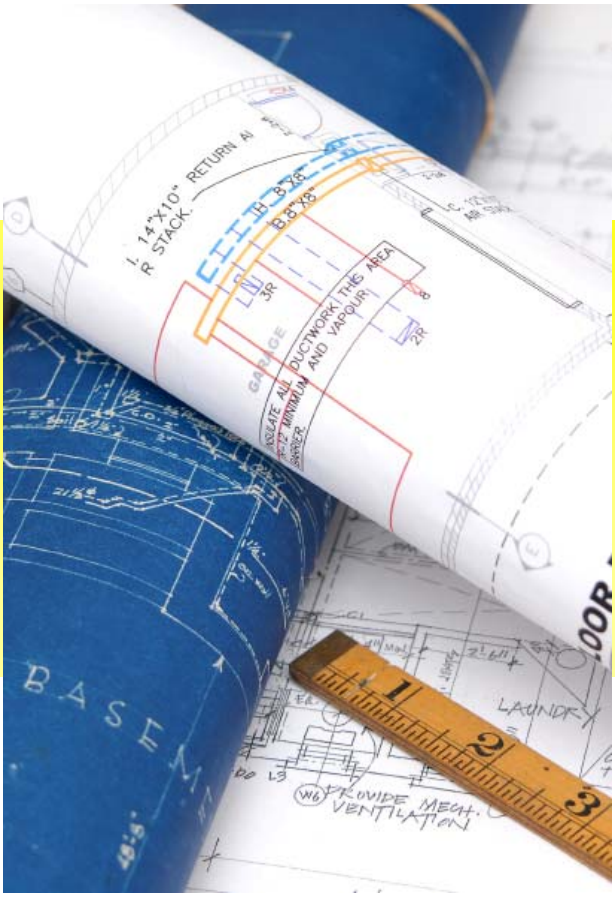
ENERGY EFFICIENCY IN THE PROVINCIAL BUILDING CODE

DISCUSSION PAPER MARCH 2009



ALBERTA
Energy Efficiency Alliance

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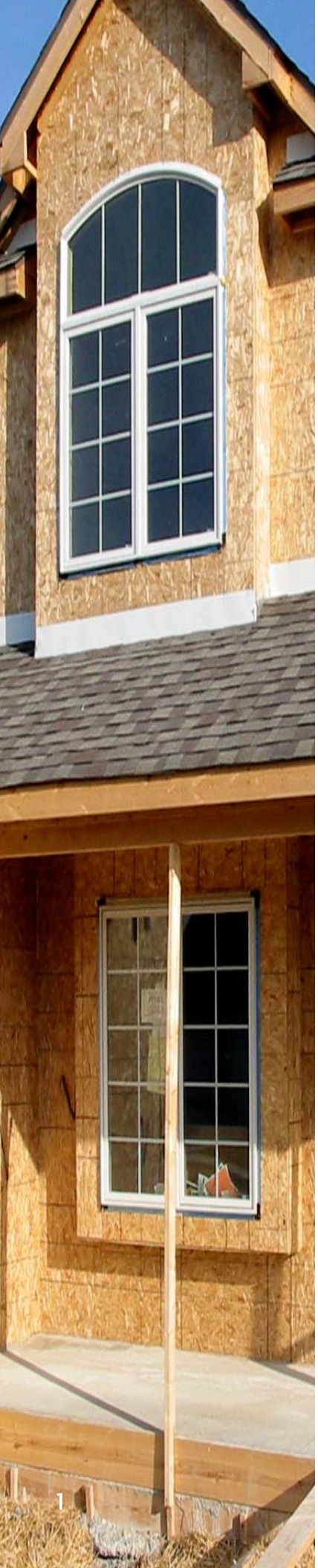


SUMMARY

In January 2008, the Government of Alberta stated it will "[i]mplement energy efficiency standards in building codes for homes and commercial buildings" as part of *Alberta's 2008 Climate Change Strategy*. Following this, in July 2008, all of Canada's premiers committed to a 20 per cent increase in energy efficiency by 2020 in their respective jurisdictions. And in December 2008, the Alberta government reinforced earlier commitments by stating in its *Provincial Energy Strategy* that it will "[s]trengthen building codes to ensure new housing and building stock being put in place for the future is as efficient as possible."

The Alberta Energy Efficiency Alliance[1] (AEEA) is a diverse group of industry, municipalities, non-profit organizations and associations dedicated to *maximizing energy efficiency within the province*. Needless to say, the AEEA has an interest in how the Government of Alberta incorporates energy efficiency within the building code and has commissioned this paper as a method of contributing to the discussion on the topic.

The purpose of this paper is to look at approaches that other jurisdictions have taken to incorporate energy efficiency into their building codes as possible models for Alberta to follow. As will be discussed, leading provinces in this area have established similar levels of efficiency standards and are moving towards EnerGuide 80 as the minimum standard for homes within the next few years. For commercial buildings, both the Model National Energy Code for Buildings and ASHRAE[2] 90.1, an industry standard for energy efficient buildings, appear to be the most common standards that provinces are instituting.

Governments are also advancing the concepts of water efficiency, energy labelling for all buildings and using low cost measures for houses to be built 'solar-ready'. Each of these measures delivers energy and environmental savings in their own right.

[1] Visit http://www.aeea.ca for more information.
[2] American Society of Heating, Refrigeration and Air-Conditioning Engineers

Efficient buildings benefit all Albertans through net cost savings and a cleaner environment. The Government of Alberta has an opportunity to become a leader in energy efficient buildings by adopting progressive standards in the short-term and setting the stage for further efficiency advancements over time.

CURRENT ALBERTA CODES

Contrary to the belief of some, the Alberta building code already contains specific minimum requirements for thermal insulation for small buildings whereas the National Building Code does not. Table 1 lists the requirements from the Alberta code. In contrast, there are currently no minimum requirements for thermal insulation in larger buildings built within the province.

Table 1: 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 – ceiling assembly	Building – general	6.0	34
	Heated garage	6.0	34

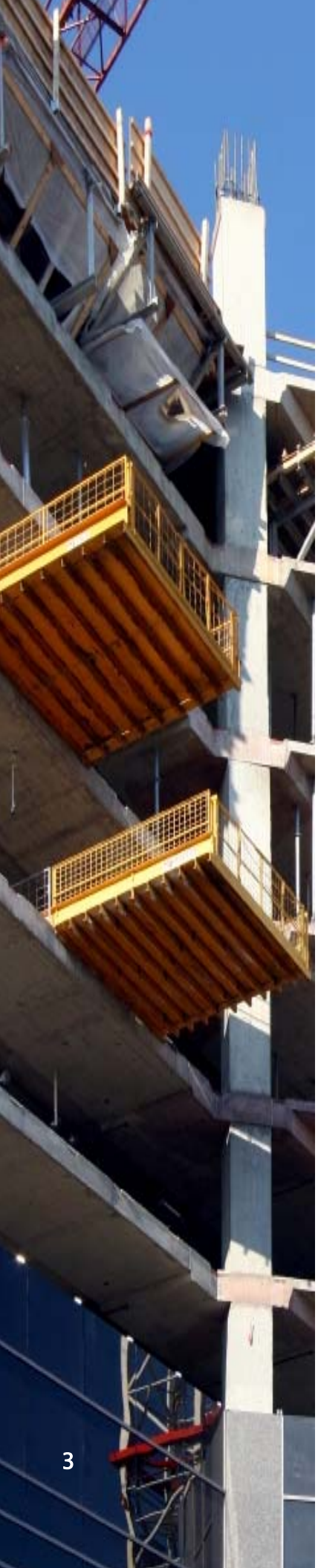
[A] Approximation calculated from the RSI value.

While thermal insulation is not the only method of improving building efficiency, these standards are a starting point for helping Albertans to improve their energy efficiency. In fact, the Alberta Government has indicated it will, "[s]trengthen building codes to ensure new housing and building stock being put in place for the future is as efficient as possible".[3] The following section outlines standards that are already in place in Canada.

Existing Buildings

It should be noted that while building codes are very useful for improving the construction of new buildings and buildings undergoing 'substantial' renovations, the majority of buildings that will exist in Alberta in 50 years are already built, and will likely not be affected by changes to the building code, as it is now applied. In order to achieve substantial reductions in greenhouse gases and savings in energy costs in the majority of buildings in the province, other strategies are required. This could involve a broad building retrofit program, energy labelling requirements, a renovation code (under development in Ontario and Manitoba), and/or requiring energy upgrades during transfer of ownership.

[3] Government of Alberta. 2008. *Launching Alberta's Energy Future: Provincial Energy Strategy*. http://www.energy.gov.ab.ca/Org/pdfs/AB_ProvincialEnergyStrategy.pdf.



STANDARDS IN OTHER PROVINCES

This section looks at the four provinces in Canada that are currently leading the advancement of energy efficiency standards in provincial building codes: B.C., Manitoba, Ontario and Nova Scotia.

British Columbia

In 2008, B.C. instituted a Green Building Code, which requires houses to be built to insulation levels greater than those currently required in Alberta, as demonstrated in Table 2. Alternatively, builders have the option to build to an EnerGuide 77 rating level through an objective based code. The provincial government also made it possible for local governments to increase local building code requirements in a number of areas, including energy. The Government of B.C. is expected to raise the provincial standard to EnerGuide 80 by 2010.

For commercial buildings, B.C. requires ASHRAE 90.1(2004) to be met, which is an industry standard for energy efficient buildings. Vancouver already requires commercial buildings to achieve an ASHRAE 90.1(2007) level, which provides greater energy savings than the provincial standards.

Manitoba

The Province of Manitoba has two standards for houses heated by natural gas – one for the northern part of the province, above 53 degrees latitude, and the southern part of the province, below 53 degrees latitude. Both of these standards are similar to comparable regions in British Columbia (see Table 2).

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. Table 2 shows that current insulation requirements in Ontario are similar to those in other leading provinces. In addition, Table 3 demonstrates that the expected payback period for some changes is as little as 3 years for the Greater Toronto Area.

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 per cent increase in energy efficiency for buildings starting in 2007 and a 25 per cent increase in efficiency starting in 2012 (compared to the 1997 building code). The estimated payback period for these changes is less than 5 years for the 2007 change, and between 5 and 7.7 years for the 2012 change (as shown in Table 4), although initial feedback from builders indicates that these payback periods can be reduced further through experience with new construction methods.

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 within the province (< 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 as shown in Table 2. The government has also indicated that they will require EnerGuide 80 or R2000 certification for new homes built after January 1, 2011.

Under an Energy Efficient Appliance Act, Nova Scotia will also require natural gas and propane furnaces to be 90% efficient, starting in 2009.

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

Table 2: Comparison of Current Insulation Requirements for Select Provinces and Select[A] Characteristics for Low-Rise Residential Buildings (Equivalent R-values – as Applicable to Gas Heated Buildings)

Province and Region	**Exterior wall assembly** (except basements)	**Basement perimeter walls**	**Roof** (except garages)
Alberta			
All regions	12	8[B]	34
British Columbia			
>3500 HDD[C], <4500 HDD	20	12	30
>=4500 HDD	22		51
Manitoba			
<=53° Latitude	20	12	40
>53° Latitude	26	24	50
Ontario			
All regions	19	12	40
Nova Scotia[C]			
All regions	25	10	40

Note: insulation levels are only one indicator of building efficiency. Air tightness, building design, building operations and equipment efficiency also contribute to overall energy use.

[A] Building code characteristics are not always consistent across jurisdictions. The characteristics that are presented in the table were found to be common for all five provinces and are somewhat representative of approaches to energy efficiency standards within building codes.

[B] To 600mm below grade. The other jurisdictions listed require full height basement insulation.

[C] Heating Degree Days

[D] Proposed energy standards planned to start April 1, 2009.

Table 3: Estimated Increased Capital Costs, Energy Savings and Payback Periods for Houses in Ontario[4]

Change	Start Date	Estimated Energy Savings[A]	Estimated Increased Capital Cost[A]	Simple Payback Periods
Increased efficiency for windows and furnaces, and higher insulation levels	Dec. 31, 2006	21.5%	$1,600	3.0 years
Near full height basement insulation	Dec. 31, 2008	28%	$2,700	4.4 years
Minimum EnerGuide 80	Dec. 31, 2011	35%	$5,900 - 6,600[B]	6.9 - 7.9 years

Note: Figures are based on a typical 2000 square foot gas-heated house in the Greater Toronto Area

[A] Compared to Ontario's 1997 Building Code

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

Table 4: Estimated Increased Capital Costs, Energy Savings and Payback Periods for Non-residential and Larger Residential Buildings in Ontario[5]

Change	Start Date	Estimated Energy Savings[A]	Estimated Increased Capital Cost[A]	Simple Payback Periods
Requires SB10 and ASHRAE 90.1 or SB10 and MNECB	Dec. 31, 2006	16 - 18%	$0.98 - $1.11 / ft2	3.3 - 4.7 years
Requires SB10 and ASHRAE 90.1 or SB10 and MNECB + 25%	Dec. 31, 2011	25%	$1.40 - $3.46 / ft2	5.0 - 7.7 years

Note: The range depends on the size, climatic location, quality and method of construction of the building. Estimated cost increases are based on typical high-rise residential and high-rise office buildings.

[A] Compared to Ontario's 1997 Building Code

[4] Ontario Ministry of Municipal Affairs and Housing. 2007. *Energy Efficiency in the 2006 Building Code*. http://www.mah.gov.on.ca/Page681.aspx. Accessed Dec. 1, 2008.

[5] Ibid.

EnerGuide for Homes

While the EnerGuide for Homes rating system is currently being used as an optional standard for meeting energy requirements within building codes, it was not originally intended to be a regulatory tool. In fact, it was originally meant as a tool to evaluate the efficiency of existing buildings.

For various reasons, however, EnerGuide rating levels are increasingly being used within building codes to provide builders with the option of an objective, rather than prescriptive, standard. This provides builders with maximum flexibility while still meeting energy objectives.

It should be noted that using EnerGuide ratings to meet building code requirements will most likely introduce additional costs, most notably a blower door test, and raises questions for home builders – as listed on page 13.

Summary

Several provinces have already successfully implemented measures to increase energy efficiency requirements in their building codes. These provinces are now in the process of developing further advancements to their building codes. The Province of Alberta has an opportunity to use this experience to help guide successful implementation of advanced energy efficiency standards within Alberta.

The leading provinces in this area have all instituted similar levels of efficiency standards for houses and are moving towards EnerGuide 80 as the minimum standard within the next few years[6]. Leading provinces are also currently requiring a minimum furnace efficiency of 90% while the federal government will require this nationally by 2010. For commercial buildings, the most current version of ASHRAE 90.1 and the Model National Building Code appear to be the most common standards that provinces are instituting. While it is expected that Alberta will determine its own approach to increasing the energy efficiency in the building code, in consultation with stakeholders, the province can use the experience of other jurisdictions to help guide successful policy implementation, and potentially assist the building community in developing additional capacity in new construction techniques.

Other jurisdictions have also taken the approach of not only making changes to current building codes, but also legislating future advancements to efficiency standards. The advantage of this approach is that it provides industry with a high level of certainty regarding future expectations, which facilitates their transition to new standards.

Due to the complex relationship between building components such as insulation, air tightness, building design, construction techniques, equipment efficiency, air exchange and windows, several AEEA members have suggested that the Government of Alberta should establish an expert technical advisory committee with representation including government, municipalities, and builders to provide advice on how to maximize the effectiveness of changes to the building code.

[6] Quebec and New Brunswick have also stated intentions to move to EnerGuide 80 before 2012.

WATER EFFICIENCY

Many provinces implement water efficiency standards within the building or plumbing codes at the same time as energy efficiency standards. Improving water efficiency helps to conserve and protect our limited water resources, and it also saves energy by reducing the need to clean, pump and heat water and wastewater.

Many jurisdictions have instituted water efficiency measure as a means of reducing water consumption. These measures have typically included maximum flow rates for faucets and shower heads, as well as maximum flush volumes for toilets and urinals. Table 5 shows a list of some of the mandated water efficiency measures from a selection of jurisdictions in Canada.

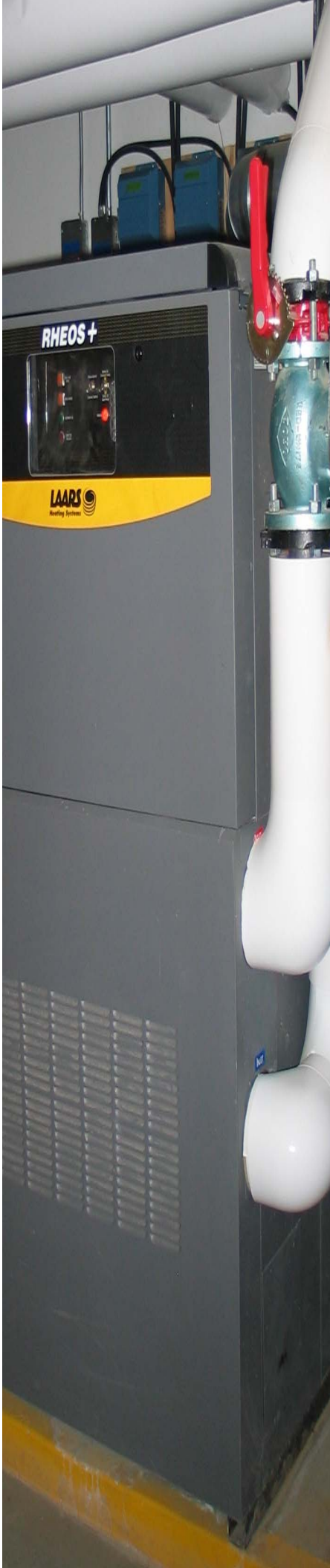
Table 5: Maximum Flow Rates for New Water Fixtures in Select Canadian Jurisdictions

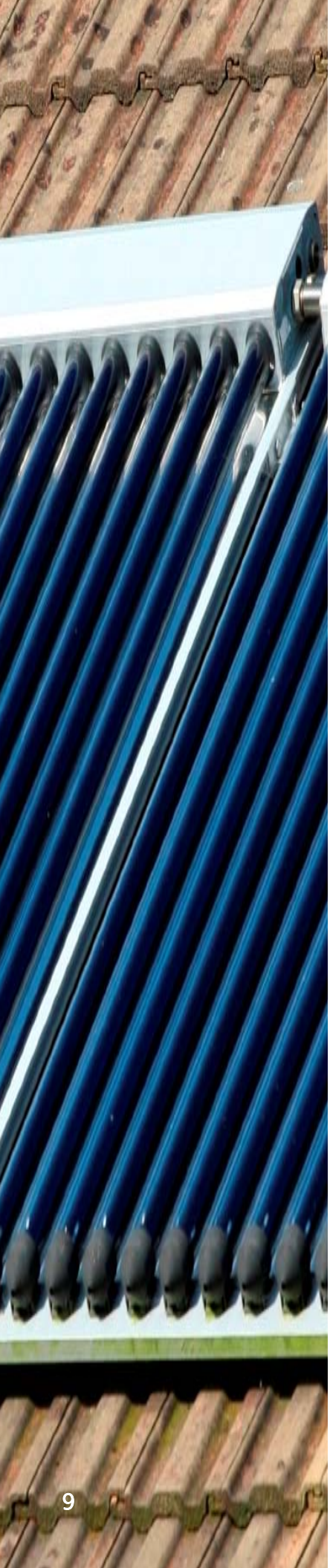
Fixture	B.C.	Ontario	Nova Scotia	Edmonton	Calgary
Faucets (l/min)	8.3	8.35	8.35	8.3 (1.9 for commercial restrooms)	8.3 (1.8 for public restrooms)
Shower heads (l/min)	9.5	9.5	9.5	9.5	9.5
Water closets (l/flush)	6	6	6	6	6
Urinals (l/flush)	5.7	3.8	3.8 or water free	3.8	3.8

Given the Government of Alberta's efforts to protect and conserve the province's water resources, instituting similar water efficiency requirements in the provincial building or plumbing codes would contribute to meeting multiple objectives.

BUILDING LABELLING

Ontario, Nova Scotia and British Columbia are also currently pursuing provincial legislation to have low-rise residential buildings labelled with their EnerGuide rating. The provinces are taking a variety of approaches to the labelling of these buildings when being built, sold or





rented. The purpose of labelling buildings is to provide consumers with information about the energy performance (and thus the approximate utility costs) of buildings, so they can make better informed purchasing, renting or leasing decisions.

SOLAR READY

A further advancement beyond adding energy efficiency in the code is to implement simple measures that make it significantly easier to add renewable energy systems to buildings. A common approach to this is to construct buildings to be 'solar ready' so that they require minimal retrofits in order to install solar water heating or photovoltaics in the future. This can include installing a low-cost conduit from the attic to the mechanical room or reserving space for future equipment installation. Each of these modifications can cost less than $100 during original construction, but could cost thousands of dollars to add as a retrofit[7].

Organizations already promoting the concept of solar ready houses include a number of builders and utilities, Natural Resources Canada, the City of Toronto, the Canadian Mortgage and Housing Corporation, and the Canadian Solar Industries Association. In September 2008, the City of Vancouver revised their building code to require all one and two unit dwellings to be built solar ready. The City of Calgary is investigating this opportunity as well.

Requiring buildings to be solar ready is a cost-effective investment as the relative cost of solar energy technologies decrease. At some point, solar energy technologies are expected to become cost competitive with current energy sources and, based on their ability to provide price certainty, they are expected to be widely used. In fact, solar water heaters are now becoming cost competitive in certain domestic hot water and swimming pool applications. The Government of Alberta has the opportunity to show foresight by instituting relatively simple actions now that will support the needs of Albertans into the future.

[7] Sedor, Andrew. 2008. *Solar Ready Housing*. UrbanCSA. http://urbancsa.files.wordpress.com/2008/11/urban-csa-solar-ready-housing-presentation.pdf

ADDITIONAL BENEFITS OF GREEN BUILDINGS

Many studies on the performance of 'green' buildings have identified a wide range of benefits associated with them. Lucuik and Hershfield[8] compiled results from several of them and found the following:

- 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 5.

Table 5: Financial Benefits of LEED[9] Certified Buildings (per ft^2)[10]

Category	20-year NPV
Energy Value	$5.79
Emissions Value	$1.18
Water Value	$0.51
Waste Value (construction only) – 1 year	$0.03
Commissioning O&M Value[A]	$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.

As we learn more about green buildings, it is clear that there are many quantitative and qualitative advantages over conventional construction practices.

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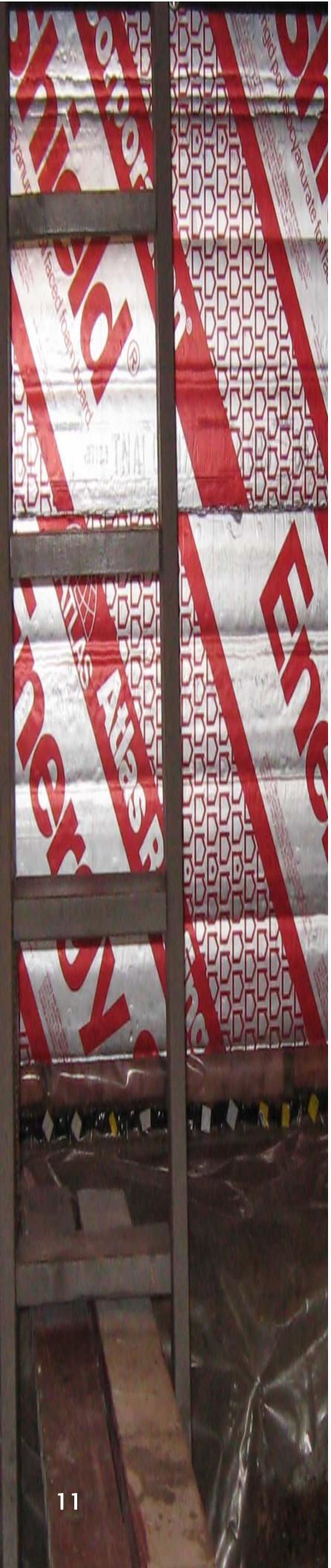
[8] Lucuik, Mark and Morrison Hershfield. 2005. *A Business Case for Green Buildings in Canada*. http://www.cagbc.org/uploads/A%20Business%20Case%20for%20Green%20Bldgs%20in%20Canada.pdf

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

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



TACKLING CLIMATE CHANGE

One of the stated goals for improving energy efficiency standards in Alberta is to reduce the emission of greenhouse gases. While energy efficiency saves money, many other strategies cost money. For example, carbon capture and storage (the central strategy within the Government of Alberta's 2008 Climate Change Strategy) is expected to cost between $40 and $150 per tonne of $CO_{2eq.}$ reduced. Therefore, it is in the interests of citizens, as both taxpayers and consumers, to institute low- and no-cost mitigation measures such as energy efficiency.

BARRIERS TO ENERGY EFFICIENCY

One of the primary barriers to energy efficiency is the purchase cost. Energy efficient buildings are typically more expensive to build, but less expensive to operate. Even if the total costs are lower, cost of the initial purchase can be prohibitive for a number of reasons.

Building purchasers may either be unaware or unconcerned about the operating cost or the overall comfort of the building. They may not pay the energy bills for the building if they are renting or leasing the space, or they may plan on selling the building within a few years.

Regardless of the reasons, inefficient buildings are more expensive and less comfortable for the people who will occupy the space over its lifetime, as they ultimately pay for both the cost of the building and the cost of the energy. It is in the best interests of these tenants, the people of Alberta, for all buildings to be built to high efficiency standards.

POTENTIAL BARRIERS TO BUILDING CODE CHANGES

Changes to government regulations are sometimes opposed as they often require changes to existing practices. For building codes, some builders will be required to institute new building practices, and consumers may be impacted by higher construction costs, although the relative impact of these potential changes is not entirely clear.

There are varying sets of building practices present in the marketplace. Some builders construct based on minimum requirements in the code, unless otherwise directed by the buyer, whereas others construct all of their buildings to a higher energy efficiency standard (eg. Jayman had committed to building all of their houses to a minimum of the Built Green Gold level). Therefore, adoption of new standards will impact building companies to varying degrees.

If builder adaptability is considered a barrier to implementing energy efficiency standards in the building code in the immediate future (eg. for any changes contemplated for 2009 or 2010), efforts should be made to overcome this barrier through adequate consultation, builder training, technology advancements and/or early signals of emerging changes to the building code. For example, home builders suggest operating within the existing code cycle for any changes. Training of advanced building techniques within trades programs can also be used to assist builders with adapting to changes to new codes and standards. Builder experiences with adapting to previous code changes would also assist in identifying successful implementation strategies. Home builders have also suggested that the government can play an important role in consumer education in order to smooth the transition to new building codes.

The cost of buildings has also been identified as a potential barrier to the implementation of greater energy efficiency standards. The degree to which changes to the building code impacts building affordability is unclear as building prices are dictated by a complex relationship between supply and demand. Factors such as housing availability, market demand, interest rates, access to loans, construction costs, land costs, development costs, land use policies, safety code requirements, rental availability and utility costs all play a role in determining the overall cost of housing and commercial spaces. The degree to which each of these factors influences overall costs is dependant on the overall market conditions, and varies over time, although builders expect to pass on additional costs whenever they can.

A conservative approach to considering the impact of changes to the building code on consumers is to assume that the final price of the building will increase by the full cost of any changes. In the case of Ontario, as shown in Table 3, the cost of building a house was estimated to increase by $1,600 on average for more efficient

windows, furnace and insulation. The corresponding energy savings, however, were estimated to be approximately $530 per year. If the $1,600 is amortized over 20 or 30 years, as with most home purchases, then the homeowner can expect to pay less over their first year, and every subsequent year, than if a less efficient home is built. Therefore, increased building costs should not necessarily be viewed as a challenge to housing affordability; although home builders suggest considering any impacts on capital costs within the context of other changes to the regulatory environment such as safety code changes, development costs or land use policies. Home builders also suggest that consumer education is important to try to address the perceived changes to affordability with disclosure of any potential increases to capital costs.

Finally, home builders have also raised a number of questions that will need to be answered prior to certain code changes:

- What are the common practices now within the building code and what changes would need to take place to achieve a minimum energy efficiency rating?
- What are the full costs of any proposed changes such as changes to material, labour or certification?
- If EnerGuide certification is required for new homes:
    - Will a blower door test be required and if so who will do the testing, what is the timeline for compliance, and are enough practitioners available?
    - If blower door testing is not required, who would be liable if a house is later found to be below the mandated requirement?

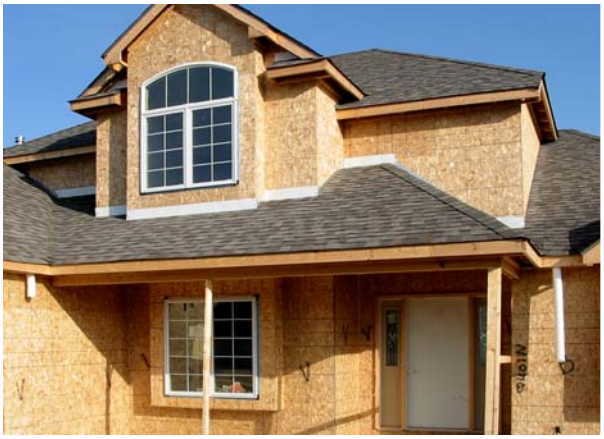
CONCLUSIONS

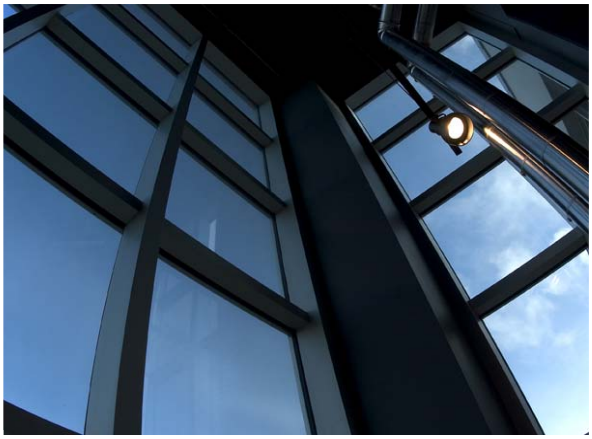
Given the clear economic and environmental return on investment, it is in the public's best interest for the Government of Alberta to ensure new buildings in the province maximize energy efficiency. This includes short-term advancements in insulation, air tightness and equipment requirements, investments in overcoming potential barriers to the short- and long-term advancement of the building code, and clarity on future changes expected to the building code to facilitate industry adaptation.

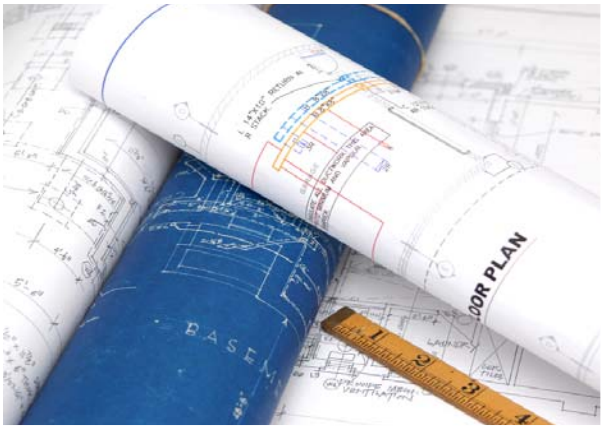
Leading provinces in this area have all established similar levels of efficiency standards for houses and are moving towards EnerGuide 80 as the minimum standard for homes within the next few years. Leading provinces are also currently requiring a minimum furnace efficiency of 90% and the federal government will require this nationally by 2010. For commercial buildings, both the Model National Energy Code for Buildings and ASHRAE 90.1, an industry standard for energy efficient buildings, appear to be the most common standard that provinces are instituting.

Governments are also advancing the concepts of water efficiency, energy labelling for all buildings and using low cost measures for houses to be built 'solar-ready'. These measures are considered complimentary to changes to efficiency standards within the building code as a method of further advancing the marketplace towards reduced energy and water use.

Alberta has the opportunity to take a leadership role in the quest for more efficient buildings. This can be done in a way that protects both the environment and the pocketbooks of Albertans. Getting greater use out of fewer resources is an important element to remaining competitive in today's global economy and maintaining a high quality of life in the province.



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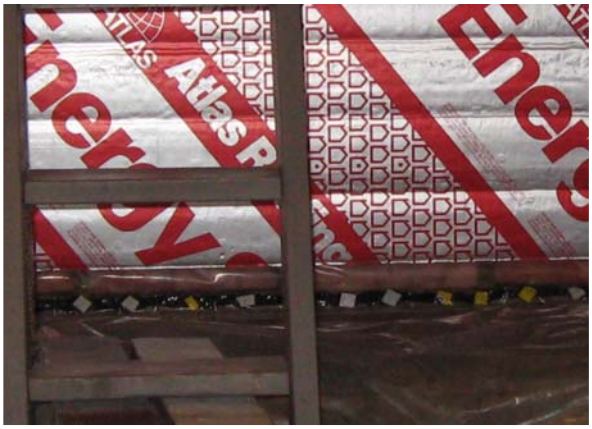
Atlas


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