiers to regulation will largely depend on the construction industry's ability to transition to higher performance building standards, the consumer's ability to afford high performance houses and buildings, the way energy improvements are analyzed and valued, and the level of compliance with energy efficiency requirements achieved through effective education, incentive programs and enforcement.

Industry readiness

Some stakeholders have voiced concern about the industry's readiness and ability to respond to more ambitious energy codes. Residential, industrial, commercial and institutional development projects are planned years in advance of obtaining building permits and changes that affect thicknesses of assemblies, particularly walls, might require redesigning projects and possibly increasing the lot dimensions of houses or buildings.

On the other hand, the construction industry for housing and buildings is showing a significant interest and market demand for high-performance energy construction. In both residential and non-residential sectors, there is evidence that the industry is moving from pioneering and pilot studies on to mainstream net-zero construction projects.

[6] As of 2011, only about 107,265 people lived in the Northern territories compared to 33,476,688 in the rest of Canada, representing approximately 0.3% of the population (Statistics Canada, 2011 Census).

A gradual and pre-determined ramping up of energy codes by pre-determined tiers would provide industry (e.g. manufacturers, builders and suppliers) with both market opportunities and time to prepare for future energy code requirements, enabling a smooth transition to increased performance requirements.

Policy Position: The CCBFC recognizes that long-term planning and communication of the energy performance end goal and implementation approach will be critical components to ensuring an effective market transition.

Costs and benefits

High performance houses and buildings require additional investments in energy efficiency measures which affect the upfront cost of construction. While these energy efficiency features reduce the operating costs for the owner, these savings can take a long time to 'pay back'. This is particularly true at current low energy prices.

Innovative financing mechanisms that recognize the value of lower operating costs may help to overcome higher construction costs. It is also important to note that in many Canadian regions and metropolitan areas it is the price of land and not the price of construction which make up the most significant portion of real estate cost.

If energy prices rise over the long term as expected, investments in energy efficiency will likely reap dividends in the long term. The cost premium of higher energy performance houses and buildings will decrease over time as today's new technologies become common building features of tomorrow. More certainty in the market regarding the direction of high performance houses and buildings will encourage investment in building-related clean energy technology, driving down the price of these technologies.

There are also broader societal benefits. For example, significant potential economic opportunities may come from increased energy performance requirements because the residential construction industry is a large industry in Canada and, unlike other industries, its economic activity is spread across the country. The green building industry is also linked to strong job creation and GDP growth.

Policy Position: The CCBFC recognizes that there is a potentially high cost to moving to very energy-efficient construction paired with progressively smaller energy savings. The CCBFC expects, however, that the broader societal, environmental and economic benefits may outweigh these costs over the long-term.

Methods of analyzing costs and benefits

There are several ways to assess the "true" cost of investments in energy efficiency and clean energy technology. For example, carbon pricing would help to monetize the greenhouse gas reductions achieved through high performance houses and buildings. There are methods, such as life cycle analysis, that expand the assessment boundary beyond energy and carbon to include the environmental impacts associated with all the stages of a product's life from cradle to grave. There is also the net present value method, which recognizes that the value of money changes over time and that the depreciation of the initial cost of energy efficiency measures needs to be considered when compared to the future value of the benefits of energy savings.

The current CCBFC policy on cost-benefit analysis for energy requirements endorses the simple pay back method to compare the incremental construction cost with the benefit of proposed energy efficiency requirements. The capital cost of a measure is divided by the predicted annual energy savings to determine the amount of time it will take to "pay back" the energy efficiency measure.

Policy Position: The CCBFC recognizes that the impact analysis method may significantly influence how the cost and benefits of high performance houses and buildings are described. In the short-term the CCBFC will continue to use the simple pay-back method to describe the impact of changes to National energy efficiency requirements but will investigate alternative methods of impact analysis.

Capacity-building through education, incentive programs and enforcement tools

The building industry is a multi-faceted industry with multiple trades involved in the construction of a single building or house. Building to a higher energy performance standard will require training, capacity-building and enforcement across all trades to ensure that houses and buildings are built to the standard that they were intended.

Compliance with more ambitious energy codes will require educating the industry on how to build to higher performance standards and educating regulators on how to effectively enforce the intended performance standards. Provinces and territories may need more training and education support before they adopt new energy performance requirements. The CCBFC could provide this support by more effectively disseminating the information gathered during the code development process. For example, more effective information transfer could be implemented in the form of training for industry and inspectors as well as code seminars and webinars. NRC and NRCan would collaborate with the provinces and territories and other industry stakeholders to build broad industry capacity on energy efficient construction and support the industry's ability to design and construct more energy-efficient buildings by providing "how to" guides on new construction strategies and improved construction processes to achieve the new energy performance levels. This kind of support will increase the likelihood that the provinces and territories will be "ready and able" to implement more ambitious energy codes.

Incentive programs for high performance housing have served and will likely continue to serve as an effective means of building capacity within the industry. For example, CMHC's EQuilibrium™ Housing Initiative and NRCan's ecoENERGY Innovation Initiative (ecoEII) have helped to grow industry experience and expertise among home builders, thereby driving down the cost premium of high performance housing. Similarly, programs such as NRCan's Commercial Building Incentive Program (CBIP) have encouraged investments in highly energy-efficient commercial and institutional buildings by offering financial incentives for design and training, partnerships, and support for technological innovation. The lessons learned from the 540 projects across Canada have helped to lower the costs of mainstream projects. These government-subsidized initiatives have helped builders and owners of high performance houses and buildings overcome the market barriers of building beyond the building code.

Enforcement tools such as certification and performance testing of houses and buildings and their mechanical systems will improve the quality and sustainability of energy savings without changing any of the prescriptive building requirements. For example, a significant improvement in air leakage could be achieved through whole-building air leakage testing. Other enforcement tools could take the form of checklists for on-site construction and post-occupancy inspections.

Policy Position: The CCBFC recognizes that education, incentive programs and enforcement tools are necessary to build new capacity in the industry and among regulators. The CCBFC wishes to ensure that energy performance requirements are properly implemented, thus resulting in real energy savings and greenhouse gas emission reductions. The CCBFC is prepared to engage with all provincial/territorial jurisdictions and the federal government to investigate the feasibility of developing effective education and enforcement tools related to the energy efficiency of houses and buildings.

Question 4:
What are some of the key regulatory considerations?

Moving towards more ambitious energy codes introduces some important regulatory considerations. Some of the most significant include considerations around differentiating energy performance requirements based on assembly type, energy source and occupancy type and how trade-offs should be addressed.

Assembly type

The CCBFC's policy direction with respect to assembly type was approved in 2010 for the NBC Section 9.36. (housing) and the NECB (buildings). It states that all assembly types are to be treated the same in terms of the overall energy performance requirements (i.e. there are no differences in requirements whether the structure is constructed from concrete, masonry, wood or steel).

It is foreseeable that more ambitious energy codes will have a higher impact on some industries compared to others. For example, the log construction, masonry construction and manufactured housing construction industries may require different and more cost-prohibitive techniques to meet the ramped up energy code.

The NECB and NBC Section 9.36. allow an increase or reduction in insulation levels as an option for any type of construction when a designer chooses to follow the prescriptive, trade-off, or performance compliance approaches as long as the sum of all areas with reduced insulation equals the sum of all areas with increased insulation. This allows for some limited flexibility in the design and construction of houses and buildings.

The limits to the flexibility in trade-off paths and an equal playing field among all assembly construction types underline the importance of the building envelope as an element with a high-impact towards energy efficiency. It also recognizes the building envelope's long service life and the significant challenges to retrofitting it after it has been constructed.

Policy Position: The CCBFC maintains its position that the overall energy performance of houses and buildings should not depend on the material or technique used to construct a building.

The CCBFC recognizes that the building envelope contributes significantly towards achieving energy efficiency and has a long service life. The CCBFC will determine the degree to which insulating the building can be traded off.

The CCBFC will work with the industry to explore effective regulatory approaches to meeting more ambitious energy codes, in particular for log construction, masonry and manufactured housing.

Energy source

The CCBFC's current policy direction (2010) states that the energy efficiency requirements for houses and buildings should not vary based on energy source. When it comes to energy supply through renewable energy production, the requirements are silent (i.e. neither do they encourage nor discourage the use of renewable energy systems). At the same time, the requirements are written as to not create barriers to the use of renewable energy systems. For example, the NECB and Section 9.36. in the NBC include enabling requirements to facilitate the installation of solar hot water heaters but they do not set minimum requirements for their energy performance and nor do they allow renewable energy generation to be traded-off against a lower performance of the building envelope or mechanical system.

As the energy performance of houses and buildings increases and jurisdictions start moving towards net-zero energy ready and possibly net-zero energy houses and buildings, the role of renewable energy systems needs to be re-examined, if such systems are to be recognized in National Model Codes. The CCBFC's current policy position allows provinces and territories to implement renewable energy systems at any point to improve upon the required minimum energy efficiency levels. The CCBFC recognizes that each province and territory has a unique energy mix and understands the need for jurisdictions to make energy supply choices based on preferred energy types.

Defining the terms "renewable energy system" and "net-zero energy house/building" in the Canadian regulatory context with the advice of the provinces and territories would be a good starting point in developing consensus. In the current context of net-zero energy houses and buildings, on-site renewable systems usually include solar photo-voltaic, solar thermal, wind and micro-hydro systems where solar access, geography and zoning laws permit. Typically, net-zero energy houses and buildings do not consider biomass to be a renewable energy nor do they consider renewable energy contributions to the electrical grid such as large-scale hydroelectricity. The discussion around net-zero energy and what is considered renewable energy could be expanded to include these aspects of energy production.

Policy Position: The CCBFC maintains its position of not placing barriers on the use of renewable energy systems and of remaining silent in the Codes regarding renewable energy credits. The CCBFC will work with provincial/territorial jurisdictions via PTPACC to assess whether there is a need to regulate renewable energy systems in houses and buildings.

Occupancy type

The CCBFC's current policy direction is that the energy efficiency requirements for houses and buildings do not vary based on occupancy except for differences in the current inherent performance levels of the existing energy performance requirements for housing and small buildings (NBC Section 9.36.) and all other occupancies (NECB).

If energy performance requirements ramp up, it may make sense to consider the varying architectural characteristics and operational profiles of specific building types. For example, different energy use intensity (EUI) values could be required for specific occupancy types (e.g. low-rise residential buildings including multi-units, schools, restaurants, parking garages, warehouses, retail, etc.) as an additional performance path option. This could facilitate a more strategic approach to improving the energy efficiency of the built environment. The EUI approach would also be helpful from an energy literacy perspective because it simplifies comparing energy use on a unit-area-basis to similar occupancy type houses and buildings.

The CCBFC had approved the work of developing the EUI method as a potential new performance compliance path for the 2015 NECB; however, the EUI method was not implemented in the 2015 NECB because of concerns from some jurisdictions.

Policy Position: The CCBFC recognizes that there are inherent differences in performance between residential and non-residential buildings. The CCBFC will continue to seek consensus on implementing EUI targets based on occupancy type.

Question 5:
What are the limitations of a regulatory approach (i.e. energy codes)?

Energy codes only cover certain aspects of the total energy used by houses and buildings. In general, energy requirements specify the energy performance related to the building asset – that is, the aspects of the house or building that last for much of its lifespan (e.g. insulation, windows, heating systems).

Life cycle of buildings

Building and energy codes only address the "use phase" of buildings – that is, their operational phase. They do not address their "non-use phases", which includes manufacturing and transport of materials before their use and the demolition, recycling and disposal of materials after their use.

Plug loads and occupant behaviour

There are building energy loads that are not regulated by energy codes. For example, the energy consumed by computers, printers, small and large appliances (e.g. stoves, microwaves, fridges) are considered as "plug loads" and are outside the scope of what energy codes address. Requirements related to lighting are outside the scope of the NBC Section 9.36. (housing and small buildings) but are within the scope of the NECB (commercial, institutional and high-rise residential).

Occupant behaviour is also outside the scope of energy codes. For example, homeowners and tenants make their own decisions about the temperature setting of their thermostat, whether to open their windows during the winter. Home and building owners also make their own decision on the size of their houses and buildings. All of these decisions affect total energy use but are typically outside the scope of energy codes. Similarly, building managers must ensure the proper operation and maintenance of commercial and institutional buildings to ensure that buildings perform as expected. If the building manager is unaware of how to operate the building systems effectively, the building will perform sub-optimally. These examples illustrate why there is an important difference between an energy code requirement and an energy reduction achievement. Post-occupancy monitoring can be used to verify that energy code requirements are translating to an actual building performance outcome.

If the energy performance requirements in energy codes were to become more stringent, the significance of plug loads and occupant behaviour would become increasingly important. For example, plug loads represent about 25% of the total energy use of an average Canadian household built to the NBC Section 9.36. In a high performance net-zero ready house, the plug loads can jump to 67% of the household's total energy use (CHBA, 2016). Similarly, even in office buildings that have energy efficient lighting, heating and cooling, plug loads can represent as much as 50% of the total electricity use (NBI, 2015).

Other policy tools

Given their increasing relative importance, other policy tools will be required to address energy loads that are outside of the scope of energy codes and to influence occupant behaviour. These tools could include equipment efficiency standards, mandatory labelling, consumer awareness, industry training, incentive programs, research and development of next generation technologies, as well as including externalities in the price of energy. The tools would support and could be developed in tandem with energy code developments. As an example, the State of California has adopted equipment efficiency requirements that support its net-zero energy code goals.

Policy Position: The CCBFC recognizes that building energy codes are just one factor influencing the energy demand of houses and buildings. The CCBFC has some control over the energy performance of building elements that can be effectively addressed through regulation. Where appropriate, the CCBFC will support efforts to address other elements affecting energy use (e.g. plug loads and occupant behaviour) in order to achieve comprehensive and meaningful energy reductions.

Question 6: Are there administrative or legislative considerations for the provinces and territories?

Moving from codes that represent the minimum level of performance to predetermined tiers of progressively ambitious requirements represents a significant departure from the status quo of regulating building safety and energy efficiency. This shift may result in significant legislative and administrative considerations.

Legislative considerations

Releasing the requirements for all tiers simultaneously would allow ambitious provinces and territories to adopt the higher tiers immediately should they wish to do so. It would also allow jurisdictions to plan and prepare for future energy performance requirements and would prompt a discussion in all jurisdictions as to what the desired minimum level of energy codes should be and how fast they should progress to their goal.

Besides the need to prepare adequate enforcement tools and training, there is also the question of how the tiered energy requirements should be published. Currently the energy requirements for buildings are published in a single document (NECB) while the energy requirements for housing and small buildings are published in Section 9.36. of the NBC. Having a series of tiers published in a short time frame within the same document may cause confusion in the industry and difficulty with the adoption legislation in some jurisdictions, especially in jurisdictions that automatically adopt national codes by reference.

There will likely be minor changes to the requirements in each tier as the industry and regulators (in the adopting regions) become more experienced and as innovative technology develops, which introduces another layer of complexity. Based on these assumptions, the tiers would need to be to be updated regularly. The CCBFC will need to determine how to effectively update the tiers and how often this should occur.

Administrative considerations

More ambitious energy requirements will necessitate training of a broader group and more rigorous and effective enforcement tools. Not only will building, fire, plumbing and electrical safety inspectors have to be aware of the different performance levels within the tiers, they also will need to have a broad understanding of the impact that the new energy efficiency measures have on the building as a system as well as being capable of assessing the conformance of high performance energy technologies. As tiered codes or stretch codes are a significant change from how codes are used today, code users and practitioners will have to learn how the tiered approach works and how it would be applied in practice. The successful transition to designing, building and enforcing net-zero ready houses and buildings will require an increased use of instruments such as modeling, component performance testing or building commissioning. For example, the blower door test (fan depressurization method), which is used to confirm the airtightness of a house or building, will be inevitable as airtightness requirements become more stringent. These instruments may necessitate changes to permit protocol and approval processes.

Policy Position: The CCBFC will work with PTPACC to enable the jurisdictions to effectively administer and legislate pre-determined future energy requirements.

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Codes Canada
National Research Council Canada
1200 Montreal Road
Ottawa, Ontario K1A 0R6