Energy Efficiency for New Homes and Buildings

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Sustainable Energy Solutions

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Green Building Leaders Report

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The Pembina Institute is a national non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance. For more information about the Pembina Institute, visit www.pembina.org or contact info@pembina.org. Our engaging monthly newsletter offers insights into the Pembina Institute's projects and activities, and highlights recent news and publications. Subscribe to Pembina eNews: http://www.pembina.org/enews/subscribe.

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Energy Efficiency for New Homes and Buildings

Contents

1. Summary

This Green Building Leaders discussion paper provides a sampling of efforts to improve the energy efficiency of new buildings through local government or provincial regulation. The research is intended to support local governments considering similar approaches in British Columbia.

Currently, British Columbia has one of the more aggressive greenhouse gas reduction targets in Canada, and its energy efficient building strategy is one of the approaches being employed to achieve the target. The recent effort to include energy efficiency in the building code has resulted in some of the highest energy efficiency standards in the country for both residential and commercial buildings.

Ensuring that the requirements for energy efficiency in new construction improve at the pace dictated by the province's climate action plan will be challenging. One approach to accelerate province-wide improvement is to enable local governments to lead the way where possible. In this manner, those communities can meet their own objectives and serve as active testing grounds for progressive building practices and policies.

While building codes are most commonly established at the provincial or state level, there are numerous examples of local governments implementing their own standards. Examples include Vancouver, Toronto, East Gwillimbury, Palo Alto and Seattle. This report explores those models to help facilitate a discussion of comparable approach in B.C.

This report has three main sections:

1. An overview of some of the most important building codes and standards available to governments looking to require higher levels of energy efficiency in new construction.
2. A review of how building codes have been used by State and Provincial governments to improve energy efficiency.
3. A review of how building codes have been used by local governments in Canada and the United States to improve energy efficiency.

2. Codes and Standards: What's in a Name?

This section covers the interactions between building codes, standards and energy performance ratings in the context of energy efficiency requirements for new buildings. Generally, a code is broad in scope and is intended to be become law through adoption by appropriate governments. A standard, in the construction context, is narrow in scope and can be given force of law if referenced in code. Energy performance ratings are used to evaluate buildings against standards, communicate the level of performance, and sometimes to set minimum requirements for buildings.

Following a more in depth explanation of codes and standards, this chapter provides information on responsibilities for developing, implementing and enforcing buildings codes; presents key attributes of the building codes used in Canada and the United States; and describes different energy efficiency or green building rating systems that have been used in Canada as bases for either voluntary or regulatory compliance.

2.1 Defining Codes and Standards

2.1.1 Building Codes

Building codes specify the set of standards to which a building *must* be constructed within that jurisdiction. They are typically inclusive of fire protection, use of hazardous materials, energy efficiency, plumbing, and environmental separation. Requirements for energy-using equipment not integral to the building (e.g. appliances) are typically included in energy efficiency acts as opposed to building codes.

2.1.2 Standards

Standards are the requirements against which products and systems are measured and compared. For example, a minimum requirement for insulation in attic spaces is a standard. Standards can be voluntary or mandatory, but they only become mandatory when referenced in codes and regulations adopted by governments.

Standards can also be prescriptive or performance-based in nature. Prescriptive standards provide specific design criteria, such as minimum levels of insulation. Performance standards provide greater compliance flexibility, by specifying outcomes (e.g. thermal resistance, air changes per hour, or a specific EnerGuide rating) without specifying how to achieve them. In some codes, a "trade-off" compliance route is permitted that allows minor deviations from the prescriptive path (for example decreasing thermal insulation in one area, but increasing it in another without

affecting overall building performance). Many codes are also allowing compliance through a mix of prescriptive, performance and "trade-off" paths.

2.2 Responsibilities for Code Development, Implementation and Enforcement

2.2.1 Code Development

At the national level in Canada, the Model National Code for Buildings provides minimum requirements for new construction and substantial renovations. The Model National Code, or any other code, is only enforceable if adopted by governments with the jurisdiction to do so. The Canadian government funds the development of model codes through the National Research Council (NRC) and the Canadian Commission on Building and Fire Codes (CCBFC). Provinces and territories are actively involved in this process through the Provincial/Territorial Advisory Committee on Codes (PTPACC).

The process in the U.S. is similar, where two primary energy codes are developed for potential adoption by states and local jurisdictions: the International Energy Conservation Code (IECC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (AHSRAE) 90.1 Energy Standard for buildings.

The development of the IECC code in the U.S. is a governed, consensus-based process under the auspices of the International Code Council (ICC). All parties are able to participate in the development process through public hearings, but final vote is restricted to individuals associated with federal, state and local governments who are members of the ICC. These codes are updated every three years. Similarly, the ASHRAE Code is developed in a consensus-based forum accompanied by a public process. New versions of the code are approved based on a vote of the membership, which includes a broader representation than the ICC (i.e., more than government members).

For any of the codes, further modifications can be made by the implementing jurisdiction to reflect regional building practices or local energy efficiency and climate change objectives. Both the Canadian and U.S. development processes are mentioned, because there are no requirements for Canadian jurisdictions to use Canadian codes.

2.2.2 Code Implementation

Provinces and territories are responsible for the adoption of building codes through legislation. Most provinces and territories have adopted a building code, which often includes regional additions, exemptions or amendments.

At the provincial, territorial and local government level, regulatory tools other than codes can also be used to affect the energy efficiency of homes and buildings. For example, official land use plans can specify permitted land uses and local governments can specify architectural controls. See the complementary report, *Green Building Leaders: Jurisdiction Options Discussion Paper,* for more information on other options for local governments to affect energy efficiency in buildings.

2.2.3 Code Enforcement

Provinces and territories are also responsible for interpretation and enforcement of building codes. In many cases however, that responsibility has been delegated to local governments where the degree of enforcement varies considerably from community to community.

2.3 Baseline Codes

Baseline codes, in the case of Canada and the U.S., are those codes developed for broad application and then adopted (and potentially modified) at the provincial, state or local level. These codes must be adopted by individual jurisdictions for them to be enforceable.

The baseline codes discussed in this section include the International Energy Conservation Code, which addresses residential and commercial buildings, the American Society of Heating, Refrigerating and Air-Conditioning Engineers 90.1 and 189 codes, which address commercial buildings, and the Model National Energy Building Code for Houses and for Buildings.

2.3.1 International Energy Conservation Code (IECC)

The IECC is an international consensus model code developed through the International Code Council. It contains minimum energy efficiency requirements for residential and commercial buildings, and offers both prescriptive and performance compliance paths. The IECC adopted, by reference, ASHRAE 90.1; therefore, compliance with the latter qualifies as compliance with the former (though only for commercial buildings).[1]

The IECC has been adopted by many U.S. states, with many using the 2006 or 2009 editions, but the 2003 version is still in place in some states. The IECC is adopted directly by more states than the ASHRAE 90.1 standard, primarily because it is developed as a model code and is part of a coordinated set of model building codes that state and local governments have historically adopted.[2]

2.3.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1

ASHRAE 90.1 applies to all buildings except low-rise residential structures, and defines the minimum energy performance for these buildings. The provisions apply to building envelope (of enclosed, conditioned spaces), heating, ventilation and air conditioning systems, service water heating, electric power distribution and metering, electric motors and belt drives, and lighting. The scope also includes new portions of buildings and their systems, and new systems and equipment in existing buildings. The 90.1 code provides both prescriptive and performance-based compliance paths.

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[1] U.S. Department of Energy. Building Energy Codes 101: An Introduction. February 2010. PNNL-SA-70586.

[2] Conover, David, Rosemarie Bartlett and Mark Halverson. Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings. December 2009. U.S. Department of Energy.

ASHRAE's 90.1 code is a common reference point for energy use in buildings. Commonly referenced versions include 2001, 2004 and 2007. The review cycle of the 90.1 is ongoing and new versions are published in three-year intervals.

2.3.3 ASHRAE 189.1

ASHRAE 189.1 differs from ASHRAE 90.1 in that it includes other elements of advanced green building beyond energy use and ventilation (e.g. water use and sustainable site management). The code is currently under development, with publication expected in early 2010. It will apply to all building types with the exception of low-rise residential buildings (similar to ASHRAE 90.1). The 189.1 code will provide both prescriptive and performance-based compliance options, and is intended to complement green building rating programs such as LEED.

This model code represents an opportunity to increase energy performance of buildings as compared to previous codes. A preliminary assessment indicates that the energy use of buildings built to this code will be on average 30% lower than the 2007 version of AHSRAE 90.1.[3] A primary reason for the significant improvement in energy performance is the requirement for a continuous air barrier.

ASHRAE 189.1 will also require compliant buildings to provide on-site renewable energy (e.g. solar photovoltaic, solar thermal, geothermal or wind), unless exempted because of poor resource availability or increased energy efficiency measures.

2.3.4 Model National Energy Codes (Canada)

There are two model codes in Canada: the Model National Energy Code for Houses (MNECH) and the Model National Energy Code for Buildings (MNECB). Model building codes were developed in Canada as far back as 1978 and 1983, though regional adoption was limited because the use of national averages meant the code was not always regionally appropriate. Beyond the mandatory requirements that cannot be avoided, three compliance paths — prescriptive, "trade-off" and performance — are available.

The Canadian MNECs are not updated regularly, and as a result, Canadian provinces and local governments who have energy codes have tended to adopt other codes such as ASHRAE 90.1. The 1997 MNECB is available currently, and a new national code is anticipated in 2011.[4] Although the current model codes are not used in Canada as official codes, they are used as a benchmark for energy performance in some regions and for federal energy efficiency programs. For example, the Commercial Building Incentive Program (CBIP), a retired federal energy efficiency initiative, required buildings to use 25% less energy than the MNECB.

[3] Kennedy, S. A Look at the Energy Requirements of 189.1. Presentation available at www.ashrae.org/publications/page/927.

[4] http://oee.nrcan.gc.ca/commercial/newbuildings/mnecb.cfm?attr=20. March 15th, 2010.

2.3.5 Comparing Baseline Codes

It is challenging to make generalized conclusions about how energy performance differs under different codes because there are many different ways to design a building while still meeting a given code. Standards and codes have various compliance methods (prescriptive, performance), and builders and designers can trade off measures in many cases. Some direct comparisons can be made however, and the following chart illustrates how energy consumption in commercial buildings varies between several of the baseline codes described in this paper.

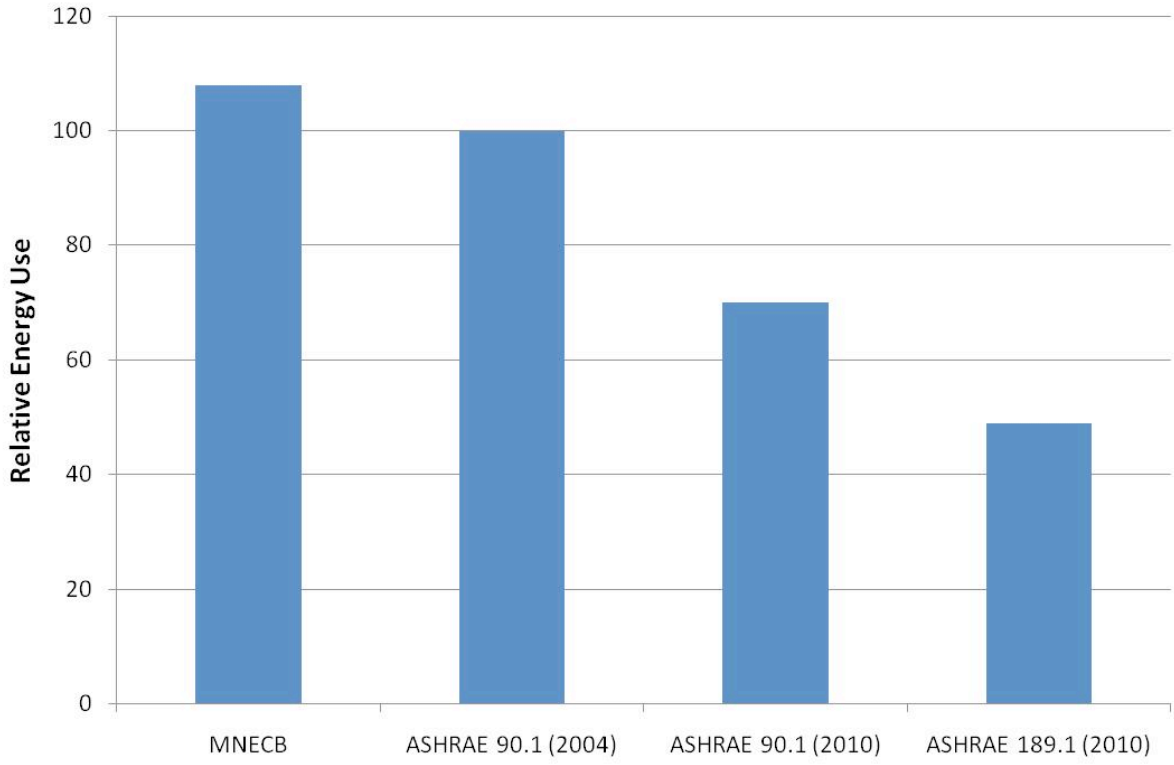

Figure 1: Graph on Energy Code Performance[5]

2.4 Beyond Baseline Codes

Progressive jurisdictions can build upon the base codes described above to focus additional effort on energy efficiency, cost savings and environmental sustainability. This section describes some energy efficiency and green building rating systems and standards that can be used to underpin those efforts.

[5] Adapted from McCarry, Blair. Green Buildings, Climate Change and the Community. Presentation at 2008 Upwind Downwind Conference: Climate Change and Healthy Cities.

2.4.1 EnerGuide for Homes

The EnerGuide rating system is not a standard or code, but does provide a standardized methodology for assessing, rating and labelling the energy performance of both new and existing homes. A number of Canadian jurisdictions have recently begun using a target rating (e.g. EnerGuide 77) to set minimum energy performance standards in their building codes.

The EnerGuide label is based on a building's performance relative to a calculated benchmark building of the same size in the same climate. This ratio is normalized onto a scale of 0 to 100, with 100 being a net-zero energy home. A one point improvement in EnerGuide rating typically results in a 3-5% decrease in annual energy use, so for example, an EnerGuide 80 home can expect to use significantly less energy than a home with a rating of 77.[6] Highly energy efficient new homes can score from 80 to 90 on the EnerGuide scale, whereas buildings built only to code with few or no energy efficiency improvements could be as low as 65 to 72. In B.C., the building code's prescriptive path for new homes is estimated to result in homes with a rating of EnerGuide 77.

Factors affecting the EnerGuide rating include mechanical equipment, window ratings, building envelope, lighting and insulation levels. Following the assessment of the home, the builder and/or homeowner receives a full report including justification of the rating received. It does not account for the energy use patterns of the occupant (e.g. thermostat settings, preferences to leave windows open, or length of showers), using average figures instead. This allows similar homes to be compared with each other.[7]

2.4.2 Energy Star for New Homes

The Energy Star certification is based on a number requirements including Energy Star windows and appliances, high efficiency mechanical systems, upgraded insulation and reduced air leakage. Meeting the Energy Star specifications is equivalent to an EnerGuide 80 rating. Third party verification is required before homes can have the label applied.

2.4.3 R2000

R2000 is a national voluntary design standard that encourages builder and consumer participation.[8] The standard includes both prescriptive and performance requirements, providing the builder with some flexibility in building techniques and materials. The R2000 standard is equivalent to EnerGuide 80 rating in terms of energy performance.[9] Prescriptive elements in the standard include minimum requirements for the building envelope, mechanical systems, indoor air quality, and water conservation and environmental features. In the case of the latter two categories, a "pick-list" of features exists for builders, allowing for some flexibility in design.

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[6] A New House that Saves. Natural Resources Canada.

[7] Natural Resources Canada, Office of Energy Efficiency, 2005, *EnerGuide for New Homes: Administrative and Technical Procedures* (Ottawa, ON: Natural Resources Canada, 2005) Appendix A, 47.

[8] R2000 Standard. 2005 Edition.

[9] R2000 Standard. 2005 Edition.

2.4.4 GreenPoint Checklist

The GreenPoint label is managed by the independent non-profit organization Build It Green and is used exclusively in California. The GreenPoint rating is voluntary and available throughout the state. Several municipalities have endorsed it and use it to support their local green building programs.

GreenPoint can be used both for single-family and multi-family homes, and has a separate rating system for existing homes (including those completing renovations). Builders and homeowners can accumulate points in a variety of areas, including energy, water and indoor air quality. There are few mandatory features in the point-based certification system, though there are minimum requirements in each category of evaluation. Homes are required to be 15% more efficient than the California state-wide building energy code, Title 24. The GreenPoint system also rewards passive solar (orientation of building) design and on-site renewable energy generation.

The GreenPoint system requires third-party review of plans before construction, in addition to site visits during construction (before drywall) and post-construction.

2.4.5 Leadership in Energy and Environmental Design (LEED)

LEED is a third-party verification and certification program that strives to be the benchmark for sustainable design in buildings. The LEED program addresses five areas of building design: sustainable site development, water efficiency, energy efficiency, materials selection, and indoor environmental quality (IEQ).[10] Designers and builders must meet a number of prerequisites in each area. Beyond this, buildings are awarded credits based on features and performance in each area with four designations possible: certified, silver, gold and platinum.

There are separate LEED certifications for new homes (LEED Canada for Homes) and new building construction (LEED-NC), as well as newer and emerging standards for existing buildings (LEED-EB), commercial interiors (LEED-CI), core and shell (LEED-CS), and neighbourhood developments (LEED-ND). The LEED Canada certification system is managed by the Canadian Green Building Council (CaGBC) and is adapted from the LEED standards developed by the U.S. Green Building Council.

LEED is a voluntary program used across Canada. Provinces and local governments have implemented green building requirements based on the LEED program to be applied to public facilities or publicly funded facilities. In East Gwillimbury, Ontario, the municipality has extended this requirement to all new commercial and institutional development.

2.4.6 BOMA BESt

Unlike other programs, the Building Operators and Managers Association (BOMA) Building Energy Standard (BESt) is an ongoing program that monitors energy and water consumption for buildings on an annual basis, and includes other criteria such as recycling in the building facilities. The program is voluntary and targets office buildings, light industrial properties, enclosed shopping centres and open air retail properties.

[10] http://www.cagbc.org/leed/what/index.php. Feb 12th, 2010.

The BOMA BESt program has evolved to become a common standard for non-residential buildings, and provides online tools for builders and developers. Applicants complete an online questionnaire and submit their information to a central database for year-to-year tracking of performance. Following the completion of the questionnaire, a third-party site visit and verification is performed. The four-level certification program represents escalating achievements in energy efficiency.

2.4.7 Green Globes

Similar to the LEED system, Green Globes awards points to designers and builders in a number of areas such as site management, water, energy and indoor environment. There are two ratings provided through the program: a score representing the percentage of available points acquired, and a quintile rating showing performance relative to other assessed buildings.[11] The Green Globes program provides an online tool for designers and builders. However, third-party certification is required before any building can display or publicize compliance with the green building initiative. GreenGlobes is a voluntary program.

[11] http://www.greenglobes.com/design/about.asp.

3. Provincial and State Building Codes

This section provides a sampling of some provincial and state efforts to include energy efficiency in their building codes. The examples include a mix of approaches ranging from straight adoption of baseline codes, to codes that go well beyond the baseline options and have been developed by the jurisdiction.

3.1 British Columbia

In 2008, British Columbia's Climate Action and Energy plans set a clear direction that new homes and buildings would be more energy efficient. The province implemented a Green Building Code, which requires ASHRAE 90.1-2004 for commercial buildings, and estimates that prescriptive requirements will result in EnerGuide 77 ratings for homes.

The stringency of these codes is expected to increase by 2011. Anticipated next steps include requiring EnerGuide 80 for all new homes, providing an option for local governments to require solar hot water ready construction for new single-family houses, and adopting the most up to date version of ASHRAE 90.1. Other planned initiatives include pursuing policies for energy labelling at the time of transfer or sale of commercial or institutional buildings.[12]

3.2 California

In 2011, California will implement its first statewide mandatory green building standard, CALGreen, which takes a more comprehensive approach than the State's existing energy code. This code establishes mandatory regulations that align with the State's greenhouse gas, water conservation and energy efficiency goals. The CALGreen code was published as a voluntary standard in 2008 and has application in both the residential and non-residential building sectors. In addition to energy and water use, CALGreen addresses indoor air quality and material use efficiency.

Tier 1 and Tier 2 standards outline improvements of 15% and 30%, compared to existing mandatory energy use minimums in the state (as outlined in California Energy Code). Similarly in the commercial sector, a 15% improvement compared to current mandatory code is anticipated.[13]

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[12] Energy Efficient Buildings Strategy: More Action, Less Energy. Government of British Columbia. http://www.energyplan.gov.bc.ca/efficiency/PDF/EEBS-2008-Web.pdf.

[13] Government of California. http://www.documents.dgs.ca.gov/bsc/documents/2010/Draft-2010-CALGreenCode.pdf.

The CALGreen code will become the baseline energy code standard for the state. Cities and municipalities will continue to have the authority to implement additional energy requirements, and will be encouraged to do so.[14] The California Public Resources Code, Section 25402.1(h)(2), gives local jurisdictions the ability to make modifications to state energy efficiency standards. Modifications must be proven to be cost effective and approved by the California Energy Commission.

3.3 Ontario

In 2007, the Province of Ontario amended its 2006 Building Code with measures to be implemented over the next several years. Energy efficient windows, higher insulation levels, and 90% efficient natural gas and propane furnaces were the first measures adopted in 2007. In 2009, the building code will require near full-height basement insulation. By 2011, houses will be required to achieve an EnerGuide 80 rating.

The Government of Ontario also requires large buildings in the province to meet the ASHRAE 90.1-2004 standard or the Model National Energy Code for Buildings (MNECB) plus an Ontario-specific supplementary standard (SB-10). The standards are equivalent to a 16–18% increase in energy efficiency for buildings starting in 2007 and a 25% increase in efficiency starting in 2012 (compared to the 1997 Building Code).

3.4 Nova Scotia

New homes must meet prescriptive or performance requirements that are equivalent to EnerGuide for New Homes 80.[15] Beginning in 2011, all new commercial buildings of more than 600 square meters must meet or exceed the 1997 Model National Energy Code for Buildings by at least 25%, or adopt the updated version of the Model National Energy Code for Buildings, expected that year.

3.5 Quebec, New Brunswick and Prince Edward Island

The Provinces of Quebec and New Brunswick have also stated intentions to require EnerGuide 80 for new houses by 2012.[16]

As part of its Climate Change Action Plan, the Government of Quebec is revising and updating the building code to include energy performance.

Prince Edward Island, which currently has no building code, is planning on implementing an energy code modeled after the actions taken in Nova Scotia. Any modifications from the Nova

[14] Myth vs. Fact: Setting the Record Straight on 2010 California Green Building Standards Code. Government of California.

[15] http://secondnature.gov.ns.ca/gov/energy. Feb 11th, 2010.

[16] Alberta Energy Efficiency Alliance. 2009. *Energy Efficiency in the Provincial Building Code.* http://www.aeea.ca/pdf/EE%20in%20the%20AB%20Building%20Code%20-%20AEEA%20-%20March%202009.pdf. Accessed October 16, 2009.

Scotia code will be designed to improve the performance of homes in Prince Edward Island relative to Nova Scotia. Prince Edward Island intends to revise the code periodically to improve new building performance. The Province is considering building labelling, though this initiative is not considered a priority at present. (Prince Edward Island will wait to see if other jurisdictions have success with labelling programs.) The code will likely be implemented before the 2012 building season, and the Province will encourage municipalities to implement codes that are more aggressive.[17]

[17] Proud, Mike. Personal communication. February 2010.

4. Local Government Building Codes

Seven examples of energy efficiency standards established at local levels are described below to provide some background on how local governments in Canada and the U.S. have set energy efficiency standards that exceed the requirements set by senior levels of government.

4.1 Vancouver

The City of Vancouver has its own building bylaw, enabled through the Vancouver Charter, that sets minimum efficiency standards for buildings. A bylaw amendment in 2008 sets specific minimum standards for insulation, building envelope, light fixtures, an energy usage display meter, gas fireplaces, toilets, heat recovery ventilators, EnerGuide audits, and solar-readiness.[18] As a result of the amendments adopted by the council, it is expected that new homes will meet EnerGuide 80. The standards for houses are expected to reduce energy consumption by 33% (and greenhouse gases by 14%) "compared to current building practices (2008)".[19]

The City has also adopted requirements for large buildings to meet the ASHRAE 90.1-2007 energy efficiency standard, which is higher than the provincial standard for British Columbia of ASHRAE 90.1-2004.[20]

In addition to the bylaws put in place, the City of Vancouver has produced passive solar heating guidebooks for both residential and non-residential buildings, is putting forward a renovation bylaw, and has adopted LEED Gold as a minimum certification level for all of the City's new facilities (including a minimum of 30% more energy efficient than the base code). Vancouver has also improved enforcement of existing bylaws.

4.2 East Gwillimbury

The Town of East Gwillimbury in Ontario requires all new residential developments requiring either Site Plan or Subdivision approval to construct to Energy Star standards. Energy Star qualified homes are approximately 30–40% more energy efficient than those built to minimum

[18] City of Vancouver. 2008. *By-law No. 9691*. http://vancouver.ca/blStorage/9691.PDF. Accessed October 15, 2009.

[19] City of Vancouver. Policy Report Development and Building. RTS No.: 7183.

[20] City of Vancouver. 2008. *New Energy Utilization Requirements for Part 3 Buildings*. http://vancouver.ca/COMMSVCS/LICANDINSP/bulletins/2008/2008-004.pdf. Accessed October 15, 2009.

Ontario Building Code standards.[21] Local governments in Ontario do not usually set energy efficiency standards for buildings, but including energy efficiency standards within their Site Plan or Subdivision approval process does fall under local government jurisdiction in Ontario (as per amendments in the 2007 Bill 51).

East Gwillimbury has also passed a motion that requires new commercial development to meet a modified LEED Silver for New Construction standard. In 2007, the motion was amended to allow greater flexibility in smaller buildings, as the marginal cost of meeting green building standards was determined to be more onerous for these buildings. To ensure improved energy performance, additional energy efficiency measures (on top of LEED prerequisites) are required by the Town — namely that energy performance must be 29% greater than MNECB.[22]

As a compliance/enforcement mechanism, a security deposit from builders is required, half to be released when the proponent provides proof of application for LEED certification, and half when certification is awarded.[23]

4.3 Toronto

The City of Toronto has adopted a bylaw that will require all new developments over 2,000 m^2 of gross floor area to construct 20–60% of their roofs as green roofs[24] (i.e., a vegetated area on the roof of a building).

The bylaw includes a set of minimum or mandatory provisions for green roofs. These include requirements for assembly, gravity loads, slope stability, parapet height and/or overflow scupper locations, wind uplift, fire safety, waterproofing, drainage, water retention, plant survivability, plant selection, irrigation and a maintenance plan.[25]

Toronto was able to adopt the green roof bylaw because of the Province of Ontario's City of Toronto Act, which allows Toronto to pass bylaws on matters ranging from "health and safety to the city's economic, social and environmental well being, subject to certain limitations."[26]

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[21] Town of East Gwillimbury. 2009. *Energy Star*. http://www.eastgwillimbury.ca/Environment/Thinking_Green_Initiatives/Energy_Star_.htm. Accessed October 12, 2009.

[22] Enermodal Engineering. An implementation Strategy for the Town of East Gwillimbury LEED Policy. Final Report. 2007. Pg. 12.

[23] Town of East Gwillimbury. Development and Legal Services Report. Leadership in Energy and Environmental Design (LEED) for New Construction. Planning Branch and Building Branch. October 1, 2007.

[24] City of Toronto. 2009. *Green Roofs*. http://www.toronto.ca/greenroofs/index.htm. Accessed October 15, 2009.

[25] City of Toronto. 2009. *By-law No. 583-2009*. http://www.toronto.ca/legdocs/bylaws/2009/law0583.pdf. Accessed October 15, 2009.

[26] Government of Ontario. 2009. *City of Toronto Act, 2006*. http://www.mah.gov.on.ca/Page343.aspx. Accessed October 16, 2009.

4.4 Palo Alto

Palo Alto, California, has adopted an ordinance that states that all residential and non-residential buildings must meet minimum green building standards.[27] Major renovations or additions are required to meet additional energy efficiency requirements, while smaller renovations are not.[28] These standards are primarily based on LEED Silver requirements and a minimum number of points on the GreenPoint Checklist, both of which offer a variety of methods to achieve compliance.[29]

The standards adopted by Palo Alto are estimated to improve energy efficiency by 15% compared to state codes. The codes are being updated in 2010. In the case of major building renovations, buildings greater than 5,000 sq. ft. must be LEED certified, but are exempt from the 15% requirement that new buildings are subject to.

4.5 Seattle

Some local governments have required minimum energy efficiency standards in buildings for a long time. Seattle, Washington, for example, established furnace sizing and duct insulation requirements in 1927. The city has also had minimum insulation requirements since 1974 and the first comprehensive Seattle Energy Code was adopted in 1980.[30]

The Seattle Energy Code specifies three paths to compliance:[31]

1. A systems analysis approach for the entire building and its energy-using sub-systems, which may utilize renewable energy sources.
2. A component performance approach for various building elements and mechanical systems and components.
3. A prescriptive requirements approach.

As part of the current code revision cycle, Seattle has proposed requiring buildings to be 20% more efficient than ASHRAE 90.1-2004. The city will also incorporate ASHRAE 189.1 into the energy code and improve enforcement.

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[27] City of Palo Alto. 2008. *Adoption of an Ordinance Adding a New Chapter 16.18 to the Palo Alto Municipal Code Establishing Local Energy Efficiency Standards for Certain Buildings and Improvements Covered by the 2005 California Energy Code.* http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=13357. Accessed October 12, 2009.

[28] City of Palo Alto. Chapter 18.44 Green Building Regulations. Table B.

[29] Gabel, M. 2008. *Application for a Locally Adopted Energy Standard*. http://www.energy.ca.gov/title24/2005standards/ordinances/2008-11-05_PALO_ALTO.PDF. Accessed October 16, 2009.

[30] City of Seattle. 2008. *Seattle Energy Code*. http://www.cityofseattle.net/dpd/energy/. Accessed October 12, 2009.

[31] City of Seattle. 2008. *Seattle Energy Code: Chapter 1, Administration and Enforcement*. http://www.seattle.gov/DPD/Codes/Energy_Code/Residential/Chapter_1/default.asp. Accessed October 16, 2009.

In the first years of energy codes, Seattle accepted the endorsement of a professional (an engineer or architect) as sufficient for compliance, but later found this was not sufficient. It was not an issue of carelessness or lack of concern for compliance, but rather the city found that not all builders, engineers or architects had sufficient knowledge or experience to effectively implement the new code.

> *"…energy code enforcement requires a full commitment from the city, measured in labor force and resources, not promises and 'green' initiatives."*[32]

Self-certification was not adequate to ensure compliance, and as such the Seattle Department of Planning and Development has developed the internal capacity to enforce the standard effectively. There are now five full time staff who conduct energy code plan reviews for residential buildings.

[32] The Online Code Environment and Advocacy Network. Seattle: Setting the Standard: An Overview of the Seattle Code Enforcement Process. Fact Sheet.

5. Further Research Possibilities

Through the course of researching and writing this paper, the following questions have presented themselves as possible next steps in Green Building Leaders research:

1. Review of how local governments outside of the U.S. and Canada have developed and/or used building codes to meet their energy efficiency and climate change goals.
2. Review of how Californian municipalities are utilizing the California Public Utility Commission's provisions that allow them to adopt codes that are more stringent than California minimums.
3. Review of the B.C. experience with water efficiency requirements that was initially developed as an "opt-in" type model by the provincial government, and after several rounds of opting in, the participation was high enough to make it a province-wide requirement.