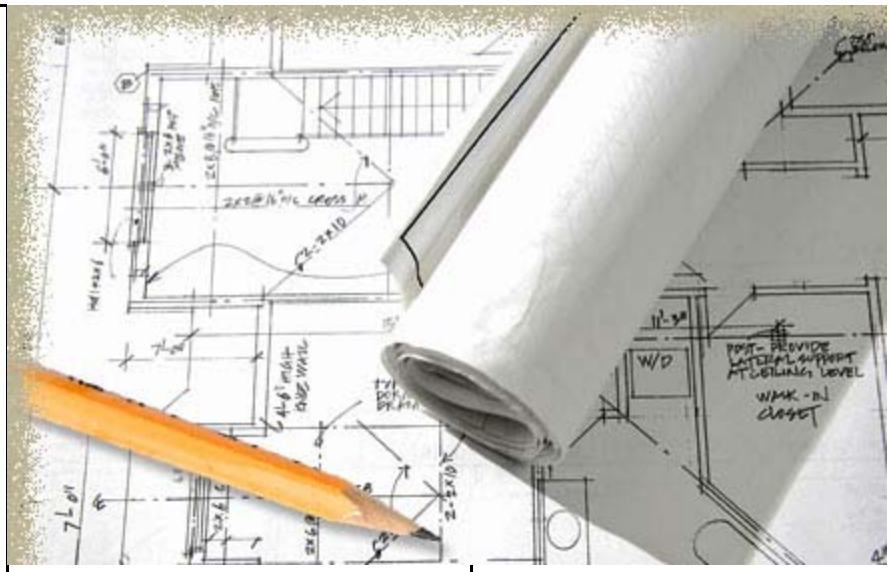
Institute for Catastrophic Loss Reduction
Building resilient communities

Institut de Prévention des Sinistres Catastrophiques
Construction de resilient communities

A Plan Forward: Building Practices to Increase the Resilience of Homes to Severe Weather

FINAL REPORT



ICLR

August, 2012

"Climate change is exposing Canada's infrastructure to conditions it was not originally designed to withstand."[1]

—Public Infrastructure Engineering Vulnerability Committee

In 2011, wildfires razed approximately one-third of Slave Lake, destructive floods hit the Prairies and Quebec, a tornado tore through the southern Ontario town of Goderich, and the Maritimes contended with 19 tropical storms that formed in the Atlantic basin. As a result of extreme weather events, Canadian homes experience billions of dollars in damage per year. And this loss is increasing; for example the Insurance Bureau of Canada estimates that insured water losses in Nova Scotia almost doubled over 4 years, from more than $20 million in 2005 to more than $38 million in 2009.[2] Over the same period, water damage losses in New Brunswick almost quadrupled.

Homes are designed for a specific climate, but a home built today may need to function over a series of challenging climatic conditions. There is a growing understanding that the nature of weather events will change throughout a home's life span, and that building design practices should allow for predictions of increased risk and intensity of extreme weather events. Many Canadians are already combating the impacts of climate change with upgrades and retrofits to their homes that promote energy and water efficiency. Upgrades can also increase the resiliency of homes. Still, as useful as these efforts are, more direct methods can and should be employed to integrate the impacts of extreme weather events directly into existing planning processes and make homes more resilient to damage from hazards expected over the next 50 to 100 years.

[1] "Climate Change: A Public Concern," *Public Infrastructure Engineering Vulnerability Committee,* June, 2007, p. 1.

[2] "Insured water losses in Nova Scotia double over four years: IBC," *Canadian Underwriter.ca*, February 23, 2012.

SCOPE OF STUDY

With support from Natural Resources Canada, in 2012 the Institute for Catastrophic Loss Reduction (ICLR) held workshops in Toronto (January 6), Halifax (January 19), Montreal (January 20), Edmonton (February 2) and Vancouver (February 3) to discuss challenges faced by homebuilders in constructing homes to withstand extreme weather. Almost 100 stakeholders participated, including homebuilders and homebuilder associations, building design experts, building code officials, building code designers, academics, urban planners, environmental experts, and insurers.

The goal of the workshops was to develop a roadmap for stakeholders in the homebuilding industry that could be used to overcome barriers associated with building homes capable of withstanding extreme weather. Each workshop began with Meteorologist and Climatologist Joan Klaassen informing participants about her views related to global climate change, noting some observable extreme weather trends in each region and summarizing some of the obvious implications of a changing climate for Canadian infrastructure. Building design expert Michael Lio then used the energy efficiency movement as a case study to illustrate how the marketplace for new homes could be transformed to integrate climate adaptation into building design. Finally, a regional building code expert provided an overview of how climate change in that region has influenced provincial code decisions and building practices. Together, the three presentations generated much discussion and debate about climate adaptation and building practices for new homes.[3]

ORGANIZATION OF THE REPORT

The first part of this report lays out the main challenges identified by stakeholders to building to a higher level of resilience, and it presents avenues to address them as well as examples of work currently being undertaken to meet the challenges. The second section provides a set of specific public policy recommendations to address the challenges.

[3] For an Executive Summary of the workshop design and preliminary findings, see Jason Thistlethwaite, "The Institute for Catastrophic Los Reduction (ICLR) Regional Adaptation Collaborative II: Builder Outreach and Climate Adaptation, Executive Summary," *Institute for Catastrophic Loss Reduction*, March 30, 2012.

CHALLENGES TO RESILIENCY IN BUILDING PRACTICES

The following were identified by workshop participants as the most important challenges to improving resiliency in building practices:

1 - The Climate Is Changing… And Change Is Complicated
2- Damage Data and Scientific Research
3 – The Challenge for Homebuilders
4 - Most Homebuyers Are Unaware Of The Risk
5 - Incorporating Climate Change Into Building Codes

(1) The Climate Is Changing…And Change Is Complicated

The 2007 Intergovernmental Panel on Climate Change (IPCC) projects the global temperature to warm by 1.8 to 4.0 degrees Celsius by 2100, depending on various scenarios of greenhouse gas emissions. The IPCC also estimates that it is "virtually certain" (greater than 99% certainty) that the climate will experience more extreme maximum temperatures, with more intense, frequent, and longer lasting heat waves. Much uncertainty remains about the level of future CO2 emissions, which makes it difficult to predict trends in global climate change. Moreover, climate change means more than global warming. For example, the IPCC has determined that it is "very likely" (greater than 90% certainty) that global warming will also include changed atmospheric circulation and storm tracks. This would bring a more active hydrological cycle, more frequent and intense precipitation events and increased flood risk as the earth's temperature rises increasing the amount of energy driving weather systems.

Regional variations in climate add even more complexity to predicting climate trends. As the Canadian Environmental Assessment Agency put it, "any determination of specific predictions at the regional level of detail requires the production of climatic information in which there is the least degree of confidence."[4] For example, workshop participants explained that Canada's coastal regions are experiencing rising sea levels while non-coastal regions are experiencing a combination of drought and more extreme precipitation events. And although all parts of the country are concerned about increased pests, the exact nature of the threat posed differs, from mountain pine beetles in British Columbia to termites in Ontario and iron-eating bacteria in Quebec.

[4] Dr. Philip Byer, Dr. Julian Scott Yeomans, and Melanie Lalani, "Addressing Climate Change Uncertainties in Project Environmental Assessments," *Canadian Environmental Assessment Agency*, 2004, p. 11.

Solutions:

Adapting Canada's building and infrastructure to make it more resilient to a warming climate is already underway in many jurisdictions. On the east coast, for example, the Confederation Bridge between New Brunswick and Prince Edward Island was built a metre higher than current requirements to accommodate sea level rise over its one hundred year lifespan. In British Columbia, several government ministries are adapting to extreme weather with initiatives such as Living Water Smart and the Emergency Response Management System, and are working with the federal Department of Fisheries and Oceans on rainwater management to encourage sustainable drainage practices on a province-wide basis. The City of Toronto's climate change adaptation strategy points out that "Climate changes are already being seen in Toronto. In the last decade, the city has been subjected to extreme heat, floods, drought, new insect pests, new vector-borne diseases and other problems made worse by climate change."[5] A number of adaptation programs have been implemented in response, including a Heat Alert system and Hot Weather Response Plan, the Wet Weather Flow Master Plan, Basement Flooding Protection Subsidy Program, Flood Warning Forecasting, Green Roof Pilot Incentive Program, and the Better Buildings Partnership.

Individual homebuilders are also taking notice. For example, one Ontario homebuilder shared that "extreme temperature and weather changes over a 24-hour period are causing a lot of grief to homeowners…with humidity control and issues related to moisture in the building." Evidence suggests, however, that many homebuilders have yet to draw a direct link between the climate change realities described above and homebuilding practices. ICLR has begun this dialogue; for example the 5 regional workshops featured a detailed explanation of climate change and its impacts on infrastructure that was tailored to each region visited. For some participants the workshops represented their first formal engagement with the concept of climate change and climate adaptation. The information was received positively by the homebuilders, with many of them indicating their willingness to engage in forums of this kind on a regular basis.

[5] Toronto Environment Office in collaboration with the City of Toronto Climate Adaptation Steering Group and the Clean Air Partnership, "AHEAD OF THE STORM…Preparing Toronto for Climate Change," *The City of Toronto*, April 18, 2008, p. 6.

(2) The Need for Damage Data And Scientific Research

A common thread during workshop discussions was concern about the lack of comprehensive data available to describe the ways in which homes are experiencing weather-related difficulty and how long buildings should be expected to last. The insurance industry shared some data, much of which was new for homebuilders, code officials and many other stakeholders. Also, a certain amount of frustration was expressed by stakeholders about access to scientific research that identifies building practices that could improve resiliency of new homes. Again, researchers shared some of the work they are currently undertaking, much of which was new for homebuilders and other stakeholders.

Solutions:

A more systematic approach to data collection about damage to homes is beginning to emerge; for example the Insurance Bureau of Canada is in the process of creating a web-based Municipal Risk Assessment Tool (MRAT) to assemble data about the risk of water damage to homes and the state of municipal storm and sanitary sewer systems. To be shared with municipalities, the tool will predict with a high degree of accuracy the probability that infrastructure failure will occur within a quarter of a city block. ICLR has been engaged to assist in the development of future Intensity Duration Frequency curves for MRAT.

With regard to disseminating the results of scientific research on resilience and building practices, ICLR's research partners have determined over the past 15 years that there is considerable scope to design and build homes that are more resilient to damage from the impacts of climate change expected in Canada, and researchers are eager to share this work. For example, one researcher described research on building practices as an "invaluable feedback mechanism" that does not currently exist. As he noted: "We can't change the way any builder is going to build a house, but we can provide the underlying information about why this might be important, and we can help with testing some of these fixes." A building code official supported this observation by adding: "We would see that as being really important as well because if we get information for a code change proposal that doesn't reflect what the builders feel they can do or it doesn't have the engineering behind it…then there is some credibility issues for us…so we really need that dialogue to be happening with us, with the builders for sure, with the engineers and the designers…and the building officials as well."

ICLR is currently facilitating a dialogue with homebuilders about specific building practices through its work with the Ontario Home Builders' Technical Committee Working Group (TCWG) review of ICLR's research and design advice. The review will coordinate feedback between ICLR and Ontario homebuilders and building code experts on a "best practices" guide for homebuilders. An important foundation for ICLR's discussions with the TCWG is the wind research program led by Dr. Greg Kopp and others at Western University's Insurance Research Lab for Better Homes, which has shown that a relatively small investment during initial construction can contribute to a significant increase in safety.

(3) The Challenge for Homebuilders

One municipal building official commented that "However (homebuilders) did it in the past, that's how we do it today." This sentiment has been echoed by Canada Mortgage and Housing Corporation, which has stated that "No other large consumer product has changed so little in appearance, structure and functional performance over the past several decades as the singe-family house."[6]

Reluctance to alter established building practices was evidenced during the planning phase for the workshops. Specifically, more than two hundred homebuilders were invited to participate, but most did not attend. Two homebuilders attended the Toronto workshop. The same was true in Halifax. Bruno Nantel, who leads Quebec's home builders' association, participated in Montreal. In Edmonton, one homebuilder agreed to participate but did not. And in Vancouver, one homebuilder attended. Attendance was strong for other stakeholders involved in home building. Representatives from homebuilding associations and new home warranty programs were among the most active participants at the workshops. Indeed, a representative from a provincial new home warranty program offered to present a list of design practices supported by ICLR to his Housing Industry Technical Committee with the intention of having his organization serve as a forum to bring the ideas to other stakeholders.

Resistance to change by individual homebuilders may reflect a lack of perceived benefit with buyers coupled with greater potential cost. Homebuyers will benefit from more durable homes, insurers will reduce their damage claims costs, and regulators will improve public safety without making significant public investments. There is no obvious downside risk for insurers or regulators. Homebuyers may expect somewhat higher prices, homebuilders likely face the possibility of having to absorb at least some of the additional costs.

Homebuilders question their capacity to absorb the risk of added construction costs that may not be entirely transferable to consumers and the implications for their competitive positioning and ultimately profitability. They wonder about how new building practices would be developed, and by whom. They question the extent to which they would be liable for repairs associated with practices that may prove difficult to implement and whether unanticipated repairs would reflect negatively on their reputations under new home warranty programs, which in the provinces

[6] "Working Paper Two: the Evolution of the Housing Production Process," 1946-1986, *Canada Mortgage and Housing Corporation,* 1986, pp. 1-3.

examined by this study extend the homebuilder's obligation for 5 to 10 years after construction is completed.[7] Quality control was raised as an issue. Especially in Ontario but in other provinces as well, production homebuilders shared that they do not normally have direct contractual relationships with the trades because of numerous levels of sub-contracting; in fact they may not know who is physically on their building sites at any one time. One homebuilder was concerned about the time and expertise needed to train the trades in new building practices, and a building envelope expert in Edmonton expressed her concern about labor shortages and the general unwillingness of the trades in that province to be re-trained.

Solutions:
One idea that proved popular with homebuilders would be a builder-approved, homebuilding program that seeks to make changes cost-neutral, easily marketable, non-technical, and free from liability. Such a bottom-up approach to altering building practices has the advantage of earning the trust of homebuilders at the outset by actively engaging them in the process. A similar process was used after energy efficiency was introduced into building practices across Canada. The original R2000 program struggled because it imposed a new set of practices on homebuilders; it changed the way they built homes, the way sales people broached potential buyers, the way trades were chosen, and the way all other aspects of construction took place. When building practices did not change to include energy efficiency, a conscious decision was made to craft a follow-up program entitled EnergyStar with a bottom-up approach that aligned the goals of the program with those of homebuilders. The new strategy was to engage 20 of Ontario's largest homebuilders at a deep level to design a program that met their specific needs (i.e., training for sales teams to reduce their unease about the technology, administrative and design support) and then ensure that the home was buildable. Other stakeholders involved in the production cycle were also aligned, including utilities, home warranty representatives, and input manufacturers. Homebuilders were then given a label that informed buyers about the energy efficient aspect of their new home.

A similar approach has been applied by ICLR's sister organization in the United States, the Insurance Institute for Business & Home Safety. Its FORTIFIED for Safer Living program has created a package of upgrades that increase a new home's resilience to extreme events by strengthening the home's outer envelope, including wall systems,

[7] Provincial home warranty programs have the following limits: 5 years in Alberta and Quebec, 7 years in Ontario and Nova Scotia, and 10 years in British Columbia.

doors, glazed openings, and its foundation. So far the program has been applied to over 200 projects in 16 states; in some cases an entire neighborhood is FORTIFIED. The program provides a FORTIFIED designation, certifies professionals to design the home, and it helps train the professionals who inspect and certify the homes. It has been embraced by other stakeholders in the U.S., including insurance companies such as the American National Property and Casualty Company (ANPAC), which has stated that the program is "becoming the gold standard in disaster resistant construction." ANPAC clients receive discounts "for building these stronger homes." The program has consciously focused on being engineering-based, affordable, demonstrable, and flexible enough that it can be applied to any form of construction.

In 2006, ICLR began working with the Co-operators to construct three *Designed…for safer living* homes. This project proved that it is possible to build disaster-resilient homes in Canada. The next logical step is to partner with homebuilders to construct additional demonstration homes that will showcase how the research and design ideas proposed by ICLR and supported by the Ontario Home Builders' Association (OHBA) can become part of everyday construction practices.

(4) Most Homebuyers Are Unaware Of The Risk

A recent public opinion poll in Alberta found that 95% of respondents "agreed" that the climate is changing, but only 65% "agreed" that climate change will have a significant impact on their lives or the lives of their families.[8] This level of disconnectedness from the impacts of climate change may signal that many people do not feel directly threatened by global warming. Or it may reflect an inability of scientists to clearly identify the future effects of global and regional climate change, which in turn allows some people to discount their risk. It may also reflect the long return period on investments in resiliency; it means, for example, trying to account for something that occurs with a very low probability, such as 2% in any given year for a 1 in 50 year event. Most people relate to these probabilities in terms of a home they will live in for an average of less than 10 years.

Another challenge is that the benefits of resiliency are not experienced directly, as with energy efficiency; instead, homebuilders and building designers pointed out that homebuyers are generally predisposed to focus more on aesthetics than functionality and other benefits. A central tenet of one presentation by a building regulator was that a more resilient home is one that is square in shape (i.e., fewer peaked roofs and dormers), with fewer openings (i.e., windows, multi-car garages) and more interior walls (as opposed to an open concept design). The presentation included a photograph of an existing home that meets new design requirements under British Columbia's building code. A homebuilder immediately volunteered that the building was "ugly." This response reflected her experiences with consumer preference for aesthetics. Some participants also shared their sense that homebuyers do not yet see themselves as a stakeholder in this debate. Many homebuyers rely on governments to mandate house construction regulations so that homes are fundamentally safe, and they assume that their insurer or even their government (in the case of a catastrophic event) will take responsibility for fixing their homes when damage occurs.

Solutions:

Notwithstanding these expectations and predispositions, workshop participants believed that securing support from homebuyers is important for resilient building practices to become common practice. A good first step is to offer immediate, tangible and easily communicated benefits from owning a resilient home. One such benefit would be lower insurance premiums for homebuyers who opt for additional resiliency

[8] Davidson, D.J., M. Haan and B. Parlee, "The Social Dimensions of Climate Change Vulnerability in Alberta: A Preliminary Assessment," *Government of* Alberta, May, 2008, p. 2.

practices when buying a new home. It was believed that this advantage could easily be made part of the homebuilders' sales tool-kit.

Encouraging individual homeowner actions to reduce risk is a common practice for insurance companies; for example insurance for new homes that incorporate new building code requirements is less expensive than insurance for older homes, and insurers sometimes implement limits on indemnification within a particular geographic area if that area suffers too many claims of a particular type, or withdraw coverage altogether if a homeowner files too many claims in a specific time period. So far Canada has little experience with adjusting insurance rates to account for the possibility of severe weather events. For example, during the Montreal workshop participants could not point to any substantial changes in insurance coverage due to the 1998 ice storm. Still, an insurance executive suggested that insurers could offer price incentives related to the most visible resiliency issues, such as identifying those activities that create the greatest number of claims, including sewer back-up or roof damage from wind, and then creating a climate change adaptation label with incentives for builders and customers.

As a long term strategy, harnessing homebuyer support for resiliency will require greater public awareness of climate change and resiliency. Some efforts at public education are already underway. The Meteorological Service of Canada is working to provide tangible information along with public weather warnings to make people more aware of the potential impacts of severe weather on infrastructure; for example, more than just telling people that wind gusts are expected to be 90 kilometers per hour, forecasts could include information about the potential impacts if the wind gusts happen in autumn, with leaves on the trees, and with snow or ice on the leaves. Potential impacts on infrastructure and human safety could also be illustrated. Building officials are finding ways to give homeowners direct advice about the impacts of extreme weather. One building official pointed out that it has become common in southwestern Ontario to have a rainstorm in February on top of 12 inches of snow. He is working with his media groups to bring homeowner attention to the implications of changing weather conditions and mitigative actions, such as keeping eavestroughs clear of debris in the winter. This investment will prevent a direct loss to homeowners in the short term, and over time it sensitizes homeowners and homebuyers to the issue of resiliency.

Homebuyers also need to be educated about the need to take personal responsibility for making their homes more resilient, instead of assuming that it is the job of

governments to keep them safe. To this end, the focus of homebuyers should be switched to a discussion about personal safety, rather than about the damage afterwards and the fact that insurers and/or governments will assume responsibility for damages after an extreme event. ICLR has worked to enhance public awareness of actions that homeowners can take to reduce their risk of loss from severe weather, such as retrofitting individual homes in different locations across Canada to showcase actions that they can take to improve resilience, and using funds provided by the Government of Canada to produce brochures for homeowners so they can assess their risk from basement flooding, wildfires, severe wind, and ice and snow, and take actions to reduce the risk.

Such a consumer-oriented approach represents market transformation in a different way from the homebuilder-centered approach described earlier. But evidence supports its usefulness. Alberta's FireSmart is a public education program that employs a number of different community-based social marketing strategies to inform and motivate communities and individual homeowners to take the steps necessary to protect their property from the risk of wildfires. The early success of FireSmart (i.e., the program has been adopted by British Columbia, Saskatchewan, Manitoba, Ontario, Nova Scotia, the Yukon Territories and the Northwest Territories) demonstrates that public education can be a useful long term vehicle to raise consumer awareness about threats from extreme weather. A representative of FireSmart shared that he considers the current debate about resiliency to be an ideal opportunity to involve the building industry in labeling FireSmart-recognized building materials and creating a certification program for homebuilders who use them. Stakeholders support the efficacy of this approach and want to see it expanded to include resiliency in general. They also appreciate the benefit of having a rating and labeling system for resiliency because it demonstrates to homebuyers that they are receiving a tangible benefit that has been quantified and standardized.

(5) Incorporating Climate Change Into Building Codes Is Complex

Currently the National Building Code of Canada (NBCC) uses a probabilistic approach that examines historic data for climate hazards and then forecasts an event likely to occur in that period. From this data, different events are assigned unique design values. Within the NBCC, design loads are specified for snow and wind, rain intensities, cold and hot temperatures, relative humidity, and ice loads. For the 2010 NBCC, Environment Canada updated and improved 7,100 specific climatic and seismic design values for 679 sites.

Although useful, experts believe it has become necessary to develop a way to incorporate assessments of future climate change into building codes. As climatologist and leading climate change expert Gordon McBean commented in 2008, "These building codes are designed for the weather of the past as opposed to the weather of the future."[9] Building code experts agree. One such expert in Vancouver commented that the NBCC is "based on the assumption that the past climate will be representative of the future climate… That is the key assumption. Is that going to hold up?" Also, a centerpiece of some of the municipal and regional climate change action plans is a recommendation for more work to improve estimates of future weather, with a special challenge being to forecast future changes in extreme weather; for example British Columbia's adaptation strategy recognizes in the introduction that "Preparing effectively for climate change will require decisions based on an understanding of future climate, not just the climate of the past." [10]

A further challenge is that much of the preceding discussion has assumed an essentially homogenous potential marketplace for resiliency. This, of course, is not the case. In addition to the regional climate differences highlighted earlier in this report, there are other notable differences between Canada's regions. Population density is one difference. Ontario welcomes approximately 100,000 new immigrants per year,[11] the majority of whom reside in the Greater Toronto Area. Denser housing to accommodate a big and growing population increases the risk of over-taxed sewer

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[9] "Climate change should influence building codes, says expert," *Leader Post*, http://www.canada.com/reginaleaderpost/news/story.html?id=ee7bf4c0-56a1-412e-a222-7feb8659aa94, July 16, 2008.

[10] Ministry of Environment, "Preparing For Climate Change: British Columbia's Adaptation Strategy," *Government of British Columbia*, February 2010, p. 1.

[11] According to the Ontario Ministry of Citizenship and Immigration, in 2010, Canada admitted 280,636 permanent resident immigrants. Of these, Ontario received 118,116, or more than 42% of the total.

systems backing up into homes. A related difference is the size of the homebuilding industry itself between regions. Large production homebuilders in Ontario build approximately 50,000 new low-rise houses per year, with the largest homebuilder constructing approximately 3,500 homes per year. At this level of output, production cycles of between 16 and 22 weeks are "sacrosanct," as one building design expert put it. By contrast, the largest builders in Atlantic Canada build hundreds not thousands of homes per year. As a result, homebuilders from different regions need to adapt differently.

Solutions:

The task is daunting. Even the most senior climate specialists are uncertain about how to directly include climate change in Canada's building codes. All agree that any plan requires continual assessment of existing and changing risks, climate change science and available technologies, ongoing and direct dialogue between the climate change community, building designers, and regulators, and the flexibility to alter strategies as new information is presented. Many specific tools are available, including lifecycle economics, parameters for enhanced resiliency, and performance-based standards and codes. Several climate scientists working together have proposed a "Climate Change Adaptation Factor", an adjustment factor that could be applied to existing climatic design values with the capacity to update them in view of the most recent climate observations while also accounting for projected increases and growing uncertainties due to projected climate changes. They would also consider the following measures: adjusting safety factors in codes and standards to reflect increasing uncertainties, increasing variability or ranges of extremes in values, growing risks for new infrastructure under changing climate conditions, developing methodologies to incorporate climate change and socio-economic scenarios into climatic design values, engineering practices for new infrastructure, prioritizing and developing adaptation solutions such as retrofit technologies for the most critically at risk regions, standards for maintenance practices to increase reliability of structures over time, and incorporating infrastructure adaptation into the planning, maintenance and replacement cycle of existing infrastructure.[12]

Stakeholders support the federal government's apparent agreement in principle to incorporate climate change into the 2015 national building code reforms. According to

[12] Heather Auld, Don MacIver, and Joan Klaassen, "Adaptation Options For Infrastructure Under Changing Climate Conditions: Occasional Paper 10," *Environment Canada, Adaptation and Impacts Research Division*, 2007, pp. 5-6.

one building expert in Quebec, "builders have no problems with competing with each other with fair rules…if new requirements are envisioned to make buildings tornado proof or more water proof, [builders] have no problems with that…I think we're looking at a pattern where if some changes are required they should be mandatory and that's about it…So, we're looking I think at mandatory things eventually down the road to make things weather proof."

While the national building code should represent the model code, stakeholders agree that provincial and territorial codes are the best way to account for important regional climate differences. Indeed, stakeholders believe that one of the greatest strengths of Canada's system of building codes is that provincial codes reflect regional differences. Some provinces have demonstrated their support for the utility of using building codes to enhance resiliency, such as Ontario's adaptation strategy, which recognizes that "Ontario's Building Code is an important policy tool in responding to the direct and indirect effects of climate change."[13]

Stakeholders also support the advancement of specific code changes, once a risk has been identified and a solution established through scientific research. ICLR has proposed several changes to Ontario's building code, including hurricane straps on wall-roof connections in garages, nail spacing of 6" instead of 12" on roof sheathing, and backwater valves on sanitary sewer laterals. Each submission is based on research by engineering professors at Western University with input from the insurance community.

[13] Ministry of the Environment, "Climate Ready: Ontario's Adaptation Strategy and Action Plan, 2011-2014," *Government of Ontario*, 2011, p. 34.

POLICY RECOMMENDATIONS TO IMPROVE RESILIENCY

A number of strategies are already being pursued by stakeholders to meet the challenges associated with building homes to a higher level of resiliency in a changing climate. Governments can also play a role. Some of the proposed policy recommendations take less time, such as endorsing the importance of scientific research or helping to facilitate dialogue between stakeholders. Others take more time, such as raising public awareness and incorporating climate change into building codes. All, however, are necessary if building practices are to become more resilient to the types of extreme weather events characterized by climate change.

Endorse Scientific Research. Much research is currently available about designing to a higher level of resiliency, and researchers are enthusiastic about sharing their work with the homebuilding community. The federal and provincial governments should formally endorse scientific research on climate change and building resiliency. Not only would political support of this research serve to enhance its legitimacy among stakeholders, it would also draw attention to the research, thereby further helping to disseminate it among stakeholders.

Encourage Dialogue. Stakeholders revealed a consistently strong desire for more dialogue with each other on key issues surrounding climate change and resiliency. This was especially true of homebuilders who believe they bear the greatest risk. As it currently stands, there is no established mechanism for stakeholders to engage with one another and consequently they operate almost entirely separately. The federal, provincial and territorial governments could facilitate ongoing dialogue between stakeholders. ICLR took an initial step in this regard with the 5 regional workshops, and it is actively engaging the building community through its involvement with the OHBA. Additional stakeholder dialogue, such as annual or semi-annual workshops similar to the regional workshops that formed the basis of this study, as well as support for continued dialogue with home builders' associations about specific building practices, would go a long way toward facilitating an exchange of expertise between stakeholders while also advancing stakeholder support for resilient building practices.

Create a Culture of Resilience. Stakeholders outlined a number of ways they are trying to raise consumer awareness and education about resiliency. Governments could help in this regard, starting with something as simple as making a public declaration in support of resiliency, as President Obama did when he declared May National Building Safety Month. As a longer term strategy, the government could assist stakeholders in creating a rating and labeling system for homes built to a higher level of resiliency.

Such a program would help raise public awareness about the importance of resiliency and the specific measures that can be taken to enhance resiliency, and it would remind homebuyers that they are receiving a material benefit.

Incorporate Climate Change into the 2015 Building Code. Cathy Taraschuk, senior technical advisor for structural design with the National Research Council's Canadian Codes Centre, said in 2008 that the impact of climate change is being assessed and is expected to be incorporated in the 2015 national building code. According to Taraschuk, "It's a big change in philosophy because our past codes were based on historical data, so to make the shift and say now we're going to be looking at future trends as well is a drastic philosophical change."[14] The federal, provincial and territorial governments should ensure that this important initiative moves forward in a timely manner.

[14] "Climate change should influence building codes, says expert," *Leader Post*, http://www.canada.com/reginaleaderpost/news/story.html?id=ee7bf4c0-56a1-412e-a222-7feb8659aa94, July 16, 2008.

CONCLUSION

Canadian homebuilders build safe homes, resilient to damage from most climate hazards. We now have the knowledge to build homes that are even more resilient to the severe weather that Canadians are experiencing and that will be experienced with increasing frequency and severity into the future. This report has shown that collective action by all stakeholders can harness that knowledge. The approach includes developing partnerships among stakeholders, improving data about severe weather damage to homes and making it available to stakeholders, sharing scientific research and showing homebuilders how building practices can be changed to enhance resiliency, crafting a market transformation approach that works for homebuilders, educating the public and securing consumer support for resiliency, and ultimately including climate change and new building practices into building codes. While experience with bringing energy efficiency into the mainstream indicates that such a highly integrated approach does not happen over night, most stakeholders agreed that over the next several years they have a significant opportunity to make important strides toward building safer homes for future generations.

Acknowledgements

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APPENDIX 1

Workshop Participants

TORONTO (January 6, 2012)

1. Jon-Carlos Tsilfidis, Fairside Homes
2. Joe Vella, Fifthshire Homes Ltd
3. Marc Savard, Quebec APCHQ
4. Greg Kopp, Western University
5. Mike Bartlett, Western University
6. Greg Oulahen, Western University
7. Steve Penna, Manager, Inspections, City of Brampton
8. Monirul Mirza, Environment Canada
9. Nancy Smith, Ontario Ministry of Municipal Affairs and Housing

HALIFAX (January 19, 2012):

1. Pinehurst Homes, Todd Ching,
2. Pinehurst Homes, Project Manager
3. Tim Peters, Building Official/Development Officer
4. Keith Robertson, Solterre Design
5. Ted Ross, Building Code Coordinator, Gov. of Nova Scotia
6. Gerard Donahoe, Building Code Coordinator, Gov. of Nova Scotia
7. John Hattie, NS Home & Bldg Designers Association
8. Stephanie Nowe-Morris, Architect
9. Linda van Vulpen, NS Home & Bldg
10. Lisa Tondino, Architect
11. J.P. Felix, Architect
12. John Dobbs, Architect
13. Sheila Keating, Architect
14. Tony Gillis, Architect
15. Michael Grunsky, Architect
16. Michael Harvey, Architect
17. Peter Connor, Architect
18. Richard Earle, Architect
19. Therese Leblanc, Architect
20. Troy Mansfield, Building official
21. Keith Tufts, Architect
22. Jeremie Leblanc, CMHC
23. Vince Strickland, Gov of Nova Scotia
24. Kelvin MacPhee, Integra Spec.
25. Richard Doucette, Government Works
26. Steve Olmtead, Insurance Bureau of Canada
27. Ramzi Kawar, LEED AP
28. Cynthia Street, Architect
29. Darrell Spencer, Architect, Armed Forces
30. Don Smeltzer, management consultant, Munisource
31. Martin Livingston, CRESCO Homes
32. Andrew Holley, CRESCO Homes
33. John Faddoul, CRESCO Homes
34. Michael Napier, Architect

35. Matt Jarsky, Architect
36. Grant Langille, Unifund, Johnson Inc. Insurance company
37. Will Green, Adaptation Specialist, Gov. of Nova Scotia
38. Brennan Vogel, Sustainability Solutions Inc.
39. Kevin Lewell, Building Official, City of Halifax
40. Shelley Benoit, Building Official, City of Halifax

MONTREAL (January 20, 2012):

1. Bruno Nantel, Quebec Home Builders Association
2. Jack Chadirdjian, Insurance Bureau of Canada
3. Bernard Marchand, Insurance Bureau of Canada
4. Jocelyn Laflamme, Desjardins Insurance
5. Melanie Glorieux, Landscape Architect
6. Caroline Larrivee, Ouranos

EDMONTON (February 2, 2012):

1. Alphonse Pilon, Marcson Homes
2. Bob Doiron, Peace Hills Insurance
3. Daphne Matthews, Peace Hills Insurance
4. Wayne Wyborn, Portage la Prairie Mutual
5. Cam Dupuis, CMHC, Edmonton
6. Jim Bechtold, CMHC, Edmonton
7. Ingo Viehweger, Alberta New Home Warranty Program
8. Ingo Viehweger associate, Alberta New Home Warranty Program
9. Adam Gossell, Gov of Alberta, Fire smart
10. Tracy Price, Gov of Alberta, Firesmart Community Protection Specialist
11. Joan Maisonneuve, CHBA, Alberta

VANCOUVER (February 3, 2012):

1. Chris Higgins, Canada Green Building Council
2. Edward Quek, Commercial Insurance Mger, Economical Insurance
3. Chris Marcinkiewicz, Team Leader Commercial Insurance, Economical Insurance
4. Thomas White, Climate Action Secretariat, Environment, BC
5. Tamsin Mills, City of Vancouver, Engineering
6. David McPhie, Climate Action Secretariat, BC
7. John Nicol, Ministry of Energy and Mines, Bldg and Safety Standards, BC
8. Mike Foster, Building Inspector, City of Chilliwack
9. Paul Weber, Processing Centre Building Branch, City of Vancouver
10. Jennifer Pouliotte, Climate Change Adaptation Advisor, BC
11. Marcraft Homes, Erynn Johnson, Operations Manager
12. Marcraft Homes, second representative
13. Steve Young, Climate Action Analyst, City of Victoria
14. Jack Christopher, New Home Warranty Program
15. Dave McBeth, New Home Warranty Program
16. Art Doyle, New Home Warranty Program
17. Jackson Pelling, New Home Warranty Program
18. Joe Pomper, New Home Warranty Program
19. Kandiah Pavananthan, Vancouver, Bldg Development Services

20. Troy Glasner, Ecogroup
21. Michael Heimann, Passive House Training
22. Deborah van der Horst, Passive House Training
23. Jeff Fisher, Urban Design Institute
24. Bill White, Security and Emergency Program Dir, BC Housing
25. George Bozanin, Intact Insurance
26. Richard Kadulski, Architect

APPENDIX 2

Institute for Catastrophic Loss Reduction
Institut de Prévention des Sinistres Catastrophiques

"Building Practices for a Changing Climate"

A Workshop Hosted By
The Institute for Catastrophic Loss Reduction

January 6, 2012
20 Richmond Street East, Suite 210
Toronto, Ontario

The Institute for Catastrophic Loss Reduction, an independent, non-profit research institute, invites you to join a representative from Environment Canada, building code specialists and other regional stakeholders to discuss challenges faced by homebuilders in constructing homes to withstand extreme weather. Based on feedback from workshop participants in Toronto, Halifax, Montreal, Edmonton and Vancouver between January and February, a report will be produced that identifies the major challenges faced by homebuilders from extreme weather and that develops a set of strategies to be used by Canada's home building community to overcome these challenges.

8:30 – 8:45 am: Introduction and Welcome

- Paul Kovacs and Jason Thistlethwaite

8:45-9:15 am:

Session 1: Building for the Future: The Climate Change Challenge

- **Speaker: Joan Klaassen, Senior Climatologist/Meteorologist, Environment Canada**
    - Questions: What are the observable climate and extreme weather trends in Ontario? What are the short-term and long-term projections for a changing climate, and their implications for built infrastructure? How reliable are these projections?

9:15-9:45 am:

Session 2: Challenges Generated by Extreme Weather for the Building Community

- **Speaker: Michael Lio, Michael Lio & Associates**
    - Questions: What are the challenges of building a home to manage extreme weather? What strategies and practices can homebuilders employ to mitigate property damage from extreme weather? What concerns are being expressed by homebuyers related to extreme weather?

9:45-10:15 am:

Session 3: Challenges Generated by Extreme Weather for Building Codes

- **Speakers: Mike Seiling, Chief Building Official, City of Kitchener**
    - Questions: Who writes the building code? How does the regulatory process of the building code function and what is the role of the municipality/building officials? How does the building code influence efforts to protect homes from extreme weather? Do

building code provisions reflect extreme weather? Are there any specific extreme weather trends that building officials have identified?

10:15-10:30 am: Coffee Break

10:30 am – 12:00 pm:

Session 4: Group Discussion

- The goal of the group discussion is to use the presentations as a foundation for identifying the most significant challenges in developing building practices to cope with extreme weather, and potential strategies that could help address these challenges.
- Questions:
    - What specific types of extreme weather are of greatest concern in building and designing homes in Ontario? Do recurring design issues contribute to property damage from extreme weather? How will climate risks alter building practices? Are builders using any new practices intended to protect a home from extreme weather? What are the most significant challenges in developing or implementing new practices? Are there any market opportunities for builders in developing practices to protect homes against extreme weather? How can the building code process better incorporate concerns about extreme weather into building design?

12:30 pm: Lunch and Further Discussion

Speaker Biographies

Paul Kovacs
Executive Director, Institute for Catastrophic Loss Reduction
President and CEO, PACICC
Adjunct Research Professor, Economics, the University of Western Ontario.
Paul is an economist specializing in insurance issues, natural disaster loss prevention, and public policy. Since 1997 he has been an active participant with the UN/WMO Intergovernmental Panel on Climate Change, and was a lead author of the 2001 IPCC report on climate change. Paul serves on a number of boards, including the Canadian Council for Social Development and the Meteorological Service of Canada.

Joan Klaassen
Senior Climatologist/Meteorologist
Adaptations & Impacts Research, Environment Canada
Joan's career in meteorology and climatology has spanned over 32 years in both the private sector and federal government, with experience in management, weather forecasting, meteorological consulting, climatological and climate change studies. Within Environment Canada, she has been the lead or co-lead of climate studies that have focused on high impact extreme events, and she has been co-investigator on climate change related research, with a specific focus on extremes for infrastructure design, codes and standards, emergency management, and disaster preparedness.

Michael Lio
Principal
Michael Lio & Associates
Michael is a professional engineer with a specialty in building science. He is nationally recognized as an expert in energy efficiency and building codes. Michael is a member of the board of Tarion Warranty Corporation, the Canadian Energy Efficiency Alliance, and the National Building Code's Housing and Small

Buildings Committee. He is a past chair of the Ontario Building Code Committee and former president of EnerQuality Corporation. Michael teaches building science at the University of Toronto.

Mike Seiling
Chief Building Official
City of Kitchener, Ontario
Mike Seiling, CBCO, CET
Mike is the Chief Building Official for the City of Kitchener with over 25 years of private and public service in the construction industry. As Chief Building Official he is responsible for the administration and enforcement of the Ontario Building Code that includes building permit issuance and site inspections. Mike is a Construction Engineering Technologist and is qualified with the Ministry of Municipal Affairs and Housing. He believes in being proactive and fostering relations with industry partners. He is an Executive member of the Ontario Building Officials Association.

With federal funding support through Natural Resources Canada's Regional Adaptation Collaboratives Program

Natural Resources Canada | Ressources naturelles Canada | Canada

Tor reserve a spot at this free workshop, or for further information, please contact Leslie Coventry at lcoventry@iclr.org