The Alberta Building Code and Regional Air Quality

Report for the Calgary Region Airshed Zone

FINAL REPORT

Jesse Row

March 2010

the PEMBINA institute
Sustainable Energy Solutions

Row, Jesse
The Alberta Building Code and Regional Air Quality
Final Report, published March 2010

Editor: Roberta Franchuk

The Pembina Institute
Box 7558
Drayton Valley, Alberta
Canada T7A 1S7
Phone: 780-542-6272
Email: info@pembina.org

Additional copies of this publication may be downloaded from the Pembina Institute website: www.pembina.org.

About the Pembina Institute

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 Instituteœs projects and activities, and highlights recent news and publications. Subscribe to Pembina eNews: http://www.pembina.org/enews/subscribe.

About the Author

Jesse Row is the Director of the Sustainable Communities Group at the Pembina Institute. His focus is working with municipalities on energy planning and other orders of governments on energy policy.

The Alberta Building Code and Regional Air Quality

Final Report

Contents

Executive Summary

In 2008, the Calgary Region Airshed Zone (CRAZ) completed a Particulate Matter (PM) and Ozone (O_3) management plan. Part of this plan was to investigate the opportunity to reduce emissions from buildings through changes to building standards.

Building standards are most often changed through amendments to the provincial building code. The Government of Alberta has announced a plan to increase energy efficiency standards within the Alberta Building Code and has recently conducted public consultations on the topic. It is expected that new standards for buildings in Alberta will be set in 2010.

Many other provinces in Canada have also increased energy efficiency standards within their building codes in efforts to reduce both emissions and costs. Experience in other jurisdictions shows that an energy efficient building can cost consumers less from ôDay 1ö as the increased cost of the buildings is mortgaged over decades while lower heating bills are realized immediately. Several jurisdictions are targeting EnerGuide 80 or equivalent as the energy standard for houses, and ASHRAE 90.1 as the energy standard for larger buildings.

The Government of Ontario has estimated that adoption of EnerGuide 80 will reduce energy consumption by 35% compared with their 1997 building code (approximately EnerGuide 71) for a 2000 square foot gas-heated house.[1] The Government of Alberta cited the same figures as an example of the payback that may be expected from the same changes to the Alberta Building Code.[2] The Government of Alberta has also stated that ñnew homes in Alberta are averaging an EnerGuide rating of between 67 and 72ò.[3] A 35% reduction in energy consumption is therefore considered conservative when estimating the impact of increasing the code to an EnerGuide 80 level given that this will be a minimum construction level, and some homes will likely be built to higher efficiency.

The Government of Ontario also estimated that adoption of ASHRAE 90.1 for large buildings will reduce energy consumption by 25% compared with their 1997 building code. This is also the figure used to estimate a similar change to the code in Alberta.[4]

With these levels of energy efficiency introduced in Alberta, emissions from residential, commercial and institutional buildings in CRAZ would be reduced by an amount equivalent to

---

[1] Ontario Ministry of Municipal Affairs and Housing, *Energy Efficiency in the 2006 Building Code* (2007), http://www.mah.gov.on.ca/Page681.aspx

[2] Government of Alberta, *Energy Efficiency and the Alberta Building Code: Building Greener Homes in Alberta*, http://*www.municipalaffairs.alberta.ca/documents/ss/GreenerHomesWrkbk.pdf*

[3] Ibid.

[4] Ontario Ministry of Municipal Affairs and Housing, *Energy Efficiency in the 2006 Building Code* (2007), http://www.mah.gov.on.ca/Page681.aspx

10% of 2006 emission levels within 10 years, and over 40% of 2006 levels by 2050. More detailed results are presented in Table 1.

Table 1. Annual Emission Reductions from Adoption of EnerGuide 80 or Equivalent for Residential Buildings and ASHRAE 90.1 (2007) for Larger Buildings

Pollutant	Total Building Heating Emissions in 2006 (tonnes / yr)	Emission Reduction (tonnes / yr)			
		2020	2030	2040	2050
Particulate Matter (PM)	1557	150	308	467	625
Inhalable particulate (PM_{10})	1440	139	285	432	579
Respirable particulate ($PM_{2.5}$)	1333	128	264	400	536
Nitrogen Oxides (NO_x)	3930	405	818	1232	1645
Volatile Organic Compounds (VOC)	1568	149	308	467	626
Sulphur Dioxide (SO_2)	450	52	102	153	203
Carbon Monoxide (CO)	9229	894	1836	2778	3720

It was also found that building standards have been advanced by local governments using the powers available to them. Examples include setting standards at a sub-division approval level, through specific powers to establish local building codes, or through existing approval mechanisms used when a building is sold or rented.

It is important to note that some barriers potentially exist to the adoption of new building standards. These include a resistance of the building industry to any regulatory changes, changes to building practices, new skill requirements, the possibility of new enforcement requirements, and the potential for perceived impacts on affordability due to increased purchasing costs.

Despite these potential barriers, building standards, whether at the provincial or local level, present an opportunity to significantly reduce emissions from the residential, commercial and institutional sectors through a single action. In addition, more energy efficient buildings can also reduce the overall cost of owning, renting or leasing, and operating a building, thus saving consumers money within the first year.

1. Introduction

The Calgary Region Airshed Zone has contracted the Pembina Institute to investigate the potential impact of changes to energy efficiency requirements in the Alberta Building Code on particulate matter (PM) and ozone (O_3) precursor emissions in the region.

PM and ground level ozone are commonly referred to as smog. These air pollutants harm human health and are visibly unattractive. PM and O_3 levels in the Calgary region have increased to a level requiring a management plan be put in place. In 2008, CRAZ completed such a management plan and is now in the process of implementing it. This report is part of that implementation.

The Alberta Building Code is important to air quality in the region as it is estimated that there are over 400,000 homes in the region[5], and an estimated 30 million m^2 of commercial and institutional floor space. These buildings primarily use natural gas for heating, although some homes use wood as well. Energy efficiency standards for new buildings, therefore, have an impact on the amount of natural gas and wood these buildings burn over their lifetime, and thus the emissions from heating.

In January 2008, the Government of Alberta stated it will ñ[i]mplement energy efficiency standards in building codes for homes and commercial buildingsò as part of Albertaôs 2008 Climate Change Strategy. The province is currently conducting research and consultations on the code changes and is expected to propose specific changes in 2010.

This report summarizes the potential impact of those changes on air quality within the Calgary region. It begins by summarizing the current emission levels from buildings in the region and the impact that the building code has on building-related emissions as well as affordability. It then describes the current process being undertaken by the provincial government to update energy efficiency levels in the Alberta Building Code, the efficiency levels being considered and the efficiency levels already in place in other provinces. This information is then used to estimate the impact on building-related emissions over the next 40 years.

The second half of the paper looks at different approaches to improving the energy efficiency of buildings. This includes approaches that have been taken by municipalities across North America to improve the energy efficiency of both new and existing buildings within their jurisdictions.

The paper finishes by identifying potential barriers to the establishment of new building standards.

[5] Calgary Region Airshed Zone Emissions Inventory for 2006.

2. Emissions from Buildings

This section looks at the emissions currently coming from natural gas use within buildings, as well as the potential reductions in emissions from various changes to the building code.

2.1 Current Building Emissions

Residential Buildings

The 2006 emission inventory for the Calgary Region Airshed Zone includes over 400,000 dwellings. These dwellings are estimated to consume 120 GJ of natural gas each year on average. Using standardized emission factors from the U.S. Environmental Protection Agency, the combustion of this natural gas was estimated and then added to the anticipated emissions from wood burning to heat homes. The resulting emission levels are presented in Table 2.

Table 2. Emissions from Residential Buildings in the Calgary Region Airshed Zone, 2006

Pollutant	tonnes / yr
Total Particulate Matter (TPM)	1390
Inhalable particulate (PM_{10})	1285
Respirable particulate ($PM_{2.5}$)	1189
Nitrogen Oxides (NO_X)	2380
Volatile Organic Compounds (VOC)	1490
Sulphur Dioxide (SO_2)	29.6
Carbon Monoxide (CO)	8030

Non-Residential Buildings

Emissions from commercial buildings were estimated in the CRAZ emission inventory based on the 2006 provincial emission inventory completed by Environment Canada. The emission levels for CRAZ were prorated based on population. These results are presented in Table 3.

Table 3. Emissions from Non-Residential Buildings in the Calgary Region Airshed Zone, 2006

Pollutant	tonnes / yr
Total Particulate Matter (TPM)	167
Inhalable particulate (PM_{10})	155
Respirable particulate ($PM_{2.5}$)	144
Nitrogen Oxides (NO_X)	1550
Volatile Organic Compounds (VOC)	78
Sulphur Dioxide (SO_2)	420
Carbon Monoxide (CO)	1199

Emissions from buildings make up 16% of the respirable particulate ($PM_{2.5}$) in the region (when excluding road dust), 8% of the NO_x emissions, 6% of the CO emissions, 3% of the VOC emissions, and 2% of the SO_2 emissions. Despite relatively low numbers in some categories, emissions from buildings are still viewed as a worthwhile target for emission reductions as they primarily occur in highly populated areas where air quality concerns are among the highest, the number of people exposed to the emissions are also potentially high, and opportunities to reduce emissions through legislative changes is a process that is already underway.

2.2 Current Building Standards

A review of the Alberta Building Code previously undertaken revealed insulation requirements for small[6] buildings as summarize in Table 4. There are currently no energy efficiency requirements for larger buildings.

[6] Small buildings are defined by Part 9 of the building code as houses and buildings up to 600 m^2 or 6458 ft^2.

Table 4. Thermal Insulation Requirements for Small Buildings from the Alberta Building Code, Section 9.25.2.1

Location of Assembly in Which Insulation is Placed		Minimum Thermal Resistance	
		RSI	R-value[A]
Wall assembly (except basements)	Building exterior	2.1	12
	Between building and attached garage	2.1	12
	Exterior of heated garage	2.1	12
Basement and crawl space	Perimeter walls (top to 600 mm below grade)	1.4	8
Floor Assembly	Perimeter	2.1	12
	Exposed cantilevers	3.5	20
Roof ï ceiling assembly	Building ï general	6.0	34
	Heated garage	6.0	34

A. Approximation calculated from the RSI value.

2.3 Emission Reduction Opportunities from Building Standards

In order to estimate the impact of changes to building standards on regional emissions, it is necessary to investigate the potential energy savings associated with different levels of energy efficiency.

Residential Buildings

The Government of Ontario has estimated that adoption of EnerGuide 80 will reduce energy consumption by 35% compared with their 1997 building code (approximately EnerGuide 71) for a 2000 square foot gas-heated house.[7] This corresponds to approximately 35% reduction in emissions. The Government of Alberta cited the same figures as an example of the payback that may be expected from the same changes to the Alberta Building Code.[8] The Government of Alberta has also stated that ñnew homes in Alberta are averaging an EnerGuide rating of between

---

[7] Ontario Ministry of Municipal Affairs and Housing, *Energy Efficiency in the 2006 Building Code* (2007), http://www.mah.gov.on.ca/Page681.aspx

[8] Government of Alberta, *Energy Efficiency and the Alberta Building Code: Building Greener Homes in Alberta*, http://*www.municipalaffairs.alberta.ca/documents/ss/GreenerHomesWrkbk.pdf*

67 and 72ò.[9] A 35% reduction in energy consumption is therefore considered conservative when estimating the impact of increasing the code to an EnerGuide 80 level given that this will be a minimum construction level, and some homes will likely be built to higher efficiency.

Non-Residential Buildings

For larger buildings, the same study completed by the Government of Ontario estimated that energy consumption could be reduced by 16% to 18% by upgrading the code to ASHRAE 90.1 (2001) and by 25% by upgrading the code to ASHRAE 90.1 (2007).[10] ASHRAE 90.1 is an industry standard for energy efficient buildings.

These results were used to estimate the potential impact of building code changes on emissions within the Calgary Region Airshed Zone.

[9] Ibid.

[10] Ibid.

3. Affordability

3.1 Cost Benefits of Energy Efficient Buildings

Increased energy efficiency provides an opportunity to reduce both emissions and the cost of heating. More energy efficient buildings, however, typically cost more to build. Therefore, it is important to consider the trade-off between the increased capital cost and the reduced operating costs.

Table 5 presents the cost considerations presented by the Ontario Ministry of Municipal Affairs and Housing for an EnerGuide 80 standard. These numbers were also used by the Government of Alberta during their recent consultation regarding housing efficiency standards.

Table 5. Cost Considerations for Increasing Building Efficiency for a 2000 Square foot Gas-Heated House[11]

Efficiency Standard	Estimated Annual Energy Savings[A]	Estimated Increased Capital Cost[A]
Minimum EnerGuide 80	35% (approx. $845)	$5,900 - 6,600[B]

[A] Compared to Ontario's 1997 Building Code

[B] Initial feedback from builders indicates that this incremental cost can be decreased significantly.

Table 6 uses the above numbers to illustrate how these costs result in immediate savings for a homeowner when a house is mortgaged at a rate of 8%.

Table 6. Annual Costs and Savings from Increasing Building Standards to EnerGuide 80 or Equivalent

	Year 1	Year 2	...	Year 25
Annual Energy Savings	$845	$845		$845
Annual Mortgage Payment ($5,900 cost increase at 8% interest rate)	-$553	-$553		-$553
Cumulative Net Savings	$292	$585		$7,307

These figures demonstrate that energy efficient buildings can benefit consumers financially during the first year of ownership. Figures presented by the Government of Ontario for commercial buildings show an even better payback than those demonstrated for EnerGuide 80 houses.

[11] Ontario Ministry of Municipal Affairs and Housing, *Energy Efficiency in the 2006 Building Code*. Some figures are calculated.

It is important to note that the energy savings present in Table 6 will change as natural gas prices increase or decrease. The figures displayed are based on a price for natural gas for the residential consumer of approximately \$0.57 per m^3. Residential rates in Alberta are currently lower than this, but still nearly pay off the additional cost of the higher efficiency home even at todayǿs rates for a fixed 5-year natural gas contract. These savings will be even greater as the additional cost of higher efficiency homes is reduced through experience with new building practices.

3.2 Additional Benefits of Green Buildings

In addition to cost savings, ǵgreenǶ buildings have a wide range of non-cost benefits. These benefits have been quantified in many different studies.

Lucuik and Hershfield[12] reviewed the performance of several green buildings and found the following results:

- Good daylighting increases productivity by 13%, can increase retail sales by 40%, and can increase school test scores by 5%
- Increased ventilation increases productivity by 4 to 17%
- Better quality ventilation reduces sickness by 9 to 50%
- Increased ventilation control increases productivity by 0.5 to 11%
- High glare reduces performance by 15 to 21%

A separate analysis by Kats et. al. shows an impressive return on investment in the areas of energy savings, operating and maintenance savings, and productivity and health benefits, as shown in Table 7.

---

[12] Mark Lucuik and Morrison Hershfield, *A Business Case for Green Buildings in Canada* (2005), http://www.cagbc.org/uploads/A%20Business%20Case%20for%20Green %20Bldgs%20in%20Canada.pdf

Table 7. Financial Benefits of LEED[13] Certified Buildings (per ft^2)[14]

Category	20-year NPV
Energy Value	$5.79
Emissions Value	$1.18
Water Value	$0.51
Waste Value (construction only) ï 1 year	$0.03
Commissioning O&M ValueA	$8.47
Productivity and Health Value (Certified and Silver)	$36.89
Productivity and Health Value (Gold and Platinum)	$55.33
Less Green Cost Premium	($4.00)
Total 20-year NPV (Certified and Silver)	$48.87
Total 20-year NPV (Gold and Platinum)	$67.31

[A] Commissioning process leads to lower operations and maintenance costs.

[13] Leadership in Energy and Environmental Design Green Building Rating System. The levels of performance (from lowest to highest) are: Certified, Silver, Gold and Platinum.

[14] Gregory Kats et al., *The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force* (2003), http://www.cap-e.com/ewebeditpro/items/O59F3259.pdf

4. Building Code in Alberta and Other Provinces

This section summarizes the process currently being undertaken to update the Alberta Building Code and describes the energy efficiency requirements in place in other provinces. [15]

4.1 Alberta

The Government of Alberta is currently in the process of increasing energy efficiency requirements within the provincial building code. They have commissioned two research papers to investigate options for accomplishing this in both small and large buildings, and have recently completed a period of public consultation regarding code changes for houses. The input from the research and public consultation is expected to be compiled and recommendations provided to the Minister of Municipal Affairs by the end of 2009.

At this time, government consultation documents indicate that houses in Alberta are currently built between levels of EnerGuide 67 and 72, whereas the building industry has stated that they believe many home builders are already building to a 75 to 77 level. Natural Resources Canada reports that houses built between 2000 and 2009 that have been tested in Alberta averaged an EnerGuide level of 70.

As will be presented in the following sub-sections, many provinces are moving towards EnerGuide 80 or equivalent as a minimum standard. There is also a process to include energy efficiency requirements in the National Building Code by 2012, which the Government of Alberta has stated it will likely adopt by 2014.

Indications are that the Alberta Government would like to reach an EnerGuide 80 level by 2014 and will use the next code update (expected in 2010) to set interim mid-range efficiency requirements in preparation for the anticipated change in 2014.

4.2 British Columbia

In 2008, B.C. instituted a Green Building Code, which provides prescriptive requirements for houses to meet. Alternatively, builders have the option to build to an EnerGuide 77 rating level

---

[15] Information from this section has been taken from: Alberta Energy Efficiency Alliance, *Energy Efficiency in the Provincial Building Code* (2009), http://www.aeea.ca/pdf/EE%20in%20the%20AB%20Building%20Code%20-%20AEEA%20-%20March%202009.pdf

through an objective-based code. The province is now working on another code update to require EnerGuide 80 or equivalent.

The provincial government also made it possible for local governments to increase local building code requirements in a number of areas, including energy.

For commercial buildings, B.C. requires ASHRAE 90.1 (2004) to be met.

4.3 Manitoba

The Province of Manitoba has two standards for houses heated by natural gas ð one for the northern part of the province, above 53 degrees latitude, and one for the southern part of the province, below 53 degrees latitude. Both of these standards require insulation levels similar to comparable regions in British Columbia.

4.4 Ontario

In 2007, the Province of Ontario amended their 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 to be adopted in 2007. In 2009, the building code will require near full-height basement insulation, and by 2012 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 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 to 18% increase in energy efficiency for buildings starting in 2007 and a 25% increase in efficiency starting in 2012 (compared to their 1997 building code).

4.5 Nova Scotia

The Government of Nova Scotia plans to adopt a new building code on April 1, 2009 that sets out increased energy efficiency requirements for small buildings ($< 600\ m^3$ and not more than three stories in height). The standards for insulation will be among the most stringent in the country for similar latitudes. The government has also indicated that they will require EnerGuide 80 or R2000 certification for new homes built after January 1, 2011.

The Government of Nova Scotia has also indicated their intentions to regulate all large buildings by 2011.

4.6 Quebec and New Brunswick

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

5. Impact on Regional Emissions

This section summarizes the estimated impact of various building code changes on emissions within the Calgary Region Airshed Zone.

If the building code is changed to require efficiency levels equivalent to EnerGuide 80, a 35% reduction in heating energy can be assumed. Based on projections for population growth[16] and past housing starts[17], the annual emission reductions for this single change to the building code (if implemented by mid-2010) amount to nearly 10% of 2006 levels in the residential sector by 2020 and approximately 40% of 2006 levels by 2050. These figures do not account for any other changes to building or equipment standards such as improved furnace or wood stove efficiencies. The results are further described in Table 8.

Table 8. Annual Emission Reductions from Adoption of EnerGuide 80 or Equivalent for Residential Buildings within the Calgary Region Airshed Zone

Pollutant	Total Residential Emissions in 2006 (tonnes / yr)	Emission Reduction (tonnes / yr)			
		2020	2030	2040	2050
Particulate Matter (PM)	1390	130	270	409	549
Inhalable particulate (PM_{10})	1285	120	250	379	508
Respirable particulate ($PM_{2.5}$)	1189	111	231	351	470
Nitrogen Oxides (NO_x)	2380	223	461	700	939
Volatile Organic Compounds (VOC)	1490	140	290	440	591
Sulphur Dioxide (SO_2)	29.6	2.8	5.8	8.7	11.7
Carbon Monoxide (CO)	8030	752	1559	2367	3174

[16] City of Calgary, *Calgary and Region Socio-Economic Outlook: 2009 – 2019* (2009).

[17] Calgary Economic Development, *Housing Starts* (2009), http://www.calgaryeconomicdevelopment.com/relocateAndExpand/RECalgaryEconomy/housingstarts_QHh8BW.cfm

For non-residential buildings, if the building code is changed to require efficiency levels equivalent to ASHRAE 90.1 (2007), a 25% reduction in heating energy can be assumed. Based on the past growth in commercial and institutional floor space[18] and an assumed 30-year turnover[19], the annual emission reductions for this single change to the building code (if implemented by mid-2010) amount to just over 10% of 2006 levels in the commercial sector by 2020 and approximately 44% of 2006 levels by 2050. The results are further described in Table 9.

Table 9. Annual Emission Reductions from Adoption of ASHRAE 90.1 (2007) or Equivalent for Large Buildings within the Calgary Region Airshed Zone

Pollutant	Total Commercial Building Emissions in 2006 (tonnes / yr)	Emission Reduction (tonnes / yr)			
		2020	2030	2040	2050
Particulate Matter (PM)	167	20	38	57	76
Inhalable particulate (PM_{10})	155	18	36	53	71
Respirable particulate ($PM_{2.5}$)	144	17	33	49	66
Nitrogen Oxides (NO_x)	1550	183	357	531	706
Volatile Organic Compounds (VOC)	78	9	18	27	36
Sulphur Dioxide (SO_2)	420	50	97	144	191
Carbon Monoxide (CO)	1199	142	276	411	546

[18] Natural Resources Canada, *Comprehensive Energy Use Database: Commercial/Institutional Sector Alberta. Table 1: Secondary Energy Use and GHG Emissions by Energy Source* (2009).
[19] Marbek Resource Consultants Ltd., *2007 Conservation Potential Review: The Potential for Electricity Savings through Technology Adoption, 2006 – 2026. Commercial Sector in British Columbia Housing Starts*, (Prepared for BC Hydro, 2007).

6. Examples of Local Standards

An alternative to introducing new building standards at the provincial level is for municipal governments to establish energy standards at the local level. Seven examples are described below to provide some background on how setting standards at the local level has already been accomplished in some municipalities.

6.1 Vancouver

The City of Vancouver was able to establish its own building by-law through powers outlined in the Vancouver Charter. The City states that Vancouver ñhas the greenest building code in North America for one and two family dwellings.ò The standards for houses are expected to reduce energy consumption by 30%.[20]

The by-law 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, a vertical service shaft and a cable raceway.[21]

The City has also adopted requirements for large buildings to meet the ASHRAE 90.1 (2007) energy efficiency standard, which is a higher standard than the ASHRAE 90.1 (2004) that is the provincial standard for B.C.[22] AHRAE 90.1 provides options to meet compliance either through prescriptive measures or by meeting certain overall objectives through trade-offs.

6.2 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 to 40% more energy efficient than those built to minimum Ontario Building Code standards.[23]

Energy Star for New Homes has methods to achieve certification either through meeting certain performance criteria or by following certain prescriptive requirements.

---

[20] City of Vancouver, ñGreen Buildingò (2008), http://vancouver.ca/sustainability/building_green.htm.

[21] City of Vancouver, *By-law No. 9691* (2008), http://vancouver.ca/blStorage/9691.PDF

[22] City of Vancouver, *New Energy Utilization Requirements for Part 3 Buildings* (2008), http://vancouver.ca/COMMSVCS/LICANDINSP/bulletins/2008/2008-004.pdf

[23] Town of East Gwillimbury, ñEnergy Star,ò http://www.eastgwillimbury.ca/Environment/Thinking_Green_Initiatives/Energy_Star_.htm

Local governments in Ontario do not usually set energy efficiency standards for buildings as this is provincial jurisdiction. East Gwillimbury was able to overcome this barrier by including energy efficiency standards within their Site Plan or Subdivision approval process ð an area of municipal jurisdiction.

6.3 Toronto

The City of Toronto has adopted a by-law that will require all new developments above 2,000 m^2 of gross floor area to have between 20 to 60% of their roofs constructed as green roofs[24] (i.e., a vegetated area on the roof of a building).

The by-law 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 by-law because the Province of Ontario has a specific City of Toronto Act, which allows Toronto to pass by-laws on matters ranging from ñhealth and safety to the cityõs economic, social and environmental well being, subject to certain limitations.ò[26]

6.4 Palo Alto

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 be approved by the California Energy Commission.

Palo Alto, California has adopted an ordinance that states that all residential and non-residential buildings meet minimum green building standards[27]. These standards are primarily based on LEED Silver requirements and a minimum number of points on the GreenPoint Checklist[28], both of which offer a variety of methods to achieve compliance. The standards adopted by Palo Alto are estimated to improve energy efficiency by 15% above state codes.

[24] City of Toronto, ñGreen Roofs,ò http://www.toronto.ca/greenroofs/index.htm

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

[26] Government of Ontario, ñCity of Toronto Act, 2006,ò (2009), http://www.mah.gov.on.ca/Page343.aspx

[27] City of Palo Alto, *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

[28] M. Gabel, *Application for a Locally Adopted Energy Standard by the City of Palo Alto,* http://www.energy.ca.gov/title24/2005standards/ordinances/2008-11-05_PALO_ALTO.PDF

6.5 Memphis

Memphis, Tennessee has added an ordinance to their Municipal Housing Code outlining minimum energy efficiency for rental properties where tenants pay the utilities[29]. While this may not be the only energy efficiency ordinance in place in Memphis, it is worth noting because this ordinance applies to existing buildings as well as to new building construction.

The ordinance includes qualitative descriptions of minimum requirements for windows, envelope sealing, insulation, heating and cooling units, duct work, thermostats, and plumbing.

6.6 Seattle

Some local governments have required minimum energy efficiency standards in buildings for quite 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 adopted the first comprehensive Seattle Energy Code 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.

6.7 Berkeley

Berkeley, California has adopted a somewhat unique energy efficiency ordinance that requires any building sold, exchanged or substantially renovated (renovations must be of a value of $50,000 or above) to meet minimum energy and water efficiency standards[32].

The ordinance includes prescriptive residential standards for insulation of ceiling spaces, water heaters, and water pipes; sealing and insulation for ductwork; water fixture flow rates; lighting efficiency; weatherstripping for exterior doors; chimney air flow; and toilet capacities. For commercial buildings, prescriptive standards exist for HVAC systems, service water systems, lighting, commercial refrigeration equipment, motor-driven equipment, swimming pools and spas, and building envelope. The extent of upgrades required under this ordinance is limited to a defined Maximum Expenditure amount.

---

[29] City of Memphis, *An Ordinance to Provide for Minimum Energy Efficiency in Rental Property* (2009), http://www.cityofmemphis.org/pdf_forms/energy_efficiency_rental_properties_ordinance.pdf

[30] City of Seattle, ñSeattle Energy Code,ò http://www.cityofseattle.net/dpd/energy/

[31] City of Seattle, ñSeattle Energy Code: Chapter 1, Administration and Enforcement,ò http://www.seattle.gov/DPD/Codes/Energy_Code/Residential/Chapter_1/default.asp

[32] City of Berkeley, *Title 19, Buildings and Construction* (2009), http://www.codepublishing.com/CA/Berkeley/html/pdfs/Berkeley19.pdf

7. Potential Barriers to New Building Standards

Despite the environmental and economic benefits of more energy efficient buildings, some barriers potentially exist to the adoption of new building standards whether provincially or locally.

A recent study by the Alberta Energy Efficiency Alliance[33] compiled feedback from stakeholders on potential barriers to changes to the provincial building code. The barriers identified included:

- Trades people will need to be trained in new building practices.
- Advanced building standards often require a blower door test to ensure compliance. This introduces new compliance procedures and the need for new service providers.
- While the overall cost of a more energy efficient building is often less than conventional buildings, consumers may perceive a decrease in affordability due to a potentially higher purchase price.

Recent input from home builders into the Government of Alberta consultation process also shows that there is resistance from the home builder industry to any changes to the building code. Some builders have also indicated they favour voluntary advancements in building standards as opposed to regulated changes.

[33] Alberta Energy Efficiency Alliance, *Energy Efficiency in the Provincial Building Code.*

8. Conclusions

The analysis completed shows that emissions from new buildings can be reduced by 25 to 35% through building standard changes similar to those other jurisdictions have already put in place. These standards are typically enacted provincially, and the Government of Alberta is currently undertaking a process to increase energy efficiency requirements in its building code. It is unclear whether the new standards enacted in Alberta will be comparable to standards established in other provinces in either the short or medium term.

Examples were also identified where local governments have taken the initiative to institute their own building energy efficiency standards. This has been done at a sub-division approval level, through specific powers to establish local building codes, or through existing approval mechanisms used when a building is sold or rented.

As has been demonstrated, there are many different opportunities to reduce emissions from buildings within the Calgary Region Airshed Zone. For example, improvements to the building code are capable of creating annual emission reductions that are close to 10% of 2006 emission levels for the residential, commercial and institutional sectors within 10 years. Mechanisms for both provincial and local governments to reduce emissions through building standards represent an opportunity to make a noticeable impact to overall emissions from the building sector through a single change to provincial or local policies.