GREEN BUILDING IN NORTH AMERICA

Paper 3b: Institutional Efforts for Green Building:

Institutional Efforts for Green Building in Canada and the United States

Alex Wilson, Jennifer Atlee and Douglas Webber

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Executive Summary

In the United States and Canada, green building is taking off. The continuing growth of an environmentally friendly market, proliferation of municipalities adopting green codes and requirements, and increased recognition of the Leadership in Energy and Environmental Design (LEED®) program and other voluntary green certification programs will go a long way toward transforming the building industry. It is significant that green building *already* makes good business sense, even without the support of an economic structure that takes much account of environmental factors.

However, it is important to recognize that *the extent to which green building is being implemented now, or is likely to be implemented through the continued expansion of existing programs, is still far below the desired level.* In championing the goals of The 2030 Challenge, we must recall that 2030 is only 23 years away. The green building movement has advanced considerably since 1984, 23 years in the past, but as it currently holds only roughly five percent of the market, with just a tiny percentage of buildings meeting the 2030 carbon-neutral goals, there is still much to be done. Green building needs to be rapidly implemented at an ambitious performance level and on a huge market scale. To speed up the pace of change, we need an integrated strategy to move the related trades through the learning curve as quickly as possible. It is in rapidly scaling up these efforts that institutional approaches can have the greatest benefit. In addition, a special effort must be made to improve existing buildings, address occupant behavior, and institutionalize effective feedback and continuous improvement.

This report outlines the wide variety of institutional approaches available to advance green building in North America. Ideally, and in practice, these modes are used together to form well-rounded green building policies. An integrated approach—in policy, as in building design—can solve multiple problems at once, while lack of integration can *create* multiple problems at once. Within the body of this report are recommendations at all levels—from simple improvements of existing systems to more far-reaching, economy-wide shifts. The final chapter provides an overarching view of major barriers to rapid market transformation to building green, and key strategies to address those barriers (summarized in the table below). Given different priority issues, cultural and political norms, and existing levels of adoption of green building practices, the implementation strategies for these broader and more detailed recommendations may differ dramatically among the three countries.

Green building has garnered much attention for its potential contribution to solving the climate problem. While it is critical to implement strategies along these lines, it is also critical to recognize climate as just one example of the kinds of problems that increasingly confront us. We need not just to take a strong stand to address climate change but also to learn our lessons from the climate problem and recognize the importance of addressing issues early.

Principal Implementation Challenges and Solutions

Barriers	**Solutions**
1.INERTIA: Significant time and effort are required to implement change	Invest in strong, up-front measures to speed change - Build capacity - Lower the cost of change - Implement government purchasing programs
2. LACK OF CREDIBLE DATA: Consumers and decision makers lack the data to make good decisions	Measure performance and require labeling - Measure actual and real-time performance - Facilitate benchmarking - Require labeling of product and building performance - Develop national indicators
3. MARKET DISFUNCTIONS: There is a lack of full-cost accounting	Establish market signals that drive responsible decisions - Tax carbon through politically palatable tax shifting - Implement cap-and-trade programs for carbon - Explore other market approaches - Encourage innovative financing mechanisms
4. SHORT-TERMISM: Long-term risks and benefits are weak motivators for change	Set clear, aggressive, long-term targets, along with specific, incremental steps - Set ambitious national and international targets - Regularly raise the bar - Support research to continually advance the state of the art
5. SILOS: Historical divisions and territoriality inhibit change	Take an integrated approach and learn from others - Take an integrated approach to policy - Create teams and processes that cross traditional boundaries - Consider a wider scope - Cooperate on goals, standards, and markets - Ensure that broad agreements do not prevent stronger action at a smaller scale - Learn from others, and facilitate the transfer of knowledge and technology

These overarching recommendations could greatly aid green building in all three North American countries. If the recommendations were carefully and ambitiously implemented in a coordinated fashion, the resulting transformation would be unprecedented. While much can be done even in the absence of such coordination, working together would amplify the gains. Actions to advance green building can be part of ambitious national and trinational energy and environmental programs. There are tremendous opportunities for increased coordination and learning among Canada, Mexico and the United States.

Introduction

A wide variety of institutional approaches is available to advance green building in North America. This report does not attempt to be comprehensive. Rather, the objective is to review a sampling of initiatives that have been implemented in the three countries, and then draw lessons from these to develop recommendations for moving forward. As with some of the other background papers on green building that have been developed as part of the Commission for Environmental Cooperation (CEC) Secretariat's green building report, this paper explores policies in the context of what would be required to meet the goals of The 2030 Challenge, which were proposed by the founder of the nonprofit group Architecture 2030 and embraced by the American Institute of Architects (AIA) and the Royal Architectural Institute of Canada (RAIC).

This report is divided into seven sections, representing different modes of intervention in which government agencies and other institutions can engage. Each section concludes with section-specific recommendations. Ideally and in practice, these modes would be used together to create well-rounded green building policies. Effort is made in this report to clarify the best uses for each approach in an integrated policy system. For example, an integrated approach to swiftly ramping up green building would need systems that:

(A) encourage top performers to continually raise the bar for green design and practice and encourage advancement of the state of the art;
(B) ensure that even the worst performers achieve an adequate level of performance;
(C) continually move the majority of the new and existing building stock to higher levels of performance; and
(D) support A through C in a way that is flexible, economically beneficial, continuously evolving, and regionally and globally appropriate.

Each of these recommendations requires a unique set of strategies. Mandated performance requirements can ensure adequate performance across -the-board. Well-designed incentives, market-based adjustments, and consumer and trade education can shift practices of the majority. And well-designed and properly implemented voluntary standards and cutting-edge competitions continually raise the bar for top performers. Education is a critical component of market transformation, and adequate research and development is a necessary component of continual improvement. The final chapter provides an overarching view of major barriers to rapid market transformation to building green, and key strategies to address those barriers.

Performance Mandates

This section explores how mandating specific actions to achieve a minimum acceptable level of performance (through building codes, zoning laws, and product performance regulations) has both helped and hindered green building. We discuss lessons learned and how the process of developing, implementing, enforcing, and updating these mandates could be improved (for instance, through agency coordination). This section also explores what needs to be in place for mandated standards to be effective.

National Plans

Every newly elected president of Mexico is required to develop a comprehensive national development plan in the first six months after taking office that includes more than 30 sector programs. There is no equivalent in the United States or Canada. While the United States does have some broad measures that address energy use nationally, such as the Energy Policy Act (discussed in following sections), there is a need for an ambitious coordinated vision and action plans in both the United States and Canada. Citizens are motivated by clear and ambitious challenges. A real vision, with clearly articulated goals and endpoints, can energize residents, spur competition, expand markets, justify new policies, and chart a course for previously inconceivable actions and allocations of resources. Sweden's goal to be carbon-neutral by 2050 is an example of such a broad and far-reaching vision and action plan. The United States has risen to such challenges in the past—witness the Manhattan Project in World War II and the Apollo Project in the 1960s, both of which involved major investment around a rallying end-goal.

Energy security would be greatly enhanced through the implementation of national energy programs that establish specific, ambitious targets for each major sector, then develop strategies that create synergies through the interconnection of sectors such as building, transportation, land use, and energy supply. This would involve a massive, but not unprecedented, investment in research and development (R&D), training, and direct purchasing. Stretch-goal projects have proven to be major drivers of technological innovation and national pride in the past—and could be again. An initial step would be to develop national energy plans that clearly address sector strategies and interconnections.

To tackle climate change and meet ambitious emission reduction goals, building-sector plans need to focus not just on new buildings but also on the existing building stock. For example, a "Rebuilding America" program for existing homes could seek to halve energy use in a quarter of existing homes in the United States over the next ten years through a combination of direct grants, low-interest loans, and tax incentives.

Ideally, a more comprehensive national plan dealing with environmental and health issues would follow a national energy plan. Energy touches a wide variety of environmental issues, but there are other concerns, such as hazardous chemicals, resource extraction impacts, land degradation, and human health. These issues deserve the level of attention and coordination that is just starting to be granted to energy. Implementation of such a plan, like that for energy, would require a variety of policies, including a combination of mandatory and voluntary initiatives.

While there is clear benefit to nationally coordinated and adequately funded initiatives, the policies and recommendations that follow below do not require national coordination, and their implementation should not await effective national planning.

Building Codes

Building codes regulate how buildings are built, in order to protect the safety and health of occupants and to hold practitioners accountable for their work. Building codes can hinder or help the spread of environmentally friendly building practices, and sometimes they do both at once. On the down side, some existing prescriptive codes prevent or discourage the use of alternative

building materials and innovative design strategies, or even unintentionally require environmentally harmful practices. On the up side, building codes addressing energy, water, and indoor air quality can protect the environment, and occupant health. This section provides a brief history of building codes, discusses lessons learned, and explores how developing, implementing, enforcing, and updating these codes can facilitate green building.

A Brief History of Building Codes

The first known building code was included in Hammurabi's code of laws, around the 1700s B.C. The Babylonian king of Mesopotamia ruled that the builder of a house should be put to death if a building he constructed fell and killed its owner. Building codes became less draconian but far more specific as they responded to damage and loss of life from fires, earthquakes, and other building failures. Steps along the way included London regulations in 1189 A.D. for the construction of common walls and for rights to light access, drainage, and safe egress in case of fire; US Colonial-period bans on wood chimneys and thatch roofs; and the New York City Tenement House Act of 1867, covering such things as fire escapes, ventilation, water supply, toilets, and stair railings. In 1905, the National Board of Fire Underwriters, an insurance industry group, wrote the first National Building Code for the United States. Seismic codes were adopted in many geologically active areas following the San Francisco earthquake in 1906.

By 1940, three different code organizations had been established in the United States, with model codes that reflected regional variations and made it difficult to work across different code-enforcement areas. Decades of efforts to harmonize the three codes ultimately resulted in the creation of the International Code Council (ICC) family of codes, the first full edition of which was published in 2000. Included in the 11 codes making up the ICC family were the International Building Code, International Residential Code, and "International" versions of the Mechanical, Plumbing, Fire, and Energy Conservation codes (the National Fire Protection Association [NFPA] later split from the ICC process and began developing its own building code to compete with the ICC).

In Canada, responsibility for building regulation lies with the provinces and territories. Originally this responsibility was delegated to municipalities, but this resulted in increasing variation in requirements across the country, which created problems for designers and product suppliers. In response to this, in 1941 the National Research Council developed the first National Building Code (NBC) of Canada, a code model for adoption. Since then the code has been updated about every five years. The provinces and territories have also since limited the influence of municipalities by adopting a provincial or territorial standard code (either the NBC in its entirety or the NBC with modifications) for use by respective local municipalities.

Code developers have only recently begun developing model codes to comprehensively address the broader impacts of the built environment. However, there has been a gradual shift from a sole life-safety focus to use of codes as a mechanism to improve environmental performance, with code language addressing the efficient use of energy and water as well as the design of sewage systems to limit contamination of water supplies and protect surface waters and aquifers. Interestingly, these attempts have proven to hinder as well as help the environment. Most building codes in the United States prohibit the use of gray water (wastewater from a building, excluding that from toilets, dishwashers, and kitchen sinks), even though that use offers more environmentally responsible wastewater disposal for people in rural areas with onsite treatment systems.

Following the energy crisis of the 1970s, some US states developed their own energy codes before the first Council of American Building Officials (CABO) Model Energy Code (MEC) was created in 1977, which used the voluntary American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) Standard 90-75 as its basis. During the 1980s many states adopted the MEC or specific ASHRAE standards (90-Series standards) to reduce energy consumption in residential and commercial buildings. The MEC has been referenced in various laws, such as the National Affordable Housing Act of 1990 and the Energy Policy Act of 1992. The 2000 International Energy Conservation Code (IECC) superseded the MEC, though some building codes still reference various editions of the MEC.

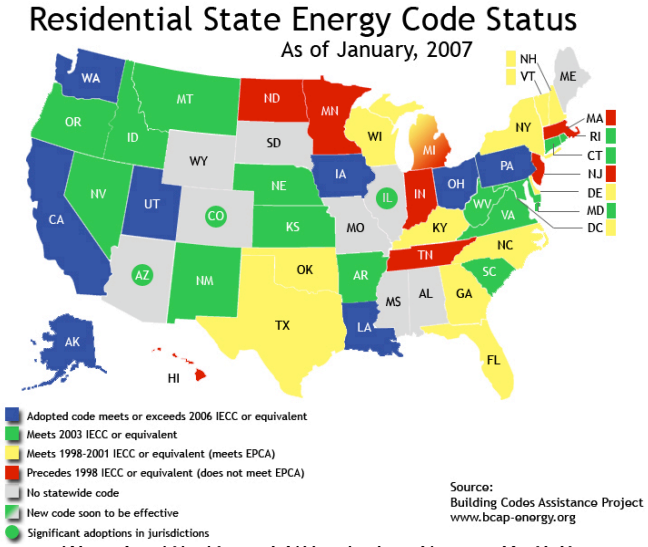
In Canada the first Model National Energy Code for Buildings (MNECB) was published in 1997. The MNECB was developed by the same Code Commission responsible for developing the NBC. The MNECB provides both a prescriptive path and a performance path, allowing designers to prove that their buildings comply with an acceptable level of energy efficiency. The acceptable levels, which are different for different climatic regions in the country, were determined using regional construction and heating energy costs in a life-cycle cost analysis. The National Code Commission has just been given the authority to update the Model (MNECB), which is long overdue. This renewal should create new interest in the energy code and increase its influence.

Energy and Environmental Codes Today

United States

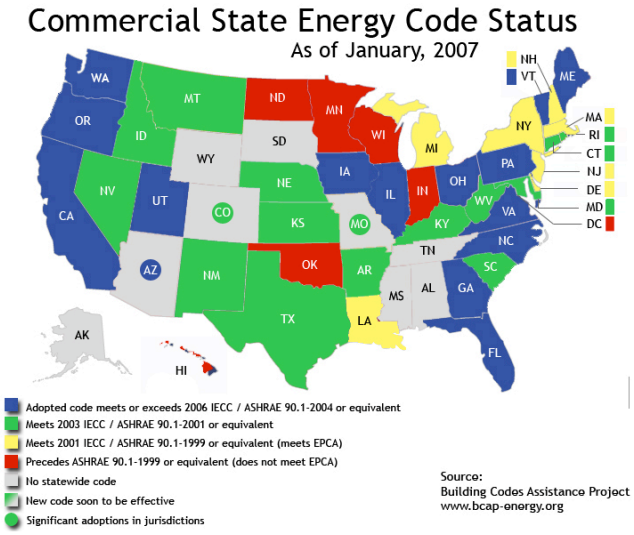
As of January 2007, according to the Building Codes Assistance Project (BCAP), eight states had adopted a residential state code that meets or exceeds the 2006 IECC, and 14 more had adopted a code that meets or exceeds the 2003 IECC. For commercial buildings, 14 states had adopted the equivalent of the 2006 IECC code, and 14 more had adopted the equivalent of the 2003 IECC code. Only four states have not adopted any energy code, but many more states still lag significantly behind the 2006 code (see Figures 1 and 2). Adoption is significant, but by no means uniform or complete.

Figure 1: Residential State Energy Code Status, as of January 2007



Source: Building Code Assistance Project, <www.bcap.org>.

Figure 2: Commercial State Energy Code Status, as of January 2007



Source: Building Code Assistance Project, <www.bcap.org>.

More recently, a few jurisdictions have moved beyond energy and implemented, or begun to consider implementation of, mandatory comprehensive green building standards, usually after working for a time with voluntary standards or preferred purchasing requirements. Among these are Austin, TX; Battery Park City, NYC, NY; Frisco, TX; Novato, CA; Santa Cruz, CA; Sebastopol, CA; Seattle, WA; and Telluride, CO. The District of Columbia, after gradually instituting requirements for buildings that are in some way connected to the government, recently ruled that, by 2012, all privately owned commercial projects larger than 50,000 ft^2 (5,000 m^2) will be required to achieve LEED certification. Boston has also instituted mandatory green building requirements for all buildings, public and private, over 50,000 ft^2 in size. The Boulder, CO, Green Points program and the City of Frisco, TX, Green Building program are examples of locally developed programs whose requirements are enshrined in the local building codes.

LEED was not designed to be a building code and so, in 2006, The United States Green Building Council (USGBC) began working with ASHRAE, the Illuminating Engineering Society of North America (IESNA) and AIA on the creation of Standard 189, Standard for the Design of High-performance Green Buildings Except Low-rise Residential Buildings, intended to be completed in 2007. The standard resulting from this consensus of members of the American National Standards Institute (ANSI) has scope and recommendations that have much in common with LEED. However, instead of a rating system, Standard 189 is written in enforceable language that could be incorporated into building codes much the way ASHRAE 90.1 and the IECC standards are today.

Standard 189 has also directly tackled three major challenges for standards and rating systems. Unlike LEED and other point-based rating systems, most of the standard is made up of criteria that cannot be traded off, so that a building cannot pass unless it shows strong performance in each of the categories. Standard 189 also provides both simple prescriptive and innovation-

enabling, performance-based options for all categories, in recognition that neither method is inherently better but each serves a different need (see sidebar below, on Measures of Performance). Lastly, Standard 189 was designed to address the bothersome gap between modeled and actual performance by requiring measurement and verification for 12 to 18 months after occupancy and requiring commissioning if the building fails to achieve an efficiency target benchmarked to the US EPA's Portfolio Manager. While such requirements would be difficult or impossible to implement in the current code enforcement structure, the inclusion of this language in the standard begins the much-needed process of assessing and requiring actual performance improvements, and of using that information to improve building design and modeling tools to reduce the performance gap.

Canada

The National Building Code (NBC), which forms the basis for all provincial codes, does not specifically address energy efficiency. This omission has left it to the provinces to consider MNECB or other energy-related requirements for reference in their own building codes. Currently the use of energy codes is largely voluntary across the country, with municipalities enforcing compliance to different degrees, as described below.

The Ontario Building Code (OBC) 1997 required that large buildings (over 600 m^2) be designed using good engineering judgment, as is defined in a number of standards, including the MNECB and ASHRAE 90.1. 1989. For smaller buildings (less than 600 $m^{2)}$, this Code defined specific energy efficiency requirements, such as minimum levels of insulation for above-grade and below-grade walls. The minimum insulation levels required in the 1997 Code were lower than those required in the previous version, OBC 1990. The OBC has been detached from the objectives of green construction, and its changes in terms of energy performance have been driven more by energy prices than environmental performance.

The OBC 2006 similarly relies on reference to best practices that address large-building energy performance, such as ASHRAE 90.1 2004, MNEBC, and the supplementary standard SB-10 included in the OBC. However, this 2006 version has a new section on resource efficiency, Section 12, that includes specific requirements for increasing energy and water efficiency in housing and buildings of less than 600 m^2.

In British Columbia, code requirements specifying minimum thermal resistance values for insulation were introduced into the BC Building Code in 1992, and then only for houses. The current BC Code (2006) refers to best practices such as ASHRAE to design heating, ventilation and air-conditioning (HVAC) systems and, as in the 1992 version, establishes minimum requirements for thermal resistance values for housing and small buildings. A new code modeled on the National Building Code is in development, and it is expected to have objective base requirement similar to the Ontario Building Code.

Large Canadian municipalities, notably Toronto and Vancouver, have led the field in requiring energy conservation through building design. However, given their distinctive regulatory regimes, the cities have approached this differently. Vancouver is unusual in its ability to establish its own building performance requirements, and it has used this to create requirements for energy efficiency and other aspects of green building. In 1993, Vancouver mandated the use

of toilets using six liters of water or less per flush, two years ahead of the province. As of 2004, all new large buildings must meet ASHRAE 90.1-1999 requirements. Vancouver has also moved beyond energy to comprehensive green building requirements. The City is currently rewriting a number of municipal bylaws which, when complete, will result in all new buildings meeting the majority of credits required for certification through LEED-NC Canada simply by meeting local regulations.

In Ontario, municipalities are not permitted to set any performance requirements above those mandated by the Ontario Building Code. As a result, they have extremely limited regulatory control. Toronto has relied on leading by example (retrofitting municipal buildings), incentives (the Better Building Partnership, and the Toronto Atmospheric Fund), and voluntary standards (the Toronto Green Development Standard). These are discussed in other sections of this paper.

In Alberta, both Edmonton and Calgary have adopted a Sustainable Building Policy that requires large, new, publicly funded buildings to achieve LEED Silver certification.

Standards referenced in Canadian building codes often originate in the United States or are influenced by US standards. ASHRAE 90.1, for example, is still used in many jurisdictions as an accepted energy code. Standard 189 is being watched with interest and will certainly influence the Canadian market.

Codes in Practice

While in many countries code adoption takes place at the national level, with all three North American countries code adoption and enforcement takes place at the local or regional (state or provincial) level. Codes derive their legal authority from their enactment as laws, ordinances, or statutes, and their effectiveness depends on enforcement of those laws. This creates a variety of challenges in the three countries.

United States

While it appears likely that most US jurisdictions will eventually employ the ICC system, in most cases each jurisdiction makes its own determination of which codes and which versions of those codes—if any—to adopt. Many jurisdictions amend the codes they adopt. Amendments may be in response to local or regional conditions, such as high winds, wildfires, or earthquakes, and additions often include appendix chapters for traditional or regional building approaches—for example, use of adobe in the southwestern US states. Federal governments can, however, pass legislation or develop programs that either directly or indirectly supersedes local codes, such as the low-flow toilet requirements included in the 1992 Energy Policy Act.

At the other end of the process, local building officials have the authority to approve alternative designs, materials, and methods of construction as long as these are deemed adequate to meet the intent of the building code. All codes have such provisions for dealing with building practices, materials and systems not specifically addressed in the code. The extent to which a building code hinders environmentally preferable alternatives may depend as much on code interpretation by the local building official as it does on the language of the code itself.

Just as important as the process by which codes are adopted is the process by which they are developed, changed and enforced. Few people are aware that the building code development and change processes are open to the public. Anyone—a business, interest group, or individual—can propose changes to the codes. On an annual basis, all filed proposals go through the same

process—committee review, scheduled hearings, and voting. This process results in many changes to codes every year. Typically, supplements are published annually and then consolidated into a new edition of the code every three years.

Canada

The National Building Code (NBC) provides considerable uniformity across the country. The provinces can, and in many cases do, modify the national code for their jurisdictions, but the similarities remain greater than the differences. The code is written by code users—designers, developers, builders, manufacturers, regulatory officials, owners, and managers—and it represents minimally acceptable construction practice. Code requirements do not necessarily reflect "best" practice—that is, they do not lead the market—but, because of their role as the minimum legal performance standard, they still have an enormous impact on the industry.

The current NBC (released in 2006) is Canada's first objective-based code. This means that, although a complete set of prescriptive and performance-based requirements remains, the objectives or intent for each are also included. This was done both to facilitate discussion regarding future code updates and to provide developers with a clear purpose for each clause, thereby clarifying the requirements for innovative technologies.

The Code Objectives in the NBC are grouped under the categories of safety, health, and fire and structural protection. As an example, under "safety," the NBC states: "An objective of this Code is to limit the probability that, as a result of the design or construction of the building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury due to fire." It then lists where these risks would originate (including "collapse of physical elements due to a fire or explosion"). Intended or not, the wording of the objectives leaves more room for subjectivity on the part of local building officials than does that of the prescriptive or performance clauses in the Code.

The 2006 Ontario Building Code, which is based on the 2005 NBC, adds objectives in a broader range of categories, including specific environmental objectives:

- Under the energy conservation category, the Ontario Building Code states that "An objective of this Code is to limit the probability that, as a result of the design or construction of a building, a natural resource will be exposed to an unacceptable risk of depletion or the capacity of the infrastructure supporting the use of the resource will be exposed to an unacceptable risk of being exceeded, caused by the consumption of energy."
- Under the environmental integrity category, the Ontario Building Code states that, "An objective of this Code is to limit the probability that, as a result of the design, construction, or operation of a building, the natural environment will be exposed to an unacceptable risk of degradation."

These are worthy goals, but it could be argued that these objectives are not met by the prescriptive requirements.

Sidebar: Measures of Performance

Prescriptive vs. Performance-based Codes and Standards
Codes and standards can be based on method (prescriptive) or outcome (performance). Most ICC codes follow a *prescriptive* approach, describing in detail what to do and how to do it. In contrast, the ICC's International Performance Code (IPC), and ASHRAE 90.x are performance-based, specifying the objective being sought but not how to get there. The prescriptive approach is often easier to administer and verify. It is straightforward and relatively easy to implement for both builder and code official, but it can stifle innovation or even require poorer-performing options. Performance-based approaches add a layer of complexity but increase the freedom of designers. The performance approach requires that the proposed designs, materials or methods be supported by calculation, test results or other demonstrations of adequate performance. Building officials must be able to analyze the project rather than just ensure that it conforms to common practices with which they are familiar. Ultimately, neither method is inherently better—each serves a different need.

Modeled vs. Actual
So-called performance-based standards are usually based on modeled performance rather than actual performance. A body of evidence indicates that actual building performance has in many cases not met modeled performance. This gap needs to be addressed. Measurement and verification of performance is an area in need of much improvement.

Total vs. Normalized
Ultimately, the value of any approach—voluntary or mandatory, performance-based or prescriptive, large- or small-scale—lies in its impact on the issue it was originally designed to address. As with measurement of actual building performance, comprehensive review of the impact of policy decisions is often not completed, and there are few or no measures of absolute performance. Relative performance measures, such as "20 percent better than code," or the number of new LEED buildings, are valuable indicators but should be considered in conjunction with measures of total consumption, total emissions, and other absolute measures. Measuring these absolute goals (such as country-level CO_2 reductions) can improve policies by providing feedback or a way to check whether other regulatory or voluntary initiatives are achieving the aim for which they were originally developed.

Barriers to Greening Building Codes

Most building codes were developed to protect the public from fire and other hazards attributed to the built environment. The cautious prescriptive approach of these codes has effectively minimized these risks to people and property. Unfortunately, however, such codes typically ignore the effects of buildings on human health and the environment, including the natural systems on which, many experts argue, everyone's health, safety, and welfare depend. Narrow scope and prescriptive methods hinder environmentally friendly building in a number of ways:

1. **By hindering the use of alternative building materials and innovative design strategies:** Alternative materials and strategies are rarely specifically banned. Instead, they are excluded by default, because they are not included in the prescriptive code. Designers can, and often do, seek variances; however, the time and expense of doing so often discourage this approach. A survey by the Development Center for Appropriate

Technology (DCAT) explored the impact of perceived barriers and found that 65 percent of code users indicated that they have chosen not to include a green alternative because they expected it would not be approved. Code officials may not be knowledgeable about proven alternatives.

2. **By unintentionally requiring environmentally harmful practices:** Building codes often institutionalize modern, resource-intensive ways of building, while older, low-tech systems are excluded. Less common are instances in which the chosen strategy to mitigate a particular immediate safety issue is directly at odds with environmental or health objectives. For example, codes that require "plenum-rated" data cables in commercial buildings may effectively require the use of fluoropolymer cable insulation, and fluoropolymers have recently been shown to exhibit health risks. In another example, the code requirements for flame retardants in foam padding may protect building occupants from fire but cause long-term health problems as these brominated flame retardants escape from those materials into the air and are ingested.
3. **By not imposing requirements for environmentally preferable practices:** Until very recently, there were no requirements regarding a building's use of energy or water or its production of waste. Like all building codes, such requirements would ensure that all buildings achieve a basic level of performance, safeguarding society from potential harm.

Green building strategies that have historically been the most hindered by codes include the use of natural materials, green roofs, and gray water harvesting systems. Many natural materials and methods of construction, such as adobe or rammed earth, are well-established and proven; because they are less manufacturing-based, however, no company has pursued code-listing, so these materials are not automatically approved by codes.

One organization that is tackling all sides of the problem is the Development Center for Appropriate Technology (DCAT) in the United States. DCAT is working to bring a context of sustainability into the codes by promoting the idea that the goals of green building and the goals of code officials are shared: we *all* want buildings that are safe for people and the environment. DCAT argues that we must find a better balance between the need to minimize risk to people in specific buildings and the need to minimize collective risks to the public that result from the cumulative environmental consequences of buildings and the building industry.

Urban Planning and Zoning Laws

The overall purpose of land-use planning and zoning regulations is to ensure that development conforms to acceptable standards as agreed to by the community or a relevant government body. Typically, municipal plans establish vision and intent, in relation to land use, while zoning codifies that intent into legal standards and regulations. Zoning regulations have been used in North America for many decades to regulate everything from the siting of power plants and landfills to setbacks from rivers and wetlands to protect these ecosystems.

Land-use Planning in North America

Variously referred to as town planning, urban planning, and urban design, municipal land-use planning in North America dates back to William Penn's design for the city of Philadelphia, Pennsylvania, in 1682. A few other early examples of comprehensive city and town planning

include James Oglethorpe's 1733 grid of Savannah, Georgia, Pierre L'Enfant's 1791 design of Washington, DC, and Frederick Law Olmsted's 1859 plan for New York City's Central Park. These plans guided the development of their respective areas, generally starting with an open slate.

The Canadian Institute of Planners defines planning as "the scientific, aesthetic, and orderly disposition of land, resources, facilities, and services with a view to securing the physical, economic, and social efficiency, health, and well-being of urban and rural communities." Land-use planning involves a wide range of activities, from architecture and landscape architecture to zoning and transportation infrastructure planning to protection of open space and wetlands. Commonly, zoning regulations, including the delineation of land-use districts, evolve out of land-use planning.

Many aspects of environmental protection and green development have land-use planning at their heart. Providing alternatives to automobile use, such as public transit, pedestrian pathways, and mixed-use development, is an important aspect of land-use planning. Zoning puts teeth into land-use planning.

History of Zoning in North America

The first zoning in North America was adopted in 1916 in New York City in response to the construction of the Equitable Building, which towered over existing buildings and blocked views from windows and access to sunlight. This zoning regulation became the basis for zoning throughout much of the United States. The Standard State Zoning Enabling Act, which grew out of the New York City zoning law, addressed such urban issues as floor-area ratio regulations and air rights.

Not long after New York pioneered zoning in the United States, in 1922 the town of Euclid (near Cleveland), Ohio, adopted a version of the New York City code that addressed the needs of smaller towns and what would soon be called *suburbia*. *Euclidian zoning*, as it is now known, was adopted to segregate different land uses—keeping industrial buildings away from residential areas, for example. As typically adopted, Euclidian zoning creates districts in which certain types of development are permitted and others are not and where allowable development density may vary.

The first zoning law in Canada was adopted in 1924 in Kitchener, Ontario. Early zoning regulations were implemented to ensure that undesirable land uses were prevented from being established in new neighborhoods. In early codes this included limiting access of various racial and ethnic groups.

Zoning as a Benefit or Impediment to Green Building

While zoning regulations are typically adopted with the best of intentions—and some such regulations play an important role in protecting areas such as wetlands and open space—zoning can also be an impediment to environmentally responsible development. The Euclidian zoning found in much of the United States and Canada can make people significantly more dependent on automobiles, because the different land uses (such as residential, commercial, retail, and industrial) are typically kept separate. Establishing such zoning, with its separated land uses,

often makes it impossible to build a grocery store within walking distance of most residential development, and can make walking or bicycling to work more difficult.

In the United States and Canada a movement emerged in the 1990s to address the harm done by Euclidian zoning. This effort has been led by the Congress for the New Urbanism (CNU; online at <www.cnu.org>). The New Urbanism movement (also referred to as neotraditional development) seeks to encourage compact, "walkable" neighborhoods that incorporate diverse, mixed uses with defined greenspaces. This form of development, which is modeled on such pre-zoning cities as Charleston, South Carolina, and New Orleans, Louisiana, helps to build stronger, safer communities in which people get to know their neighbors.

The New Urbanist projects are typically governed by specialized zoning adopted specifically for each project. Traditional neighborhood development (TND) districts are established through regulations designed to ensure compact, pedestrian-friendly development. In some areas, proponents of New Urbanism have succeeded in replacing the conventional (Euclidian) zoning with TND zoning more broadly—not just for specific development projects. This is the case in San Antonio, Texas, and Cornelius, North Carolina, for example.

Discussion and Recommendations

Building codes in the United States and Canada have historically focused on the safety of each building project while largely ignoring greater environmental and human health consequences. Similarly, zoning laws were frequently designed to address specific urban issues, without recognizing the larger implications of those measures. Solutions need to be both structural and educational: they need to educate decision makers about unintended consequences of old regulatory approaches; they need to incorporate these lessons into both the language and implementation of new codes and zoning laws; and they need to ensure that the updating process for zoning addresses new thinking about responsible land use. National plans have the potential to aid in this process, coordinating actions and providing a wider-view of consequences and ambitious goals.

Recommendations:

- **Develop an ambitious national energy plan:** Develop national energy plans at the scale of the US Manhattan Project or Apollo Project to motivate citizens and mobilize resources on the scale needed to address climate and other upcoming challenges. Include funding for high-priority building programs, such as a "Rebuilding America" program for widespread energy retrofits of homes.

- **Expand the scope of building codes:** Shift the focus from solely immediate impacts (such as structural collapse and thermal comfort) to the long-term health and environmental impacts of construction. Increase the authority of municipalities to remove barriers to green development and to require better energy and environmental performance. Facilitate adoption and regular updating of energy codes and environmental building codes. Consider wider adoption of indoor air quality (IAQ) codes, integrating components of passive survivability, and requiring dependable ventilation.

- **Revise codes that are barriers to more responsible, green building:** Fund a process for testing and adopting traditional as well as innovative new technologies and building systems into building codes, even when such technologies and systems are not being advanced by industries that can support code testing. Encourage performance compliance paths to reduce barriers to innovation.

- **Facilitate both standardization and local adaptation of codes:** Adopting national codes can reduce a municipality's costs of administration and enforcement. However this streamlining should be balanced with appropriate regional customization to address climate-appropriate design, local culture, and local economies. Consider, and account for, to the extent possible, unintended consequences of code and zoning requirements. For instance, increasingly stringent and comprehensive international codes may restrict the supply of adequate housing in some low-income areas where traditional building systems are used. A two-tiered code, special financing, or other support may be needed to address this issue.

- **Support effective land-use planning:** Provide funding for grant programs that can be used to carry out planning.

- **Remove zoning regulations that hinder responsible, green building:** Eliminate prohibitions on cluster development, requirements for outmoded and environmentally damaging stormwater management practices, prohibitions on gray water use and rainwater collection, requirements for wider-than-necessary streets and larger-than-necessary parking lots, and requirements for large building lots and even large houses in residential areas (most minimum-house-size regulations have been removed from public zoning as unconstitutional—but they are very common as covenants in private subdivisions or developments). Removing these obstacles to green development allows more progressive practices to be implemented.

- **Promote zoning provisions that encourage responsible development:** Encourage relatively new zoning ideas, such as traditional neighborhood development (TND) districts, which can help to create more pedestrian-friendly cities, protect open space, reduce dependence on automobiles, and foster stronger communities.

- **Use an integrated and comprehensive approach:** Address equipment, materials, codes, land uses, and zoning in a comprehensive manner. This may involve collaboration of federal, state or provincial, and local authorities, as well as independent agencies.

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- International Code Council (ICC): <www.iccsafe.org>

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- *Developing Green Building Programs: A Step-By-Step Guide for Local Governments*: <www.globalgreen.org/media/publications/StepByStep.pdf>
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Sidebar: Product Performance Laws and Standards

Building green goes far beyond the materials used, but selecting environmentally friendly products remains important. The availability and quality of green building products, like the buildings themselves, have improved dramatically in recent years, due to increased market demand, regulatory action, the development of voluntary standards, and other factors. Greening products and manufacturing would fill another report; this summary is meant only to highlight key comparisons and policies.

For products, as with whole buildings, regulatory requirements and voluntary standards play overlapping and complementary roles in driving product improvements. Some efficiency improvements will happen without product requirements, particularly when clear consumer information such as Energy Star labeling (described later) is available to help drive consumer demand. However, as with building codes, minimum-efficiency standards are still needed to ensure a uniform level of basic performance. Efficiency requirements are also needed to overcome market failures, such as fast-replacement purchases, which don't leave a consumer time to carefully review options, purchases by landlords and builders who don't pay the operating costs of the products they purchase, and high first costs for equipment when efficiency features and non-energy features are both considered "extras" for only expensive "trade-up" models.

Laws

US states have frequently adopted stringent product requirements ahead of national standards, sometimes driving manufacturers to favor broader legislation that would create uniform requirements on which to base national product development and sales. Manufacturer aversion to an existing morass of state-level standards eased the way for federal appliance energy-efficiency requirements initially adopted in the National Appliance Energy Conservation Act of 1987, with updates in the 1992 and 2005 Energy Policy Acts.

Also, in an increasingly globalized market, requirements from one country can influence manufacturing processes, product availability, and new standards in other countries. For

example, in 1972, Sweden established maximum flush requirements for toilets at 6 liters (1.6 gallons), creating low-flow toilets that were imported into the United States and eventually prompting Massachusetts to adopt a similar requirement in 1987. The Massachusetts requirement was rapidly copied by other states, 17 of which had 1.6 gallon-per-flush (gpf) regulations in place before the Energy Policy Act of 1992, which took effect in January 1994, established 1.6 gpf as a national requirement.

Shower systems exhibit how the letter of the law can be met while the intent of the law is bypassed completely. The Energy Policy Act of 1992 also established a maximum flow rate for showerheads of 2.5 gallons per minute (gpm). Manufacturers of high-end custom homes have circumvented this limit by installing shower systems with multiple showerheads—some of which use as much as 20 gallons per minute.

Standards

"*The international language of commerce is standards*."—Former US Secretary of Commerce Donald Evans

As is the case with buildings, voluntary standards, certifications, and other screening methods for individual products have helped to drive market demand and to clarify for consumers and tradespeople which claims are substantiated and which are unfounded ("greenwash"). Today, product standards address issues such as recycled content, indoor air quality, energy efficiency, and forestry practices—providing a basis for third-party certification. In addition to single-attribute certification programs, new comprehensive certifications are appearing that cover all aspects of environmental and social responsibility.

The best-known US government–run voluntary standard is Energy Star, which was introduced in 1992 as a voluntary labeling program identifying and promoting energy-efficient products. The program now covers more than 50 product types. Standards are often written with the expectation that they will become more stringent over time.

Increasingly, manufacturers are working together to develop voluntary standards—with the incentives of pre-empting regulation, clarifying green value to consumers, and ensuring that certification systems reflect their products in a good light. To this end, some industries have developed their own standards, which may or may not be as stringent as third-party or government standards. While industry standards may be robust, it is important to recognize that conflicts of interest have the potential to influence the design of standards. The most robust standards are generally considered to be those developed through a formal, voluntary, consensus process, such as ANSI, characterized by openness and due process. However, many of the green product standards currently available are consortia standards, developed outside the formal process. Depending on the development group, these may be more or less stringent than consensus standards. Standards may be defined as first-party, second-party, or third-party, expressing increasing levels of separation between the standard developer and the company and product to be certified. These distinctions have trade implications as well. In the World Trade Organization Agreement on Technical Barriers to Trade (WTO/TBT), purchasing criteria developed in accordance with internationally accepted principles of standardization (transparency, due process, consensus, etc.) are not considered technical barriers to trade.

Their voluntary nature makes the standards palatable to those who want less government interference, but it also means that marketing these programs to consumers must remain a key component so that demand will increase and participation will rise. One way that this is accomplished is through inclusion of these product standards in larger green-building programs and preferred purchasing requirements. Ultimately, the line between mandatory or voluntary programs for the environmental performance of products can become blurred. The Forest Stewardship Council's voluntary standards for wood have made their way into purchasing specifications and mandated performance requirements, while chemical-emissions limits for California have become part of a voluntary industry standard for paint. By developing the technology-leading Energy Star standard and then requiring federal agencies to make their purchases Energy Star–accredited, the EPA has been able to push development and rapid adoption of new technologies.

Consumer Information

While certification programs verify performance, they are not necessarily set up to provide consumers with comprehensive comparative information. The Energy Star label isn't just a checkmark, but provides information on comparative energy use of a product. In addition to complying with the European Union's required CE (*Conformitée Européene)* Marking, which ensures that a product meets all applicable standards and associated information requirements, many companies selling to European markets are also completing environmental product declarations (EPDs). EPDs provide standardized environmental information in the form of brochures that differ by country in appearance but always include: (1) a product description; (2) life-cycle indicators based on ISO 14040; and (3) additional information such as performance expectations, recycling or disposal, and details about risks and toxicity. In the United States, a number of voluntary systems in development (including Pharos and GreenFormat) are attempting to provide more comprehensive consumer information on building products, but full disclosure of environmental information remains the exception.

Summary

In short, requirements eliminate the worst offenders, while both mandated requirements and voluntary standards can be—and have been—used to drive the development of new, greener products. Voluntary standards are often more politically feasible, but their effectiveness depends on clear market demand—which must be built through advertising and education. Mandates do not require the same level of outreach, and they work when market approaches don't. Regardless, there may be industry winners and losers as new technologies supersede old ones—in market share, or by mandate. Industry players may thus actively participate in defining the terms of the mandate or standard to ensure that it is favorable to their technology. As with buildings, whether mandatory or voluntary, the development of stringent performance-based standards that are technology-neutral can encourage innovation without defining market outcomes. However, it can be difficult to achieve an innovation-advancing level of stringency.

Recommendations

Support product efficiency requirements by adopting standards for a wider range of products and harmonizing product efficiency requirements for North America. Regularly re-examine and tighten these standards.

Support development and use of robust third-party certifications, to provide standardization, transparency, and verification of claims, which facilitates comparisons and drives market demand.
Support the process of agreement on voluntary standards, to clarify demands on manufacturers, facilitate trade, and reduce consumer confusion.
Support mandatory labeling, to provide easy-to-use and pervasive consumer information on product sustainability.

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Voluntary Programs

Voluntary green building initiatives from both governmental and nongovernmental groups are transforming the building industry in the United States and Canada. This section describes and explores the effectiveness of such programs, offering recommendations for the future of such initiatives throughout North America.

Voluntary programs that address the performance or quality of products have a long history in North America. For instance, Underwriters Laboratory (UL) was founded in Chicago in 1894 to test and certify products for safe performance. The UL stamp (ULC in Canada) has become a recognized indicator of quality in the manufacturing industry today—and as code bodies began requiring UL certifications on products, UL testing became a de facto standard in many industries. The Good Housekeeping Seal was established in 1912 by the Good Housekeeping Institute, which was an offshoot of *Good Housekeeping* magazine. Both of these were early, voluntary programs to recognize safe, healthy products, and they have served as models for programs aimed at green building.

Single-issue building programs pre-date comprehensive green building programs and are generally simpler to understand and administer. Some of these single-issue programs, such as Energy Star, continue to be important drivers of green building. However, buildings built solely to these standards inevitably ignore other environmental considerations.

As more comprehensive programs were developed, they frequently incorporated existing and developing single-issue standards, while sometimes with different targets. While a number of issues and features distinguish major green-building standards—such as LEED, Building Research Establishment Environmental Assessment Method (BREEAM), and Green Globes—there is also significant agreement over what constitutes best practice in green building. The differences stem more from the development process, philosophy on particular issues, and stringency than from the areas the rating systems consider.

Single-issue Energy-efficient Building Labeling Systems

United States

One of the first government-based voluntary programs to address issues that are now considered part of green building was the Green Lights Program of the US Environmental Protection Agency (EPA). Launched in January 1991, this program sought to encourage corporations to adopt energy-efficient lighting technologies. It was followed by the EPA's Energy Star program, in mid-1992, which originally focused on the energy consumption of personal computers and computer monitors: models that used less than a defined amount of energy could carry an Energy Star logo. Many other products joined the Energy Star program in the following years.

In 1995 the EPA Green Lights Program was merged into Energy Star and Energy Star was broadened to address residences. A recent update of the Energy Star Homes standard requires homes to be at least 15 percent more energy-efficient than demanded by the 2004 International Residential Code (IRC). Energy Star Homes are eligible for Energy-efficient Mortgages (EEMs) from participating lending institutions, allowing potential home-buyers to assume a higher mortgage because monthly energy costs will be lower. In 1999, EPA expanded Energy Star to recognize commercial buildings. To earn the label, a commercial building must score 75 or better—corresponding to the top 25th percentile—in EPA's Portfolio Manager, a Web-based tool that compares the building's energy use after at least one year of operation to that of similar, existing projects in its database. More than 3,200 commercial buildings have now earned the Energy Star label. EPA provides partners with both technical support and recognition. Energy Star, administered by the US EPA and the Department of Energy (DOE), has become the best-known national, energy-performance rating program.

Energy Star has generally opted, with success, for boosting participation in the program over making the standards for eligibility tighter. Lighting upgrades, at the least, have been conferred on more than three billion square feet of commercial space so far—an area equivalent to all the office space in the western third of the United States. Pulte Homes, the largest home builder in the nation, has committed hundreds of homes to the program; thirty plants across the United States are now producing Energy Star homes; and over 725,000 of the nation's new homes have earned the Energy Star label. This sort of market transformation is what the comprehensive green building programs still only aspire to achieve.

Canada

R-2000

The R-2000 program, launched in Canada in 1981, was one of the world's first voluntary building-rating programs. The program was developed by a partnership between the Canadian Home Builders Association (CHBA) and Natural Resources Canada (NRCan).

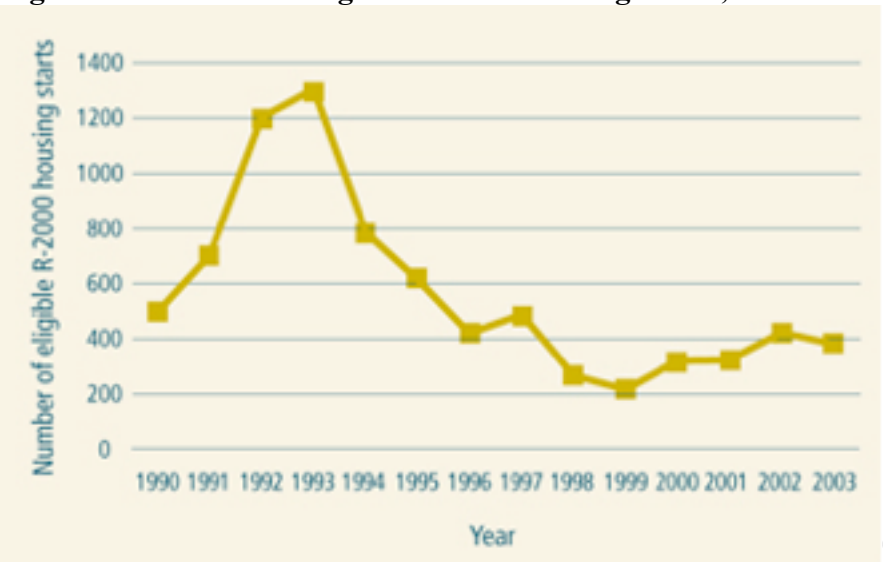
The R-2000 Standard uses performance targets for energy, with a particular emphasis on reducing heat loss and air leakage. Energy targets, calculated using an approved simulation software program (HOT2000), are tailored for each specific home, based on its size, fuel type, lot orientation, and geographic location. Air-leakage performance is confirmed for each house

through on-site testing. Modification pursuant to R-2000 targets results in about 30-percent energy reduction, compared with energy use in a conventional, minimally code-compliant home.

In recent years the Standard was expanded to address design measures beyond energy, including higher-quality ventilation; products with low levels of harmful chemicals, dust, and other indoor air quality pollutants; and strategies to reduce potable water use. These issues were incorporated into the Standard by adding a prescriptive "pick list" of acceptable products and systems.

When first launched, R-2000 was combined with a significant incentive of $1,000 per house, and NRCan and CHBA actively marketed the program. It was most successful in the early years, likely due to these measures (see Figure 3).

Figure 3: Number of Eligible R-2000 Housing Starts, 1990–1993

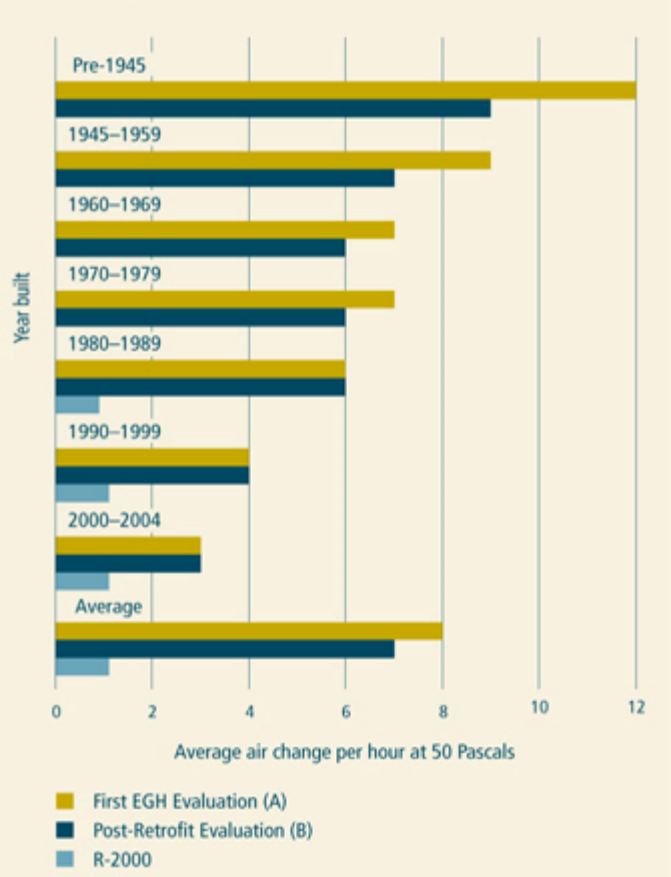


Source: *Improving Energy Performance in Canada*. Report to Parliament under the Energy Efficiency Act, 2003–2004. Online at <http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/parliament03-04/chapter4.cfm?attr=0>.

The on-site air-tightness testing requirement remains unique to R-2000. Most building-assessment programs rely on predicted, rather than actual, performance. The R-2000 program is likely responsible for the air-barrier expertise in the Canadian housing industry, which seems well ahead of the industrial, commercial, and institutional sectors. Compliance testing had a positive impact on the market. However, large builders complain about the risk of failure in some number of houses in a development, which creates problems for the marketing department (or potentially costly rework on the failed houses).

Figure 4 shows national air-leakage trends for periods up to 2004, during which the air-tightness requirement for R-2000 was about 1.1 air changes per hour (ACH), at 50 Pascals (Pa) pressure difference.

Figure 4: National Trends in Air Leakage, pre-1945 to 2000–2004



Source: *Improving Energy Performance in Canada*. Report to Parliament under the Energy Efficiency Act, 2003–2004. Online at <http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/parliament03-04/chapter4.cfm?attr=0>.

Canada EnerGuide

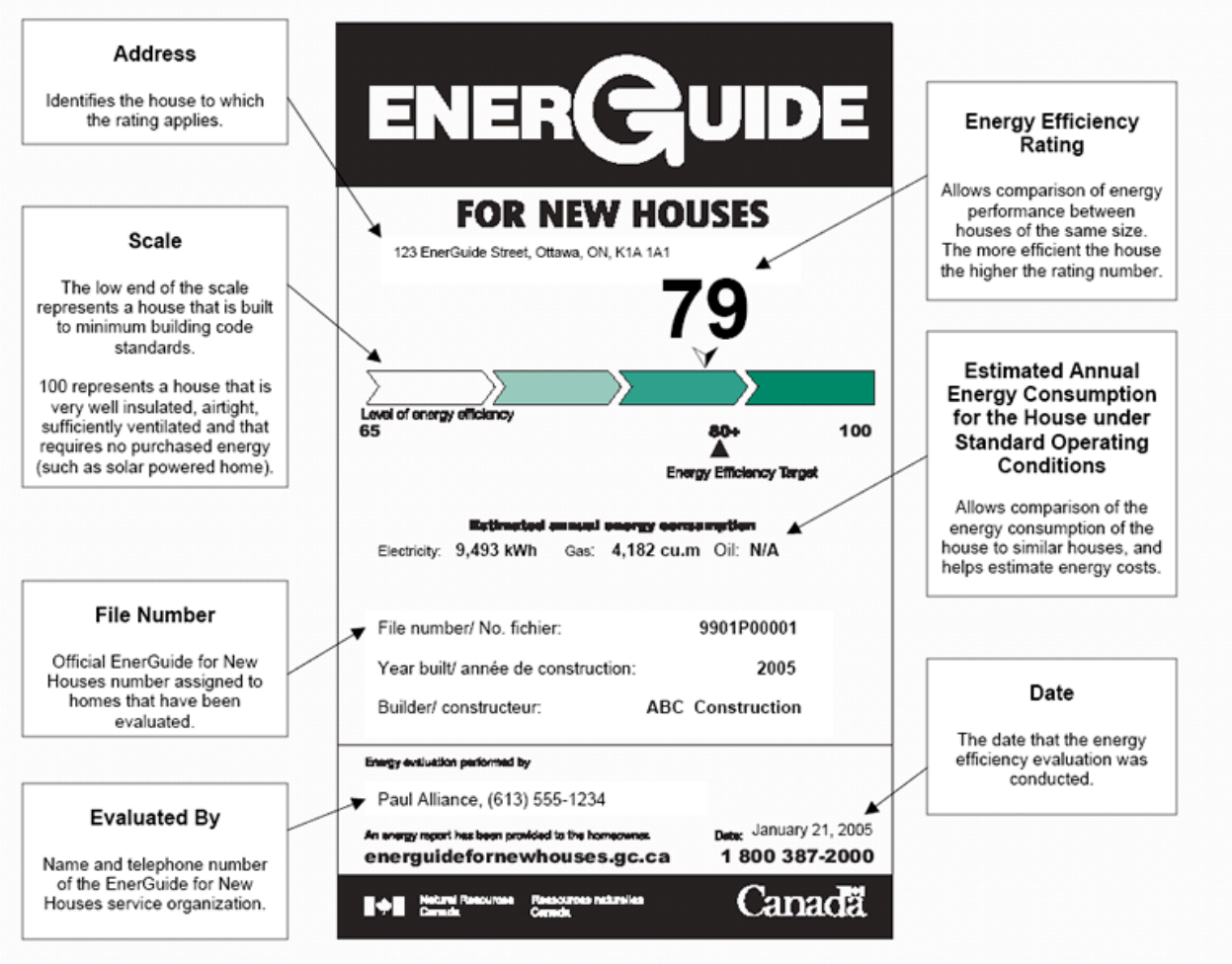
EnerGuide is an energy-labeling program developed by Natural Resources Canada (NRCan) to communicate to consumers the impact their purchasing decisions have on energy consumption. EnerGuide programs have been developed for household appliances, heating and cooling equipment, houses, and cars (see <http://oee.nrcan.gc.ca/energuide/index.cfm>). EnerGuide labeling is mandatory for some products (primarily household appliances) but remains voluntary for houses (see Figure 5).

EnerGuide for new homes consists of an energy analysis of plans, proposed energy efficiency upgrades, and verification by inspection and testing before a rating between 0 and 100 is determined. The service is provided by evaluators who have been trained and licensed to practice with organizations listed by NRCan. EnerGuide for homes is being replaced by EcoEnergy for Buildings and Houses.

The 2006 Ontario Building Code requires that, by 2011, all new homes achieve an EnerGuide Rating of 80 or more. This is the energy performance requirement associated with achieving certifications for both R-2000 and Energy Star for New Construction. Other provinces may

consider similar upgrades in new codes being adopted across the country (subsequent to the release of the National Building Code 2005).

Figure 5: The Energuide for New Houses Label



Source: Natural Resources Canada, <http://oee.nrcan.gc.ca/residential/personal/new-homes/upgrade-packages/label.cfm?attr=4>.

Canada Energy Star for New Homes

Energy Star is a certification mark originally developed in 1992 by the US EPA (see above). The certification was first applied to New Homes in Canada in 2001. The energy efficiency measures required for certification typically include upgrades from standard code requirements for insulation, windows, envelope, air barriers and air sealing, and efficiencies of heating, air conditioning, and domestic hot water as well as installation of certified Energy Star appliances. A new home constructed to an EnerGuide rating of 80 (2007), and incorporating certified appliances will achieve Energy Star for New Construction certification. The program was launched in Ontario in 2005. Since its inception the program has grown to hold an annual new construction market share of nine percent (Office of Energy Efficiency, 2006 Trades Report). Nationally in 2006, over 800 Energy Star–qualified homes were constructed, and the logo is very well known in the market place.

Recognizing a gap in the market, there have been discussions regarding creating an Energy Star program for multi-unit residential buildings, but this is still at a preliminary stage.

EcoEnergy, formerly Canada Commercial Building Incentive Program (CBIP)
CBIP was developed as an incentive program and, as such, it is discussed in more detail below in the section on financial mechanisms. However, it is important as a voluntary program in that it has defined a process for certifying the predicted energy performance of large buildings (it has been used for hospitals, schools, multi-unit residential buildings, and office buildings). CBIP, and now EcoEnergy, provides a detailed protocol for using the EE4 simulation software to compare a building as designed to a similar building designed in minimal compliance with the Model National Energy Code for Buildings (MNECB); 25 percent better than code has been the threshold for CBIP funding, although the funding was recently canceled.

Comprehensive Green Building Assessment Programs

US LEED

Anyone looking into green building in the United States will quickly discover the LEED® rating system. Leadership in Energy and Environmental Design (LEED) has transformed the US building industry. The program experienced exponential growth, expanded into Canada with a slightly modified version, and is now moving to other countries. The LEED rating system is a method for providing independent verification of environmental performance for buildings. At its core, LEED is a checklist of credits for green building attributes, developed through a consensus process.

LEED's origins can be traced to an earlier environmental certification system for buildings, the Building Research Establishment Environmental Assessment Method (BREEAM), which was launched in 1990, and a Canadian version of BREEAM known as the Building Environmental Performance Assessment Criteria (BEPAC). BEPAC was launched in 1994 but never fully implemented due to its complexity. Inspired by BREEAM and the developing BEPAC, David Gottfried became a driving force for a rating system in the United States. Gottfried founded and chaired the American Society for Testing and Materials (ASTM) Green Building Subcommittee (ASTM E50.06) in 1992, then left to found the faster-moving US Green Building Council (USGBC) in 1993, drafting a proposal for a green building rating system that was one of five initial issue papers presented at the Council's first meeting. When work on a US rating system began in 1994, the Council initially considered the idea of working with BREEAM to create a US version, but instead began developing a new rating system, which acquired the LEED name in 1996. Rob Watson, then with the Natural Resources Defense Council and on the board of USGBC, took the lead with this development.

The Committee generated several drafts for review, but even after version 1.0 was officially adopted by the Council there were lingering concerns. Also, the Council lacked the resources to roll out a full program, so pilot projects to test the system were solicited at the Council's August 1998 meeting. The first twelve buildings were certified to LEED 1.0 on 30 March 2000, before the USGBC formally released version 2.0 in May 2000. The latter has been followed over the years by a number of further revisions in the continuously evolving system.

During this time, USGBC has also developed a suite of other rating systems for different building types, in addition to the original LEED (now LEED for New Construction, or LEED-NC), and building type–specific Application Guides for: campuses, retail spaces, healthcare facilities, labs, lodging, volume-building programs (in which one design is used for many buildings), and multifamily residential buildings. These systems and guides are developed by volunteer committees along with help from USGBC staff and are informed by other systems. For example, the healthcare initiative is being informed by the "Green Guidelines for Healthcare Construction," which is being developed by a consortium convened by the Center for Maximum Potential Building Systems, of Austin, Texas. The Application Guide for Labs has strong participation from the Labs for the 21st Century program of the DOE and EPA. Meanwhile, other organizations are building on the LEED system as they reference it for their own purposes. The World Green Building Council supports national green building councils around the world, many of which have developed locally appropriate versions of LEED.

LEED development in practice

As LEED began gaining traction in the marketplace, the policies it contained became subject to more scrutiny and criticism from stakeholders. Complaints ranged from controversy over specific issues and concern that the accreditation process for LEED professionals was lax to concerns over excessive paperwork requirements. As a volunteer-based and consensus- driven organization, USGBC's response has been to develop committees to address concerns and bring large decisions to member ballot. The consensus process means that USGBC, a nonprofit organization of architects, construction companies, product manufacturers, engineers, consultants, and many others, is required to address all member concerns. For example, before version 2.0 was accepted, LEED was revised to address the California Energy Commission's concern that any building built to code in California would meet the energy prerequisite for LEED certification because that prerequisite was no better than California's Title 24 requirement.

USGBC has also adjusted the LEED process to reflect member and user feedback. In response to charges that people with limited knowledge of and experience in green design were gaining LEED accreditation, the Curriculum and Accreditation Committee developed a new exam to meet third-party standards for professional accreditation. Feedback about burdensome documentation requirements prompted the revisal of the application method in 2002 and a major software development effort aimed at accepting and processing applications online.

As LEED continued to grow, so did the scrutiny. In October 2005, two members of the LEED community, Auden Schendler and Randy Udall, wrote an article entitled "LEED Is Broken; Let's Fix It," which put into words a number of complaints within the building industry. These included the program's cost, complexity, and bureaucratic requirements, as well as a disconnection between point allocation and actual environmental benefit, which is exhibited through "point mongering" and inadequate prerequisites for credit in fundamental areas like energy efficiency.

Many of the concerns about LEED have been addressed. At USGBC's November 2006 Greenbuild conference, CEO Rick Fedrizzi announced that, provided it was approved by member ballot, all new commercial LEED projects would be required to reduce emissions by 50 percent compared to current emissions levels, and that all projects would have to achieve at least two out of a possible ten points for the building's energy efficiency. There are great hopes that LEED version 3.0 will address a number of other concerns.

LEED was not, and is still not, perfect. One of LEED's great strengths, however, is its means for addressing complaints. LEED is continually improved through member effort. Still, some problems are difficult to overcome because of the nature of the rating system or the development process used. Streamlining LEED has proven consistently difficult. While, in general, members want to keep LEED simple, when choosing the best solution for any particular issue, they tend to vote in favor of the more technically robust and complicated solution. The cost of certification and the time required to prepare an application will continue to be barriers for many—creating the so-called "shadow-LEED" of design teams using the system as a guide or internal requirement without going through formal certification. While the use of LEED in this manner is still advancing green building, it confuses the market, and the lack of verification may limit the success of green strategies. At the other end of the spectrum, some developers wishing to capitalize on market demand for LEED may direct funds toward ensuring LEED certification at the expense of additional green features, and cherry-pick credits based on the cost to achieve them rather than on design appropriateness. The rating system allows a design-by-checklist approach. For example, once a design team has determined that they will not pursue a certain credit, the system provides no incentive to the team to at least do what they can in that direction. Similarly, once the threshold for a credit is met, there is no incentive to do even better.

As checklists go, however, LEED is remarkably sophisticated, having benefited from countless hours of work (mostly volunteer) from leading green architects, engineers, contractors, and other professionals. LEED includes a few open credits for innovation, which, while adding work for application reviewers, greatly enhance its flexibility.

BREEAM Canada and Green Globes

BREEAM was developed and launched in the UK in 1993 and has been successfully administrated by the Building Research Establishment (BRE) there since. It is one of the original whole-building assessment systems and has influenced the development of other systems across the world. Some countries, including several in the Asian Pacific, have adopted it for use in their jurisdictions.

The development and administration of BREEAM Canada, and its evolution into Green Globes, have been led by Jiri Skopek, of ECD Energy. In 1996, Environment Canada and ECD Energy modified BREEAM for Canadian use as a Canadian Standards Association (CSA) standard. The CSA publication was a valuable introduction in Canada to green building assessment, but the use of the document in assessing buildings was limited. The process proved to be too complicated, and too early for the market. To address the complexity concern, ECD Energy and Environment Canada worked with TerraChoice to develop a more streamlined, question-based tool, which was introduced as the BREEAM Green Leaf eco-rating program. This program was used more

actively by government agencies such as Public Works Government Services and the Department of National Defense.

In 2000, BREEAM Green Leaf took another step in simplifying the certification process by launching an online process under the new name Green Globes. The original Green Globes was a very effective tool in that it was easy to work with; it allowed design teams to work individually online, focusing on their areas of influence on the issues relevant for each phase of the project. However, given that the program was managed by a private consulting firm and was missing a well-developed verification process, the system lacked credibility in the market.

In its latest iterations, Green Globes has addressed the credibility concerns. Its existing-buildings system has been adopted by BOMA Canada (Business Owners and Managers Association), giving it improved marketing and credibility. The Green Building Initiative (GBI) acquired the rights to distribute Green Globes in the United States and, as part of this, has begun the process of establishing Green Globes as an official ANSI standard. BOMA Go Green has been offered for just over a year, and almost 500 buildings have been certified.

BEPAC

The Building Environmental Performance Assessment Criteria (BEPAC) is a method developed to evaluate environmental performance of new and existing buildings. It was developed in the UK in 1987, for researching energy performance of buildings, as well as for developing modeling and education tools to improve environmental building performance. In 1993, Ray Cole and others developed and launched a Canadian version.

BEPAC laid the groundwork for many of the subsequent green building assessment tools, including LEED. BEPAC was conceived as a set of environmental criteria to assess building performance. These criteria were frames in five categories: Ozone Layer Protection, Environmental Impacts of Energy Use, Indoor Environmental Quality, Resource Conservation, and Site and Transportation. The credits were organized within four modules differentiating the base building from the future use and the modifications performed by tenants: base building design, base building management, tenancy design, and tenancy management.

Each one of the criteria could obtain from 0 to 10 points. The points in the categories of Ozone Layer Protection and Environmental Impacts of Energy Use were awarded over a continuous performance assessment, and in the remaining categories the points were given if the required features were present in the building. A weighting factor was assigned to the different points assessed to highlight their relevance within each category or the effort required to achieve the credit.

The system of assessment categories incorporated in BEPAC reflects the urgency there was to address problems that were critical at the time it was created (in the 1990s), such as ozone layer depletion. The system also added an extra level of rating complexity by differentiating between the different stages in the life span of the building: base building construction, and long-term tenant use. This extra level of assessment is being incorporated in the recently released LEED

Rating System for Commercial Interiors, and also in LEED Core & Shell, a rating system focusing on the cores and shells of buildings.

BEPAC has had significant impact on subsequent programs but it did not see wide use as an assessment tool. Handicaps that were subsequently identified included the complexity of the messaging (there was not a simple indicator such as LEED's Silver or Gold classes), and allowing evaluation by proprietors.

Canada LEED

The USGBC version of LEED has been in use in Canada since 2002. Since that time nearly 400 buildings have been registered. In 2004, the Canada Green Building Council launched LEED Canada NC v1.0 under license from the US Green Building Council. LEED Canada was very similar to LEED-NC in the US. Canadian Standards were referenced where possible and some minor changes in performance thresholds were made.

The Canada Green Building Council (CaGBC) has negotiated a new arrangement with the USGBC that allows much greater autonomy regarding the development of LEED Canada. Canada's LEED Complete is now in development and expected to be launched, in pilot, in 2008. This system will provide a more interactive process, providing assessment at completion of design and construction, as well as after a one-year post-occupancy evaluation.

What Is Next?

Issues that all systems will be dealing with in upcoming years are (1) improving the link between rating system scores and actual environmental benefits, (2) making the system simpler and less costly to administer, and (3) increasing market penetration.

With regard to improving the link between rating system scores and actual environmental benefits, two main areas of future work are: incorporating life-cycle assessment (LCA) into rating systems, and increasing the extent to which rating systems are performance-based.

Both USGBC and GBI are considering how to integrate LCA into their systems. A likely approach, being championed in both rating systems by Wayne Trusty, president of the Athena™ Sustainable Materials Institute, is to allow designers to select commercial and residential building assemblies from a library of assemblies that have been rated using LCA software, and earn points based on the LCA results for those assemblies. In February 2007, GBI announced completion of a library of 400 assemblies rated with Athena's Environmental Impact Estimator (EIE) software.

With regard to performance-based systems, it may be a contest that shows the way to a radically different approach. The US EPA's Lifecycle Building Challenge seeks to encourage innovation in buildings designed for adaptation and disassembly, with the aim of eventual full recovery of systems, components, and materials. The Living Building Challenge put out by the USGBC Cascadia Chapter attempts to raise the bar to define a true measure of sustainability in the built environment. Instead of a point-based system, the Living Building Challenge consists of 16

performance requirements, all of which must be met for a building to earn certification. This means that, according to the Cascadia Chapter, while the challenge is difficult to achieve, understanding and documenting compliance is inherently easy. Some of the requirements in version 1.0 of the Challenge are indeed both simple and ambitious. Examples include: "Net Zero Energy: 100 percent of the building's energy needs supplied by on-site renewable energy on a net annual basis;" "Net Zero Water: 100 percent of occupants' water use must come from captured precipitation or reused water that is appropriately purified without the use of chemicals;" and "Sustainable Water Discharge: 100 percent of storm water and building water discharge must be handled on-site." However, other, more complicated requirements involve materials selection and use; these include indoor air quality requirements, transport limitations, and construction waste management, and some feel that the Challenge could go even further.

Simplifying and reducing the cost of rating systems is complex. While this is everyone's goal, in practice it can mean unacceptable compromises, such as choosing less robust procedures, lowering the comprehensiveness of third-party review, or eliminating criteria that some consider critical. Alternately, the development of streamlined tools and the continued education of users can make a complex process faster and easier. In addition, there may be a role for more and less complex systems, provided it is clear they serve different niches and the market is not confused by efforts to make them commensurate.

Each major system attempts in its own way to address these concerns. It may be that these programs ultimately serve different niches in the marketplace, some serving a wider market, or different concerns, while others provide the most rigorous and trusted program. The existence of multiple systems could increase competition, thus driving improvements to the systems, but without sufficient differentiation it could also confound the market, preventing the apples-to-apples comparison that comprehensive systems were intended to provide.

Residential Green Building Programs

In 1991, the City of Austin, Texas, developed and launched the first residential green building program. Today, there are more than 40 local programs,[1] a handful of regional ones, and two national residential green building programs.

In general, the most successful voluntary programs have been those developed with input from a wide variety of vested interest groups—builders, government agencies, nongovernmental organizations, and product manufacturers. The groups have learned the language and challenges of each other's approaches to resource efficiency and conservation in the built environment. The result has been consensus-based programs that have broad-based credibility with the general public.

Most programs have benefited from seed funding during their program development and early implementation, with program fees for registered homes covering only a portion of a program's ongoing operation. Either private- or public-sector sponsorships (or public-private partnerships) remain essential to the sustainability of most if not all residential green building programs.

[1] The United States Green Building Council maintains a list of residential local green building programs online at <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=147>.

Programs vary widely in their structure (single-level or multi-tiered, with prerequisites or not), the nature of their criteria (prescriptive or performance-based, or both), and their certification process (builder self-certification, random spot checking by program technical staff, or third-party independent verification). The simpler programs—single-level, prescriptive criteria, and self-certification—are naturally the least expensive to implement.

Market penetration of green building programs also varies widely, but it is clear that green building has experienced not only rapid growth in several markets but staying power as well. This burgeoning growth of local green building programs over the last ten years has spurred the development of two national residential green building efforts—USGBC's LEED for Homes program and the National Association of Home Builders' (NAHB's) Green Building Guidelines (being promulgated by GBI). While the former effort is largely being championed by the architectural design community, the latter process is primarily driven by homebuilder associations and their builder members.

In a February 2007, NAHB and the International Code Council (ICC) announced an initiative to standardize the residential green building process nationwide. These two organizations are partnering to develop an American National Standards Institute (ANSI)–approved residential green building standard slated for completion by the end of 2008. While USGBC has gone to great lengths to reassure the residential building community that its LEED for Homes program is not intended or designed for codification, the typically standards-shy NAHB has opted to lead an effort with ICC that will accomplish exactly that.

Sidebar: The Elephant Is the Room—Tackling House Size

In the United States and Canada the average energy consumption per square foot of residential building space has significantly decreased in recent decades. However, overall energy consumption has continued to increase as efficiency improvements are eclipsed by increases in average home size. Since 1950, the average house size in the United States has more than doubled, even while the average family size has steadily shrunk. A 2007 NAHB survey on the "Home of the Future" suggests that this trend may be turning around,[2] but it remains a concern worthy of much greater attention than it typically gets—in itself, and also as an example of how relying solely on normalized measures like energy use per square foot can be problematic, as it is the totals that tell of the real environmental impact.

Historically, zoning regulations, restrictive covenants, and design standards for specific subdivisions have been more likely to discourage than encourage small housing. In the La Marche Place neighborhood in the 3,400-acre (1,400 ha) Wooded Hills subdivision in Little Rock, Arkansas, for example, single-level homes must be at least 2,600 square feet (242 m^2) and multilevel homes at least 3,000 square feet (279 m^2). Mortgage bankers can also *in effect* specify a minimum size for new homes by mandating ratios of house value to land value, or simply because the appraiser can't find small comparable houses. Prior to 1998, US capital-gains tax

[2] National Association of Home Builders, <www.nahb.org/news_details.aspx?newsID=4143>.

policy encouraged larger houses by requiring a family selling a home to buy a new home of equal or greater value within two years to avoid a capital-gains tax on appreciated value.

There are also examples, however, of both zoning regulations and restrictive covenants on subdivisions that specify maximum house size. Older restrictions tended to address stormwater management, but more recent restrictions have been implemented by communities to limit the trend toward so-called McMansions or starter castles.

The most radical strides in accounting for house size were taken with the Vermont Built Green (VBG) certification program piloted in 2003. In VBG a matrix listed the average size of houses by the number of bedrooms, with points awarded for smaller-than-average houses, and subtracted for larger-than-average houses. In the pilot version, one could gain VBG certification solely by meeting the minimum requirements of the program and building a very small house, whereas a home that was twice the average size might have to earn twice the number of points for VBG certification. More recently, recognizing the value of LEED's name recognition and greater resources, the developers of VBG worked with USGBC to incorporate features from VBG into the LEED for Homes program. Among these changes, LEED for Homes now considers house size, with some differences. The LEED program provides less benefit or penalty at the extremes of small and large house size, but uses a smaller neutral point, thus requiring the currently oversized average house to make more green improvements for certification. According to Jeff Gephart at Efficiency Vermont, the LEED system also makes it impossible for an extremely large home to achieve a Platinum rating.

Discussion and Recommendations

- **Expand the reach of green building rating systems:** Require the certification of government-owned buildings (see the section on government purchasing).
- **Support the continuous improvement of rating systems:** Improve the direct link between rating system scores and their tangible environmental impacts by using life-cycle analysis and performance-based assessment. Simplify the certification process, to increase market penetration, while maintaining credible results.
- **Fund research that will improve future versions of green building rating systems:** (see Technology Development). Needed research includes the development of robust LCA databases for North America.
- **Target residential remodeling:** Place a high priority on reaching the residential remodeling market. Existing houses in North America account for a large percentage of total energy used by buildings, and significantly reducing energy use in existing buildings is a considerable challenge.

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Financial Mechanisms

While financial and market issues are the topic of different background papers (Background Papers 2a, b, and c, on "Towards Sustainable Financing and Strong Markets for Green Building," expanded reports based on presentations at the Green Building in North America International Symposium, Seattle, May 2007), governments can influence the economics of green building in major ways. Broadly categorized, these include providing direct monetary or in-kind incentives, using the fiscal "steering wheel" of taxes and subsidies, and providing the targets and structure to create new markets, such as a carbon-trading system. Direct incentives and subsidies can provide a swifter boost to green building and be put in place at smaller levels of government. However, the larger actions of tax shifting and developing emissions-trading markets have the greatest potential for ensuring that green building and associated environmental technologies and practices increasingly become the norm.

Direct Government Incentives for Green Building

In the United States, various federal tax credits encourage certain aspects of green building. The Energy Policy Act of 2005 includes both tax deductions and tax credits to spur investment in energy conservation and renewable energy sources. Commercial building owners may obtain tax deductions up to $1.80 per square foot for investments in energy improvements to the building envelope, lighting, and mechanical systems that result in 50-percent energy savings compared with ASHRAE 90.1-2001.

More valuable are the Energy Policy Act's various tax credits. For commercial buildings, these include a 30-percent tax credit on solar energy and fuel cell equipment and a 10-percent tax credit on microturbine power plants. Builders of new homes that use less than 50 percent of the energy of a standard house are eligible for a tax credit. For homeowners, the law provides tax credits of up to $500 for various energy-conserving building components and appliances (including windows, roofing, insulation, mechanical equipment, water heaters, and circulation fans). The law also provides homeowners with tax credits equal to 30 percent of the cost of certain solar energy systems, up to a maximum credit of $2,000 per household. The law's tax deductions and tax credits expire at the end of 2007, though the renewable energy tax credits have been extended through 2008.

Different legislations in the United States provide production tax credits for businesses that build renewable energy systems. Technologies covered include wind, photovoltaics, geothermal, biomass, landfill gas, and trash-to-energy. This production tax credit currently extends through the end of 2008, and many observers consider further extensions likely. The law currently provides a tax credit of 1.8¢/kWh on electricity generated.

At a state level, about 15 states offer tax breaks of various types for renewable energy equipment. A number of states offer attractive renewable energy tax credits and rebates. The federal tax credits apply only to costs after state rebates or credits have been subtracted. While

most tax incentives are fairly specific, some state and local tax incentives are broader and based on the LEED rating system of the US Green Building Council.

In Canada, government-initiated financial incentives for reducing environmental impacts are poorly coordinated. Provinces provide rebates, grants, or sales tax exemptions on a variety of different products, and most of the provincial energy producers have programs that will help customers upgrade to more efficient systems in their homes. Federally, commercial interests are supported by initiatives towards more new-home building or retrofit, but there is not in place a comprehensive federal act directed at individuals, like the Energy Policy Act in the United States.

While governments in Canada have not typically used tax credits to promote green development, there is increasing interest and some existing programs. The federal government allows an accelerated capital cost allowance at a rate of 50 percent to encourage businesses to conserve energy and to use renewable energy. Eligible investments include cogeneration and alternative fuel generation as well as active solar, micro-hydro, wind, and geothermal systems. The Canadian Renewable and Conservation Expenses program allows the write-off of renewable or energy-conservation feasibility studies.

Incentives and grants are the most common financial mechanisms implemented by Canadian governments and utilities. Canada has defined incentives as monetary compensation in cases where value increases as higher standards (typically in energy) are achieved. Often, local jurisdictions attach additional incentives to existing voluntary performance programs.

In 1998, Natural Resources Canada (NRCan) launched the Commercial Building Incentive Program (CBIP), which provided financial assistance of up to $60,000 for the design and construction of each energy-efficient building. The CBIP incentive was awarded as a single payment equal to twice the predicted annual energy savings of the building as designed, compared with the estimated annual energy costs if the building were constructed to simply comply with the Model National Energy Code for Buildings (MNECB). In order to be eligible, a project had to demonstrate a minimum performance advantage of 25 percent over that of the MNECB reference building. Designs were evaluated using EE4, a simulation software package based on DOE-2.

CBIP has increased the expertise in energy-efficient design of industrial, commercial, and institutional buildings in Canada. It has also almost exclusively created an energy simulation industry. The CBIP program has provided more than $40 million in incentives to more than 900 projects nationwide. In 2005, CBIP buildings accounted for 18 percent of new commercial and institutional floor space (Office of Energy Efficiency, 2006 Trades Report).

Similar to the R-2000 program, other agencies added incentives to the national program. Toronto's Better Buildings Partnership contributed an incentive for projects in its jurisdiction. The Canada Green Building Council adopted the CBIP simulation and verification process for confirming energy performance. The program was discontinued as of 31 March 2007, but is being replaced by EcoEnergy.

Sidebar: Performance-based vs. Cost-based Tax Credits

Experience with solar tax credits in the United States has exposed problems with incentives based on the cost of a renewable energy system rather than on the energy that system delivers. The solar program in the 1970s and 1980s provided a 40-percent solar tax credit, up to $4,000 per household. Many unscrupulous companies dramatically inflated the costs of solar systems, charging $10,000 so that homeowners could earn the maximum tax credit of $4,000. Some companies even provided special kickbacks to homeowners, such as expense-paid vacations worth several thousand dollars, as incentives to get them to sign up. These solar systems performed poorly and should have been priced at $2,000 to $3,000. Everybody ended up losing, except the solar companies that made off with large short-tem profits. This sort of fraud gave solar energy a bad name and nearly destroyed the industry.

Far better are tax credits or other incentives based on the energy that a system actually delivers (or saves). This is how the US renewable energy production tax credit of 1.8¢/kWh works, and it is how all tax credits for renewable-energy systems should work. Such a credit design encourages systems that produce maximum energy at a minimum cost. It encourages high-performance systems while weeding out sales-only companies that lack good technologies.

In-kind Incentives, Grants, and Special Funding

Non-tax monetary incentives include direct grants and rebates as well as lower building permit and zoning fees, and permit fee rebates for green projects. Grants and special funding are typically used for initial demonstration projects; however, Cincinnati, Ohio, and Santa Monica, California, provide funding to a range of projects achieving LEED certification. Governments can also work with local institutions to provide more attractive lending rates, preferential insurance rates, or the waiver of certain requirements when financing green projects (these programs are discussed in detail in the Financial Mechanisms section, above).

In addition to offering direct financial incentives and tax credits, many state and local governments have begun to include non-monetary benefits in their green building programs. Incentives that speed project completion or allow a higher build-out than is normally accepted can significantly increase the value to the developer of building green at a minimal cost to government. Incentives that provide technical green building training, support, and education, or that provide free advertising for projects that achieve a set level of performance, can play an integral educational role in a government green building program.

Expedited permits or priority plan review for projects achieving a certain level of LEED certification are part of green building programs in San Francisco, California; Santa Monica, California; Sarasota County, Florida; and Issaquah, Washington. King County, Washington (see sidebar), Scottsdale, Arizona, and other municipalities include similar benefits for projects reaching locally defined green building targets. With up-front incentives like priority review, there must be a way to ensure that a building achieves the performance for which the incentive was given. With Scottsdale's original expedited permit process, some developers enrolled in the voluntary green building program got their plans approved, got the expedited permits, and then

pulled out of the program or simply failed to follow through on the green aspects of the building. To give more enforceability to the inspector, Scottsdale amended the building code so that once a building was enrolled in the program, the green building program requirements became an enforceable part of the building requirements and a required part of construction documents—thus mandating follow-through. To get out of the program, a builder would have to revise and resubmit the plans, which would be re-reviewed at an hourly fee.

Density bonuses, awarded according to criteria which can include number of buildings per acre, increased height, or number of floor limits for certain levels of LEED certification, are part of programs in Acton, Massachusetts; Arlington, Virginia; Seattle, Washington; and others. Providing density bonuses can make sense for cities, while serving as a significant incentive to the developer; green buildings use less water and energy than typical constructions, so the demands on city infrastructure may be reduced relative to typical development. Some cities for which water scarcity is an acute problem have made water conservation an explicit part of negotiating for permits or awarding density bonuses.

States, cities, and counties have developed a range of incentive packages for private green building, often including a variety of benefits and support, and requiring greatly differing levels of stringency. Cranford, New Jersey, has gone so far as to allow developers to request a particularly desired incentive, such as a density bonus, for achieving LEED certification. The introduction of such packages is typically the second step in a government's green building efforts, following the establishment of rulings that government buildings meet green standards like LEED. States and municipalities that include green requirements in their building codes have typically preceded those requirements with education and benefits packages, to help local developers and tradespeople gain interest and expertise in green building.

In Canada, as with financial incentives, in-kind incentives and grants are often linked to existing programs. Calgary and Strathcona, Alberta, offer permit-fee reductions linked to Built Green and R-2000[3], from 10-percent reduction for Built Green Bronze certification, to 30-percent reduction for Built Green Gold certification or, in Strathcona only, for R-2000 certification. The R-2000 Home program was initially supported by an incentive of $1,000 per house, with other organizations providing linked, in-kind incentives and grants soon after its launch: Manitoba provides free filing for R-2000 certification; Strathcona County provides a 30-percent rebate on building permit fees for R-2000-certified homes; Newfoundland Power provides CA$10,000 in financing for R-2000 homeowners, to aid in the construction of their home, which is repayable over time, with interest, through their utility bill. Over time, rebates have been discontinued, and there has been a significant drop in the number of certified homes.

In 2002, the federal government implemented the Pilot Emission Removals, Reductions, and Learnings Initiative (PERRL) to buy verified greenhouse gas reductions at a fixed price. This is a relatively small fund (C$15 million), with the objectives of providing incentives for reducing greenhouse gas emissions and increasing awareness and understanding of emissions trading.

Lending programs include the Canada Mortgage and Housing Corporation's Mortgage Loan Insurance premium "green refund," introduced in 2005. The refund is 10 percent of the loan

[3] See Strathcona County website, at <http://www.strathcona.ab.ca/Strathcona/default.htm>.

insurance for homeowners who buy or build energy-efficient homes or who make energy-saving renovations to existing homes[4]. BC Hydro, Manitoba Hydro, and Gaz Metro provided similar programs promoting energy efficiency. Linking agencies with similar objectives can simplify the application process for developers and increase the reward.

Sidebar: Pulling It All Together—King County, WA, United States

King County, Washington, home to Seattle, provides both a model of integrated green building policy and a goldmine in practical tools and lessons learned. King County today accounts for more than 60 percent of the LEED-certified and LEED-registered buildings in Washington State and was the first US county to sell carbon credits. King County's programs include a variety of incentives, such as technical assistance, and educational initiatives to support green building. Incentives include priority processing; ten hours of free project management assistance by the dedicated Green Tract Team for any home that receives a five-star rating in Built Green, King County's voluntary standard for residential green buildings; density bonus incentives; and two grant incentives, one for Built Green homes and one for LEED commercial buildings. The permit office is filled with educational placards, educational brochures, and product examples explaining different aspects of green building, and the grounds provide an example of drought-tolerant and native landscaping. Informational bulletins on green building are circulated to customers and staff at the permitting agency and on the agency's website. King County's green programs benefit from an urban growth boundary, which has designated the western third of the county "urban" and the eastern two-thirds "rural." Today over 95 percent of permitted housing units are within the urban boundary; the rural area is mostly forest and farmland.

The admirable level of integration achieved today took time to develop. As Katie Spataro, from the Solid Waste Division (SWD) of the Department of Natural Resources and Parks, tells it, about five years ago a frustrated customer spurred the agency in charge of permitting, the Department of Development and Environmental Services (DDES), and the SWD to coordinate. SWD was promoting green roofs, but at that time the DDES permitting agency wasn't accepting them. As Cynthia Moffitt, of the DDES tells it, at about the same time, she was looking to SWD for assistance in developing King County's new green demonstration ordinance, requested by King County executive Ron Sims. Whoever tells the story, it is clear that coordinating the programs took individual initiative from both agencies. King County is now spreading its knowledge and lessons learned through its GreenTools for Suburban City Toolkit, a resource for midsized municipalities in Washington and elsewhere. A new website, at <www.greentools.usa>, will launch in July 2008. Until then, this resource kit for suburban green building can be found online at <http://www.metrokc.gov/dnrp/swd/greenbuilding/index.asp>.

Tax Shifting and the Fiscal Steering Wheel

A fundamental issue affecting green building economics is that our current economic structure fails to take into account the full wealth of services provided by the environment (such as

[4] See Canada Mortgage and Housing Corporation website, at <http://www.cmhc-schl.gc.ca/en/corp/about/hi/index.cfm>.

stormwater management, water purification, and climate control) and thus systematically engages in activities that disrupt those services. Neither the benefits of activities that strengthen these services nor the harms from activities that damage them show up in the existing economic system. Economists label these hidden harms and benefits "externalities."

Fiscal policy can be used to correct these market signals so that the prices of energy, materials, and activities reflect their true cost or value to society. Removing subsidies and imposing significant additional taxes on any or all of fossil-fuel use, nuclear- electricity use, raw-material extraction, pollution, and solid-waste production would release market forces encouraging the use of more benign, efficient, and renewable materials and technologies. As no particular action would be specified, innovative responses could flourish.

With ecological tax reform (ETR), or *tax shifting*, these new taxes would be offset by reductions in taxes on things we like to encourage, such as labor and savings—so that the total tax doesn't change. Instead taxation is shifted to help the market reward things we want—employment and a healthy environment—rather than things we don't want—unemployment and environmental degradation.

While this strategy has yet to be applied in North America, the European Union and a few other regions have implemented many, albeit small, tax shifts since Sweden's first efforts in 1990. In Europe, much of the incentive for tax shifting arose from a desire to increase employment, typically by replacing a small portion of payroll taxes with a small additional tax on petroleum products or related emissions. ETR has been used in at least eight European countries since the mid-1990s. Debate over the potential impacts and value of ETR is far from resolution, and empirical studies on environmental and economic impact are difficult because of the small scope of existing ETR. However, the weight of research and evidence suggests that large-scale, revenue-neutral tax shifting would have a positive environmental impact and, if well designed, a positive economic and employment impact.

Efforts to institute ETR in North America face a number of barriers, including the general lack of familiarity of regulators and the public with the concept, organized special interests, the political untenability of raising taxes (even if revenue-neutral, this remains a conceptual barrier), and the 1993 failure of a Btu tax in the US Congress. According to The Pembina Institute, Canada emphasizes regulatory reform, federal/provincial policy harmonization and voluntary initiatives rather than fiscal measures.[5] Additional confounding issues are potential international trade issues from asymmetric taxation, the need to create supplementary policies and provide appropriate information to realize maximum benefits, and the potential regressive qualities of a simple ETR if efforts are not made to provide compensational benefits to lower-income people. One recommended approach for the United States is to begin developing ETR at the state level, to deal with pressing local problems and rectify unpopular local taxation schemes. As has been shown throughout this report, state-level innovation is often a model for national legislation, and successful initiatives could increase public support for and understanding of the concept, as state and local governments have shown with carbon trading and the climate change agenda.

[5] Amy Taylor, *Environmental Tax Shifting in Canada: Theory and Application*. A summary of opportunities, prepared for The Pembina Institute. Online at <http://www.pembina.org/pub/155>.

Successful state-level ETR could shift national political climates toward ETR and provide models for a national program.

Emissions Trading and Green Building

Carbon taxes and cap-and-trade systems are two approaches to achieving the same objective: reducing the emissions of greenhouse gases, which contribute to climate change. With a carbon tax, the government sets the price for the right to emit carbon dioxide, and the market determines how much carbon is emitted. With a cap-and-trade system, the government sets the allowable amount of carbon dioxide emissions, and the market determines the price of those emissions. In either case the point is to align market and environmental goals and provide flexibility in meeting environmental objectives. While voluntary markets exist, the system is most effective if mandated carbon caps are in place, initial caps are low enough to encourage investment, and caps are lowered at regular, predefined intervals. Initial credits can be gifted—or "grandfathered"—to existing industries, or auctioned off, or a combination of these approaches can be used. Auctioning makes better economic and environmental sense, but grandfathering is generally more politically feasible.

Most emissions trading schemes have focused on large emitters like power plants and industrial facilities, because for smaller emitters (like businesses, residences, and developers) the complication, administrative expense, and difficulty of monitoring and enforcement have been considered too great, at least initially. However, large-emitter markets still have a significant if not direct impact on the emissions resulting from buildings and pave the way for more comprehensive markets that include small emitters. If and when such a comprehensive scheme is developed, building owners and developers could have access to a new revenue stream from carbon reductions, which would increase adoption of advanced green building practice.

While the world's first greenhouse gas emissions trading system was actually the US's Chicago Climate Exchange (CCX), the European Climate Exchange (ECX) is the most widely known. The CCX, launched in 2003, is an increasingly active, voluntary, legally binding system for North America and Brazil. However, the lack of nationally instituted mandatory targets limits its potential. In contrast, the ECX is a mechanism for trading European Union Allowances (EUAs) under the legally binding and mandatory EU Emissions Trading Scheme (EU ETS). This trading scheme was planned as a keystone in the EU's bid to comply with the Kyoto Protocol, and was launched in a pilot phase for 2005 to 2007, with national allocations now being renegotiated for the next phase, from 2008 to 2012.

The US Regional Greenhouse Gas Initiative (RGGI) will be based, like the EU market, on mandatory emissions limits for certain emitters in the committed northeast and mid-Atlantic states. Seven states initiated the RGGI through a memorandum of understanding (MOU) on 20 December 2005, and in 2006 issued a model set of regulations, which was significantly revised pursuant to public comment. In February 2007, five western states initiated the Western Regional Climate Action Initiative, agreeing to set a regional emissions reduction goal in six months, develop a design for a regional market-based cap-and-trade program in 18 months, and participate in the GHG registry. They have been joined by Utah and British Columbia, and they encourage observers from around North America.

The National Climate Registry, also under development in 2007, is a major boon to both market-based and regulatory approaches to climate action. Based on the existing reporting requirements of the California Registry and the Eastern Climate Registry, the National Registry supports both mandatory and voluntary programs that involve the reporting of all greenhouse gas emissions source categories. Meanwhile, the Clinton Foundation and Microsoft Corporation are partnering with ICLEI–Local Governments for Sustainability (International Council for Local Environmental Initiatives) and the Center for Neighborhood Technology (CNT) to develop a suite of technology tools that will enable cities to accurately monitor, compare, and reduce their greenhouse gas emissions.

Other Market-based Approaches

Public institutions use other market tools to correct market signals and influence business decisions. These include providing Standard Offer contracts for renewable energy from small suppliers (under Ontario's Renewable Energy Standard Offer Program), instituting utility demand-side management programs, ensuring that consumers receive the appropriate level and timing of price signals through the design of energy tariffs, and simply switching electricity from average-cost pricing to marginal-cost pricing. Standard Offer contracts provide fixed pricing for renewable energy, providing clarity and confidence for small-scale energy producers. Typically the Standard Offer rates for solar electric are equivalent to peak demand rates. These are close to revenue-neutral, given that most photovoltaic (PV)-generated power is created during peak cooling periods. Utilities can also implement cost-shifting by offering utility-cost rebates for permanent demand reductions or for peak-shifting on demand. A more fundamental change would be for a utility to shift from a monopoly average-cost pricing regime for electricity to a regime that embodies marginal cost pricing. In practice, a marginal-cost policy instrument could be manifested in a number of ways; regulators could require this for electricity pricing, or utilities could offer some form of time-of-use pricing measured and reported on a real-time basis.

"Background Paper 2c: Towards Sustainable Financing and Strong Markets for Green Building: Valuing Sustainability" discusses in detail the building valuation process, which is intended to allow the value of green buildings to be accurately captured in accepted valuation protocols. This is an important driver of innovation in financing, as higher value will mean greater security and greater access to capital. However, in the current market, public institutions can act by offering revolving loan programs for energy retrofits or other additions to the public good. These have a positive impact on the market without requiring direct investment. They provide a level of public oversight, which increases consumer confidence, and financing guarantees, giving confidence to service providers and accelerating uptake. Private financing can be influenced by organizations such as the Canadian and US Green Building Councils, who provide credible measures of green building performance. This facilitates the implementation of low-interest "green" loans offered by private financial institutions.

Sidebar: Labeling and Consumer Information

Reporting requirements (such as efficiency labeling) improve the feedback of the market by providing information to consumers and citizens making decisions on purchasing and political

priorities. Strong disclosure and labeling requirements for products—including homes—such as clear information about how much more it costs to operate an inefficient model than an efficient one, can change both buying habits and producer habits. In the same way that the USDA-required nutrition labels on packaged foods have made consumers more conscious of fat and sugar content, the voluntary Energy Star labels have increased consumer awareness of energy use and life-cycle costs of appliances and other products. In some EU countries, such as France, the energy use of homes must be stated during sale, and there are increasingly comprehensive labeling requirements for products throughout Europe. The government plays an important role by identifying standards and, instead of requiring companies to meet the standards, evaluating for the public how the companies' products match up.

Ensuring that information is available would rapidly form a foundation for preferred purchasing, certifications, financing and other programs. Requiring reporting of a building's energy consumption when it is sold would affect purchaser decisions and could form the basis for effective energy-efficient mortgages as well as a host of related activities. Requiring that all sales and rental advertising and all sales and lease agreements clearly display the label communicating building performance would create a level playing field for both vendors and consumers.

Labeling could be initiated from the local to the national level and be mandatory or voluntary. As a ramp-up to eventually mandating consistent reporting, a program could provide an incentive for reporting the energy consumption of a building on resale. However, standardizing this information and making it easy to access it would enable both markets and policies to adjust appropriately. Thus government should develop a nationally consistent performance indicator for labeling, preferably in conjunction with the organizations managing existing voluntary programs. Labeling must be simple to implement, be credible, and provide a simple message.

Sidebar: Getting Better Feedback

The more information is available, the easier it is to make appropriate decisions. As the calculation of gross domestic product (GDP) does now, indicators valuing environmental services (such as water and air purification and temperature management), could help guide North American policies. While not directly targeting green building, the development, measurement and use of indicators that better reflect the ecological, economic and social wellbeing of nations and states would help decision makers and the public assess priorities. There is a large body of work on alternative indicators.

Discussion and Recommendations

Incentives should be designed and used judiciously. Some financial mechanisms are appropriate for long-term market correction, while others are meant to spur development and investment. The continuation of incentives appropriate for transitional use as long-term subsidies creates more problems than it solves. These incentives should have sunset clauses and be designed so that innovation and adoption continue beyond attainment of the credit they promote. At the same time, there is a great need for institutionalizing well-designed, long-term market corrections.

While work to accurately capture the business value of green buildings in the valuation process (discussed in Background Paper 2c) should greatly benefit green building, better market-wide accounting for environmental and human health impacts would support green building at a deeper level.

- **Make liberal use of low-cost, high-value incentives:** Non-tax incentives—such as expedited permits or priority plan review, density bonuses for certain levels of LEED certification, attractive lending rates, preferential insurance rates, and the waiver of certain requirements when financing green projects—should be widely implemented.

- **Use financial incentives and disincentives with care:** Make judicious and coordinated use of financial incentives and disincentives for change management and small-scale market correction. While ultimately the market must reward green building for the latter to become mainstream, a variety of incentives can bridge the gap as the market adjusts. Incentives should be designed specifically to reward performance and stimulate the market in such a way that the benefits continue beyond the life of the incentive. For example, energy tax credits should be based on how much energy a system delivers (or saves), not how much a system costs, in order to encourage innovation and prevent fraud. Innovative solutions, such as demand-offset programs that fund retrofits as a condition of development permits, can be used to address local-scale issues. The coordination of incentive programs, a "one-window approach," with a plan to transition from incentive to compliance as the market matures should be encouraged.

- **Research, explore, and implement means to make prices reflect environmental impact**: A variety of mechanisms are available to correct the market and enable the ingenuity of the market to be guided toward more environmentally friendly building practices. Their political feasibility and implementation details differ. These include tax shifting, cap and trade, standard-offer contracts for renewable energy, and utility demand-side management programs. All deserve serious consideration and coordinated implementation.

- **Set ambitious targets and enable the market to find the best means of meeting those targets:** Correcting the market is a critical large-scale shift that will aid green building. However, it may or may not be sufficient to create the desired behavioral changes. It is also important to clearly define the emissions reduction goal or other objectives and consider approaches to specifically aid in meeting those objectives while maximizing innovation and market creativity. In particular, mechanisms to facilitate technology transfer should be encouraged.

- **Encourage innovative financing mechanisms:** In the current market, public institutions can act by offering revolving loan programs for energy retrofit or other additions to the public good. These have a positive impact on the market without requiring direct investment. They provide a level of public oversight, which increases consumer confidence, and financing guarantees, giving confidence to service providers accelerating uptake. Private financing can be influenced by organizations such as the Canada and US Green Building Councils, who provide credible measures of green building performance.

This facilitates the implementation of low-interest "green" loans offered by private financial institutions.

- **Require labeling:** Requiring reporting of a building's energy consumption when selling a building will affect purchaser decisions and could form the basis for effective energy-efficient mortgages as well as a host of related activities. Furthermore, to create a level playing field for both vendors and consumers, it should be mandatory that all sales and rental advertising and all sales and lease agreements clearly display the label communicating building performance.

References for Readers

- For incentive packages, see references in the section on performance mandates
- Centre for Ecological Economics: <www.ecological-economics.org>
- Pembina Institute website dedicated to Ecological Fiscal Reform: <www.fiscallygreen.ca/about.html>
- Regional Greenhouse Gas Initiative: <www.rggi.org>
- Western Regional Climate Action Initiative: <www.ecy.wa.gov/climatechange/docs/07Mar_WesternRegionalClimateActionInitiative.pdf>
- The Climate Registry: <www.theclimateregistry.org>
- International Emissions Trading Association: <www.ieta.org>

Government Purchasing

Government agencies at all levels are increasingly greening their own operations and including environmental and social considerations in their purchasing decisions. These preferred-purchasing policies can have three major effects:

- **Direct Reduction:** The specifying of high-performance, green buildings and the purchasing of more environmentally preferable products to outfit them directly reduce the impacts of consumption.
- **Market Pull:** A big-enough consumer can single-handedly influence manufacturers to make available and reduce the costs of green products. Specifically, if a large consumer guarantees demand for green buildings and products that meet certain criteria, it creates an incentive for tradespeople and manufacturers to meet that niche.
- **Replication through Education:** By acting as models and by providing standards, tools and expertise to other purchasers, governments engaged in preferred purchasing educate other consumers and expand the market base for environmentally preferable buildings and products.

The US federal government has the largest real estate portfolio in the world, owning approximately 445,000 buildings and leasing an additional 57,000 buildings. The General Services Administration (GSA) acts as the landlord for more than 340 million square feet in existing building space and an additional 90 million square feet under construction. As of February 2007, **320 US federal buildings are registered for LEED™ certification, and 51**

have been certified (representing 6.4 million square feet of building space). The federal government of Canada has one of the country's largest real estate portfolios. Its Real Property Branch coordinates the office accommodation needs of approximately 105 federal departments and agencies on a city, regional and national scale. The federal government of Canada occupies 6.8 million square metres (m^2) of space, of which 57 percent is owned and 43 percent is leased. It owns 380 buildings and, at a cost of around CA$800 million, holds 2,000 leases.

While the potential direct impact of greening this existing and new building stock in the United States and Canada is substantial, it is dwarfed by the potential impact of using the government's purchasing power to strategically influence the availability of green alternatives in the market, and applying government experience to the development of educational resources and tools that other groups can use.

While this section focuses on government activities, many educational institutions and companies have also begun to exercise their purchasing power by requiring green features and whole green buildings. University efforts are particularly important for their educational role, while large corporations can drive the market through fast, coordinated action across facilities by volume purchasing and through sales offered over a defined period of time.

Federal Approaches

The United States

The Energy Policy Act of 1992, which required federal agencies to reduce their energy use by 35 percent by 2010 (compared with 1985) began a long series of legislation and executive orders that have, either directly or indirectly, affected government procurement and operation of buildings. Among them, Executive Order 13123, "Greening the Government Through Efficient Energy Management," signed by President Clinton in 1999, both reaffirmed EPACT 1992 targets and required federal agencies to "apply [sustainable design] principles to the siting, design, and construction of new facilities." In response to EO 13123, the Interagency Sustainability Working Group (ISWG) was established in 2001 to foster, encourage, and troubleshoot the adoption of green design in federal buildings.

From a small group of interested staff, ISWG grew to a 180-person interagency task force that, among other activities, authored the Federal Leadership in High Performance and Sustainable Buildings memorandum of understanding (MOU). The MOU represented interagency consensus on a set of performance-based guiding principles for the design, construction, and operation of high-performance and green buildings. In 2006, the MOU was signed by 17 federal agencies. The MOU had been signed by 19 agencies, representing 95 percent of federal buildings, when, in January 2007, President Bush signed Executive Order (EO) 13423, "Strengthening Federal Environmental, Energy, and Transportation Management." EO 13423 made mandatory the MOU's five guiding principles for all new construction and major renovations; it also addresses existing and leased buildings and consolidates and supersedes a number of prior orders, including EO 13123 and EO 13148.

The effectiveness of this order cannot yet be determined; however, the overall move toward greater interagency communication, more integrated policy, and an infrastructure to verify

achievement has clearly helped government greening efforts and green building in general. Recommendations from a 2003 Office of the Federal Environmental Executive (OFEE) report that, for the first time, assessed federal policies and practices for making its own buildings environmentally responsible have for the most part been met. Along with encouraging more integrated policy, the federal government is also moving toward more integrated education and implementation. Many now use LEED or a similar tool for their new projects. Many agencies, including the Department of Defense, previously maintained their own websites and information sources, but they are now consolidating building criteria and information into the Whole Building Design Guide (<www.wbdg.org>), which now includes a plethora of additional resources for government departments and agencies as well as the general public.

One challenge has been the lack of guidance in soliciting bids for contracts that define green beyond an agency's general environmental goals. When solicitations and project specifications don't have specific goals and requirements spelled out, agencies have no means of ensuring the performance they seek. Developing those specifics is a gargantuan task for specifiers and one that is outside their usual area of expertise. To address this, EPA, OFEE, and the multi-agency-sponsored Whole Building Design Guide (WBDG) developed the Federal Green Construction Guide for Specifiers (<http://fedgreenspecs.wbdg.org>), which provides precise language and targets to include in project specifications.

A barrier to full utilization of the strategic power of preferred purchasing is the difficulty of coordinating agencies to act swiftly with one voice. A large firm may more easily bargain for a new product with certain green features at volume prices by a certain time, thus driving the market. The federal government faces other unique structural challenges to green building. The length of some contracts can discourage continuous improvement or utilization of new technologies. For example, a contract for military housing may be 50 years long and include not only design and construction but also operations and maintenance. Also, the US government must put projects up to open bid and cannot write specifications requiring specific products.

A barrier for all sectors, including governments, is the belief or actuality that green buildings have higher initial capital costs. As discussed in "Background Paper 2b: Towards Sustainable Financing and Strong Markets for Green Building: US Green Building Finance," and "Background Paper 2c: Towards Sustainable Financing and Strong Markets for Green Building: Valuing Sustainability," although research has increasingly shown these up-front costs to be minor and rapidly recovered through lower operating costs, they remain a barrier because of budget and financing structures that do not consider operating and capital costs together. The federal government is slowly correcting this by suggesting agencies use life-cycle costing in decision-making and make other adjustments to financial structures.

Canada

Through amendments to the Auditor General Act, the Office of the Commissioner of the Environment and Sustainable Development was created. The amended Act requires federal departments to table sustainable development strategies in Parliament every three years (starting in 1997). Department representatives must also address Parliament annually to report their progress toward meeting the goals stated in the sustainable development strategies.

The federal government's policy initiatives for sustainable building practice have focused primarily on energy consumption. The Federal House in Order initiative has identified the eleven government departments that consume the most energy and set reduction targets for each of them. The Federal Building Initiative was implemented to monitor the reduction of energy consumption in federal buildings.

Federal Green Building Projects in Canada

In July 2006, the federal government of Canada established for all federal building projects a certification standard that uses a range of environmental assessment and certification tools, based on building type. The standard requires that all Crown-owned office buildings and new long-term lease office buildings achieve LEED Gold certification and that all new non-office facilities achieve LEED Silver or the Green Globes equivalent. It also requires that all newly leased federal facilities and existing-lease office space use Green Lease initiatives. Since the standard's induction in April 2004, more than 70 new lease renewals have applied the Green Lease provisions. These provisions include environmental concerns such as wastewater management, indoor air quality, recycling, energy-efficient lighting, and greenhouse gas reduction.

The Canada Green Building Council website currently lists 258 LEED-registered Canadian projects, 12 of which are federal projects. These federal building initiatives align well with the government's Policy on Green Procurement, which aims to advance environmental protection and support green development by integrating environmental-performance considerations into the procurement decision-making process. The policy requires that all departments and agencies incorporate environmental performance considerations in procurement decisions occurring throughout the life-cycle of assets and acquired services. The policy, as well as supporting guidelines and tools, is accessible at: <www.pwgsc.gc.ca/greening/text/proc/pol-e.html>.

The government, throughout Canada, has undertaken a number of high-profile capital building projects that have set high standards for green construction, including: the East Memorial Block renovation in Ottawa, Ontario, presented at the Green Building Challenge in 1998; The Greenstone Building in Yellowknife, Northwest Territories, and the Jean Canfield Building in Charlottetown, Prince Edward Island, which are expected to achieve LEED Gold; the Toronto Military Family Resource Centre in Downsview, Ontario, which achieved Four Green Globes; and the Gulf Islands National Park Reserve in Sydney, British Columbia, which achieved LEED Platinum.

State and Local Approaches in the United States

Numerous states, counties, cities, and towns have also made commitments to greening their public facilities—and both the number of initiatives and depth of commitment are rapidly expanding. Many of these programs operate in conjunction with voluntary or mandatory programs and policies directed toward greening private development practice, but no comprehensive list exists. At least 19 states have green building initiatives with a public-sector component, many of which were established, at least in part, by executive orders and many of which explicitly reference LEED standards. According to the USGBC, various LEED initiatives, including legislation, executive orders, resolutions, ordinances, policies, and incentives, are

found in 53 cities, 10 counties, 17 states, 33 school districts and 11 federal agencies across the United States and Canada. Of the more than 50 municipalities requiring LEED certification for public buildings, most require LEED-Certified or LEED Silver ratings. LEED Gold is required for certain public buildings in Scottsdale, Arizona; Fort Collins, Colorado; Portland Oregon; and Vancouver, British Columbia, Canada.

The caveat for Fort Collins illustrates one means for pushing the envelope while providing an out: ". . . all new city-owned buildings over 5,000 square feet must achieve LEED Gold certification," the legislation reads, "unless it is not technically or economically feasible to do so. If the incremental cost of achieving LEED Gold relative to LEED Silver has a payback period of greater than ten years for a particular building, then the City would opt to seek the LEED Silver certification for that building."

As in the federal sector, local and state governments are, with increasing frequency, sharing resources and making joint commitments to green building. Most notably, in June 2006, the US Conference of Mayors, which represents the 1,183 US cities with populations of 30,000 or more, unanimously adopted Resolution 50, "Adopting the '2030 Challenge' for All Buildings," which calls for all new buildings and major renovation projects to be climate-neutral by 2030. It calls for reducing fossil fuel use by 50 percent in today's buildings, 60 percent by 2010, 70 percent by 2015, 80 percent by 2020, and 90 percent by 2025, and it urges mayors everywhere to join the effort. The mayors also unanimously adopted Resolution 83, "Establishing a New Municipal Energy Agenda to Help Address the Nation's Energy and Environmental Challenges and Improve Local Communities."

Resolution 83 sets ten broad goals related to energy use in cities:
- Reducing energy use in municipal facilities;
- Promoting green buildings;
- Ensuring residential energy assistance;
- Addressing climate change;
- Encouraging diversity in energy generation;
- Improving municipal vehicle fleets;
- Encouraging incentives to improve vehicle fuel efficiency;
- Investing in transit and walkable communities;
- Sharing best energy practices among cities; and
- Encouraging private-sector initiatives.

State and local governments considering implementing green requirements for government buildings now have many examples and public resources to help them. Often these programs are the first step toward, or one part of, a more comprehensive green-building program.

Individual state and local green building purchasing programs have a direct positive effect on the environment, and showcase buildings can form the foundation of educational outreach to both the public and the private sector. Individual state and local governments may also encourage local building professionals to acquire green capabilities but rarely have sufficient market size to

influence the availability of green building technologies. If state and local governments make shared agreements regarding purchasing decisions, they may together exert a much stronger influence.

Provincial and Municipal Approaches in Canada

In 1995 the Canadian Standard Association published the document *Environmentally Responsible Procurement* to provide a guide for organizations wishing to adjust their protocols for purchasing products, services and activities in order to minimize adverse impacts on the environment. Since then, several municipalities across Canada have incorporated green procurement policies, including standards for green building. The city of Toronto started on this path by focusing on energy performance. In the report *The Sustainable Use Directory*, released in 2000, the city indicated measures to reduce energy consumption and its associated GHG emissions. The city committed to track and monitor energy consumption and costs of all City of Toronto facilities and operations, investigate and recommend energy efficiency improvements in city buildings, as well as carry out energy efficiency improvements in city facilities. The city of Toronto has also adopted the Guide to Environmental Purchasing as a tool to assist city staff to incorporate environmentally preferred products into the procurement process. It describes a number of methods for assisting the selection processes, such as the application of environmental criteria to target product and service categories.

British Columbia is also showing leadership in terms of eco-procurement commitment. The city of Richmond developed in 2000 the Environmental Purchasing Guide to provide assistance to municipal staff across British Columbia, in the form of information and resources about how to integrate environmental considerations in their purchasing decisions. Vancouver, with the perspective of staging the Olympic Winter games in 2010, is preparing a plan for eco-procurement to ensure that the contracts the games will bring into the city meet the city's environmental standards.

Discussion and Recommendations

Widespread government activities undertaken to "walk the talk" of sustainability, by specifying high-performance, green buildings and by purchasing more environmentally preferable products, have created a plethora of resources from the local to the global level (through the UNEP Sustainable Consumption production group). These activities lower costs and improve government building stock while helping the environment, driving the market to supply green building solutions, and educating other consumers. There is no need to re-invent, but rather to increase implementation and effectiveness of such programs by utilizing and contributing to the existing knowledge base.

Recommendations to improve programs and increase impact

- Work in coalitions to increase the market clout of local and state initiatives.
- Create interagency working groups to improve communication and collaboration.
- Apply government expertise to the evolution of voluntary consensus standards and rating systems, which establish definitions of "green" for the marketplace.

Recommendations for implementing a "walking-the-talk" program

- Have a program champion.
- Identify and address budget and financing structures that might hinder projects.
- Educate staff involved in building projects, maintenance, and finances.
- Integrate greening-government initiatives with other green-building programs.
- Use government green buildings and efforts for showcasing and education.
- Utilize existing resources from related efforts—there is no need to re-invent (see <www.wbdg.org>).

References for Readers

- US EPA Environmentally Preferable Purchasing website: <www.epa.gov/epp/>
- Whole Building Design Guide: <www.wbdg.org>
- See also section on Performance Mandates, in this paper
- Center for New American Dream's Responsible Purchasing Network: <http://www.responsiblepurchasing.org>
- The Federal Commitment to Green Building: Experiences and Expectations (2001): <http://www.ofee.gov/sb/fgb_report.html>
- FEMP The Business Case for Sustainable Design in Federal Facilities 2003: <http://www.eere.energy.gov/femp/technologies/sustainable_federalfacilities.cfm>
- "Where we are… Reflecting on OFEE's 2003 Recommendations," *Closing the Circle News*, Winter 2007, Issue 42, OFEE
- Public Works and Government Services Canada: <http://www.pwgsc.gc.ca/text/factsheets/real_property-e.html#portfolio>
- UN Department of Public Information: <http://www.un.org/News/Press/docs/2006/sgsm10620.doc.htm>
- UNEP Sustainable consumption production (SCP) assistance for governments: <http://www.uneptie.org/pc/sustain/initiatives/home.htm>
- UNEP SCP Resource Kit on Sustainable Consumption & Production: <http://www.uneptie.org/pc/sustain/10year/SCP_Resource_Kit.htm>

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Technology Development

Research plays a critical role in advancing technological developments throughout the economy—from computer science to materials engineering to pharmaceuticals. In some industries—particularly those in which patentable advances can be converted into high profits, such as pharmaceuticals and software—research and development is predominantly carried out by private companies. In industries with less opportunity for patentable products, such as the building industry, research is often limited to public (government) agencies.

Research and development (R&D) work that relates to green building falls into a number of categories, principally energy, water, environmental protection, and human health. Overall

budgets for these areas are large, especially in the United States, but only a very small subset of such work relates directly to green building.

In the United States, research on energy efficiency and energy alternatives became a high priority following the 1973 Arab oil embargo. President Gerald Ford formed the Energy Research and Development Administration (ERDA) in 1975, and this was merged into the US Department of Energy (DOE) when the latter was created in 1977. Billions of dollars have been spent in the ensuing decades, in developing a wide array of innovations, from solar technologies to low-emissivity coatings for window glazings.

In Canada, several institutions at both private and government levels have addressed the need for R&D aimed at reducing energy consumption. The CanMet Energy Technology Centre (CETC), a department within Natural Resources Canada, works on a consulting service–oriented basis with private firms, the public sector, trade and professional associations, utilities, universities, and other levels of government to develop leading-edge technologies in the areas of building energy efficiency and renewable and transportation energy technologies. The CETC has played a key role in fostering the development and implementation of several successful projects dealing with distributed-energy technologies and community energy planning; energy-efficient building technologies; wind, solar, and small-hydro technologies; transportation energy technologies; and hydrogen and fuel-cell technologies.

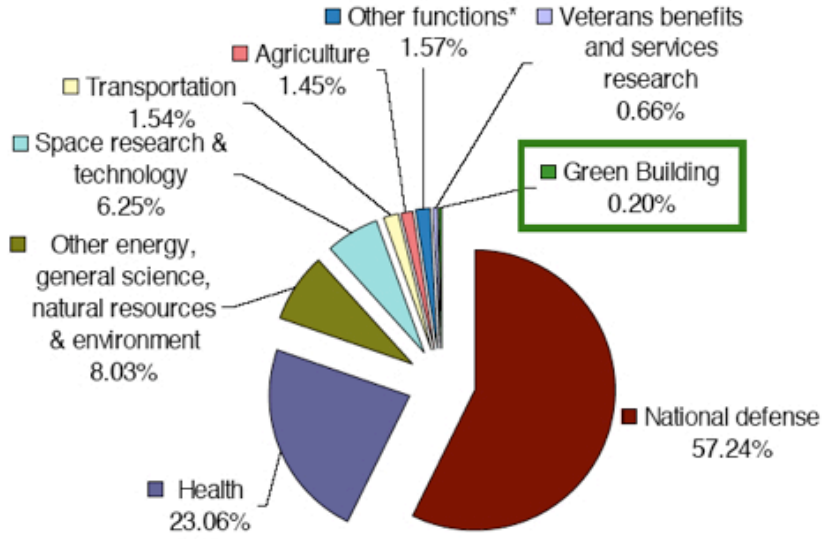
The Canadian government also created Sustainable Development Technology Canada (SDTC), in 2001. Its mission is to act as a catalyst in building a sustainable development technology infrastructure in Canada. The SDTC works with stakeholders to build capacity in Canadian clean-technology entrepreneurs. It bridges the gap in the innovation chain by speeding groundbreaking, clean technologies through development and demonstration and through preparing products for commercialization, and by helping with strategic relationships and business planning.

To date, SDTC has completed nine funding rounds and allocated a total of $241 million to 109 projects. That amount has been leveraged with an additional $617 million in funding from other project partners, for a total project value of $858 million. Since April 2002, SDTC has conducted ten calls for statements of interest (SOIs) and received 1,249 SOIs from across the country—representing some $10.1 billion in project potential from more than 3,100 companies and institutions.

Adequacy of Funding on Green Building

A recent report by the USGBC Research Committee, *Green Building Research Funding: An Assessment of Current Activity in the United States* (April 2007), points out that, in the United States, research and development (R&D) related to green building practices averaged $193 million per year from 2002 to 2005. This represents only 0.02 percent of the estimated annual value of US building construction and 0.2 percent of all federal research (see Figure 6).

Figure 6: Federal R&D Budget Authority, by Budget Function, for Years 2003–2005



** Other functions include education, training, employment, and social services; income security; and commerce. Green building data was compiled from agencies and the Office of Management and Budget (OMB); baseline federal R&D budget data comes from the National Science Foundation (NSF). The 0.2% funding toward green building does not include money from the Department of Defense.*

Source: US Green Building Council report *Green Building Research Funding: An Assessment of Current Activity in the United States* (April 2007). Chart addresses US funding only.

Despite the low level of federal research, there have been many dramatic successes in the last few decades. In relation to energy research, the National Academy of Sciences carried out an in-depth investigation of the costs and returns on dozens of research projects undertaken by the US Department of Energy (DOE) between 1978 and 2000 (*Energy Research at DOE: Was it Worth it?,* National Academy Press, 2001). DOE invested $4 million in research on low-emissivity glazings and the developments achieved cumulative consumer cost savings of $8 billion (through 2000). DOE invested $6 million in research on electronic ballasts for fluorescent lighting and society realized cumulative savings of $15 billion (through 2000).

USGBC argues that a significant increase in green building research funding is necessary. The organization proposes that this funding should increase to $1 billion per year, or 0.10 percent of the annual building construction value, which is approximately $1 trillion.

The USGBC Research Committee has been working to identify key research priorities, and a report on those priorities is expected in 2007. The findings from this body should be useful in identifying green building research priorities throughout North America.

Green Building R&D—Recommendations

Identify research priorities. Work with the USGBC Research Committee to identify research priorities. This committee hopes to issue a research priorities white paper every year or two; these documents should help the United States, Canadian, and Mexican governments identify needed research.

Support the scoping of a major research initiative on energy efficiency and renewable energy. Many experts believe that a massive R&D initiative, on the scale of the Apollo Project in the 1960s and '70s or the Manhattan Project in the 1940s, is required to achieve carbon-neutral buildings in the United States. The logical first step in such an effort would be an in-depth scoping project, probably managed by one of the national laboratories.

Fund green building research federally. Certain aspects of green building research have been well-supported by industry (for example, advanced lighting products), but many research priorities have not been broadly funded—especially those that do not have a manufacturer "constituency." Building science is not likely to be funded by industry, because these solutions are more related to design than to products. It is important for federal governments to support research efforts in green building that are unlikely to be funded by industry.

Develop specialized "centers of excellence" on various aspects of green building. Along with fully funding national laboratories, such as Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, and the National Renewable Energy Laboratory in the United States, set up and financially support national centers of excellence on such research areas as green roofs, batteries, life-cycle assessment, passive survivability, daylighting, and building science. Such research facilities could aggregate expertise in these topic areas and serve as important centers of investigation, education of practitioners, and technology transfer. They could be located at existing national laboratories or university laboratories, or developed as stand-alone facilities.

Specific Research Priorities

There are dozens, if not hundreds, of research priorities relating to green building. Listing all of these is beyond the scope of this report. However, a few that are poorly understood or not widely recognized are described here:

- **Passive survivability.** Passive survivability is a design criterion that recognizes the vulnerability of most buildings to extended power outages or loss of heating fuel or water. Given the growing risk of such problems, houses, apartment buildings, schools, and other public buildings likely to be designated as emergency refuges should be designed and built to maintain livable conditions in the event of extended power outages or loss of heating fuel or water. Many well-known green building strategies, such as high-performance wall and roof systems, very high–performance windows and glazing systems, daylighting, passive solar heating, water conservation, and rainwater harvesting, are key components of passive survivability. Others, such as providing emergency-mode

DC operation of heating equipment (for operation with batteries or PV panels) are poorly understood and need to be researched.

- **Transportation energy efficiency of buildings.** A great deal of attention has been paid to the energy consumption of buildings and efforts to reduce that consumption. Little attention has been paid, however, to the transportation energy used in getting to and from buildings. Research is needed on metrics for the transportation energy efficiency of buildings as well as on the baseline energy use for transportation by homeowners, employees, and retail customers so that savings from changes in land-use and public transportation infrastructure can be measured.
- **Combined heat and power (CHP) and district energy systems.** Combined heat and power offers one of the most important options for significantly reducing energy consumption and net carbon emissions—by boosting the overall efficiency of source-energy utilization. A CHP plant generates electricity but captures the waste heat from that power generation that is typically vented into the air or into a nearby body of water. To be utilized, the thermal energy from CHP plants is typically distributed as hot water or steam; most new systems utilize hot water, because it is a better heat-transfer medium, results in lower heat loss, and is not as corrosive to piping and equipment. While widely used in northern Europe, CHP and district energy systems are rare in North America outside of university campuses, hospital complexes, and some highly urban downtown areas. Research needs include identifying areas with high enough building density for district energy systems to be cost-effective, developing low-cost hot-water piping systems, demonstrating renewable energy sources (such as waste wood chips and solar thermal plants) to power CHP plants, and developing affordable, easy-to-connect modules for plumbing connections from district energy systems.
- **Daylighting and passive solar energy modeling tools.** Compared with those of the early 1990s, today's computer modeling tools for daylighting and passive solar energy heating are highly sophisticated. But additional improvement is needed—especially in the integration of such tools into building information modeling (BIM) tools and the development of software able to benefit from today's high-speed personal computers.
- **Life-cycle assessment of building materials.** Today's most energy-efficient buildings use more energy in their construction than will be used in their operation over many decades. Thus, it is necessary to focus on the *embodied energy* in the materials used in constructing buildings. This is part of life-cycle assessment (LCA). LCA also considers the environmental impacts of resource extraction, the pollution emissions from manufacture, the health impacts associated with use of the materials, the impacts associated with maintaining those materials over their useful life, and ultimately the impacts of disposal. There is great need for a comprehensive database of building material LCAs, the development of which is both complex and expensive.
- **Human productivity and performance benefits of green buildings.** There is a scant, but growing, body of knowledge about benefits of green buildings that accrue to the building occupants. Studies have shown that daylighting, natural ventilation, views of nature, and other features of green building speed recovery from surgery, boost worker productivity, improve test scores in classrooms, and even boost sales in retail establishments. Conclusively demonstrating and quantifying such benefits would increase incentives to build green and significantly speed up market penetration.

- **Moisture management and building science.** Controlling moisture in buildings, especially homes, is critical for maintaining good indoor environmental quality and ensuring long building life (which keeps life-cycle environmental impacts low). Unfortunately, moisture dynamics in buildings remain poorly understood. There is significant need for in-depth research on moisture dynamics and building science in buildings.
- **Economically-viable superinsulation retrofit options for homes.** Dramatically reducing carbon emissions will necessitate improving the energy efficiency of existing homes—of which there are roughly 120 million in the United States. In colder climates, homes should be extensively tightened up and superinsulated (boosting wall insulation values to R-30 or higher, for example), yet there is very little experience with such programs and little data on cost effectiveness of alternative approaches.

Education Programs

Education is the key to convincing developers, builders, building owners, government officials, and others that green building is a good idea; to ensuring that these parties effectively carry out environmental goals; and to engaging building occupants in behavior that allows the potential of these goals to be realized. The first two priorities—making the case for green building and explaining how to do it—are carried out by nonprofit organizations focused on green building (such as the US Green Building Council, the Canada Green Building Council, and the Sustainable Buildings Industry Association), by established educational institutions (including architecture schools and vocational-technical programs in schools), and by publications and websites on green building. The third—informing occupant behavior—is also helped by these publications and programs, but is best actualized by labeling and real-time feedback.

Making the Case for Green Building

To effectively make the case for green building requires communication and education programs targeted toward specific market segments. With homes, it is necessary to reach out to the general public (consumer markets) as well as those professions that influence home purchasing: lenders and financial institutions, real estate professionals, insurance providers, speculative home builders and developers, and municipal planners and zoning officials. With schools, it is necessary to reach out to municipal school boards, school administrator associations, and teacher organizations. With office buildings, it is necessary to reach out to commercial property–management organizations, commercial developers, real estate investment trusts (REITs), and lenders.

The US Green Building Council (USGBC) has done a good job of advancing green building in the United States by communicating to these various market segments, especially through its publication *Making the Business Case for High Performance Green Buildings*, but far more activity in this area is needed. Particularly effective in making the case for green building will be collaborative efforts in which groups such as USGBC combine efforts with mainstream organizations, conferences, and publications to get the word out to those who have not already bought into the need for green building. In such communications, the specific arguments can be effectively tailored to the target audience by addressing the bottom line savings to lenders, lower risk to insurers, and productivity benefits to office building owners, for example.

Along the same line, the Canada Green Building Council summarized the status of the green building industry in Canada in the report *A Business Case for Green Buildings in Canada, 2005*. This report was intended not only to define the status of the green building industry in Canada but also to highlight the benefits of green building technology and address the barriers facing the industry. Barriers identified include the lack of knowledge of green buildings by stakeholders, the youth of the industry, and the procurement (tender) processes, which are typically based on capital cost rather than value.

In general, the diffusion of green building and sustainability knowledge in Canada has been managed by the government and small or independent organizations, including the general public, single-industry associations, individual product manufacturers, professional associations, general and specialty trades, independent colleges and universities, and research institutions.

There is a significant risk that the developing market for green building will, in the short term, outpace the availability of expertise in the workforce. Furthermore, the education of the market providers of green buildings or green building services is directly related to the success of the projects. Undereducated, misinformed, or under-skilled individuals may produce unsuccessful projects, creating a negative perception of green building in the marketplace and hindering growth. The development of educational programs in an uncoordinated manner does not address issues in the interdisciplinary nature of green building projects. It can also be counterproductive to the goal of overcoming inherent communicational challenges between project participants of different disciplines and expertise.

Specific Recommendations—Making the Case for Green Building

Described below are a number of specific recommendations for communicating the importance of green building to various audiences.

- **Partner with appropriate organizations.** Nonprofit green building organizations, including USGBC, CaGBC, chapters and affiliates of USGBC and CaGBC, the Green Building Initiative, Sustainable Buildings Canada, and residential green building programs, should establish or strengthen relationships with mainstream organizations, and proffer audience-appropriate presentations, articles, and other communications to make the case for green building.
- **Support the display of case study information.** Governments should support the collection and display of information about green buildings. One such initiative is the High Performance Buildings Case Studies Database, funded by the US Department of Energy. This database currently includes about 100 green buildings and displays consistently formatted information on these buildings to allow easy comparison. Additional funding could be used to collect actual energy performance information for buildings in the database, which is not currently available for most projects, and to support the inclusion of many more buildings.
- **Walk the talk.** Governments should integrate green features into all of their own buildings. Federal, state and provincial, and local governments can educate other building owners about green building by ensuring that their own buildings include state-of-the-art

energy and environmental features. In the United States, executive orders at federal and state government levels provide a good way to communicate such intents.

- **Support education and technology transfer.** Federal, state and provincial, and local agencies can accomplish a great deal by funding nonprofit and educational organizations to carry out green building education and technology transfer programs. The willingness of governments to support education and technology transfer has ebbed and flowed in recent decades, yet the benefits of such programs are clearly demonstrated; such efforts should be ramped up.
- **Support labeling and full-disclosure laws.** Various product labeling and reporting laws at the federal and state and provincial levels have been tremendously important in educating consumers. Proposition 65 in California requires that manufacturers label products that contain likely carcinogens, and energy labels on appliances and windows help buyers select energy-saving products. For whole buildings, requirements for the disclosure of energy consumption information would help potential buyers find greener buildings—and understand the benefits.

Raising the Knowledge Base of Building Professionals

Along with education programs that make the case for green building—to increase the adoption of these practices—education must also be directed at building professionals to ensure that they have the knowledge needed to successfully implement green building practices. Education directed toward the design and building trades can and should occur in several ways, each of which could benefit from federal and state or provincial support.

First and most important, architecture schools must integrate sustainability much more comprehensively into their curricula. Some architecture schools in North America still offer almost no instruction in green building, though most have been addressing these topics much more directly in recent years. Schools may offer separate courses focusing on aspects of green design, or they may integrate sustainability more integrally throughout their curricula; either option can work, though the more integrated approach ensures that graduates of the architecture school will be exposed to more green-building-related coursework—even if it is not identified as such.

Several architecture schools in the United States, including Boston Architectural College and the San Francisco Institute of Architecture, now offer specialized certificate programs in sustainable design, with courses that can be taken by degree students or continuing-education students.

To address this issue in Canada, educational models based on the integrated design process are being implemented in academic programs such as the Environmental Design Graduate Program at British Columbia University and the Environmental Studies Collaborative Program at the University of Toronto. In these types of programs, students are placed on multidisciplinary teams and challenged to design mock green building or infrastructure projects. The assembled student team disciplines consist of, but are not limited to, architecture, engineering, trades, business and marketing, urban planning, ecology, law, and sociology.

Building-trades education, including vocational and technical (vo-tech) instruction, should also address aspects of sustainability more directly. Vo-tech instruction is especially important

because durability and performance are so closely linked to how buildings are constructed. If components are installed improperly, expected performance may not be achieved. Some Canadian colleges, such as Humber and Seneca, are responding to this need and developing cross-disciplinary technology programs to train green building operators. Organizations such as Sustainable Buildings Canada are developing joint trade training centers for building-trade apprenticeship programs and energy service companies.

Continuing education of architects, engineers, and others in the building industry is also critical. Because building design—and especially green building design—is so dynamic, designers cannot rely on what they learned when they went through architecture or engineering school if they want to operate at the leading edge of the discipline.

Fortunately, most design professions, including architecture, engineering, and landscape architecture, require members to complete continuing education unit (CEU) credits to maintain their professional registrations. The professional societies in these fields—the American Institute of Architects (AIA) and provincial architectural associations in Canada, the American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE), the American Society of Landscape Architects (ASLA), and others—manage continuing education programs for their members. Many program offerings can help these design professionals obtain their needed CEU credits. Many CEU programs, offered by professional societies and others, are focused on aspects of green building.

Numerous conferences, seminars, and workshops offered throughout North America address green building specifically (many of which offer CEU credits for professionals needing those credits). Among the providers of such programs are the United States and Canada Green Building Councils; the New Buildings Institute, the Sustainable Buildings Industry Association; Ecobuild; various magazines; and regional organizations such as Southface Institute, the Northeast Sustainable Energy Association, and West Coast Green. Increasingly, mainstream industry conferences—such as the National Association of Home Builders' (NAHB's) International Builders Show, the AIA National Convention, Construct Canada, and the ASHRAE Annual Meeting—offer a variety of green-building programs.

In Canada, new nonprofit organizations have successfully developed education programs filling niches not well served by existing institutions or organizations. Green Roofs for Healthy Cities is the most prominent of these. It focuses on increasing the awareness of the benefits of green roof infrastructure across North America. Sustainability Now focuses on green engineering practice in British Columbia. Sustainable Buildings Canada has implemented design charrettes (workshops) on real projects early in the process. These charrettes, chaired by experienced facilitators, are open to all design professionals so they can learn firsthand about the integrated design process. An added benefit for the developer of the project is the wealth of design ideas that come out of the process.

Trade publications offer another important place for practitioners to learn about green design. A handful of specialized publications focus specifically on green building (these include *Environmental Building News*, *GreenSource*, *Environmental Design and Construction*,

EcoStructure, and *Green Builder*, to mention a few), and conventional publications are providing more and more coverage of green building topics.

In addition to these private-sector sources of information on green building are excellent public sources of information. In the United States, such resources include the US Department of Energy, the US Environmental Protection Agency, various national research laboratories (especially Lawrence Berkeley National Laboratory, the National Renewable Energy Laboratory, and Oak Ridge National Laboratory), the Partnership for Advancing Technology in Housing (PATH) program of the US Department of Housing and Urban Development (HUD), the National Center for Appropriate Technology (which focuses primarily on agricultural programs and low-income energy programs), and state energy research bodies (especially the California Energy Commission and the New York State Energy Research and Development Authority). In Canada, the primary public sources of green building information are, at the national level, NRCan, and Canada Mortgage and Housing Corporation (CMHC). At the local level, a leading example is the Greater Vancouver Regional District's Build Smart program.

The Internet has revolutionized education on all levels and in all markets, including the building trades. Online resources for all of these organizations, publications and agencies have made it possible to research topics through online searches. Indeed, the bigger challenge with this information is sorting out the most reputable sources.

Specific Recommendations—Raising the Knowledge Base of Building Professionals
While a wealth of educational programs and information sources is available to building professionals, federal governments have a vital role to play in assuring continuing access to such information. Specific recommendations are provided below:

- **Enhance building performance information.** Expand the collection of building performance information on green buildings (see discussion above under recommendations for "Making the Case"). Providing actual performance information on buildings, along with "lessons learned," is one of the best ways to educate building practitioners about green design and construction. The US DOE High Performance Buildings Database should be expanded to directly address carbon emission reductions, and funding should be provided to significantly expand the number of buildings included in the database.
- **Fund curriculum development.** Significant improvement to architecture school and vo-tech school instruction could be achieved through the funding of green design and construction curricula. With DOE support, a National Association of State Universities Land Grant Colleges (NASULGC) working group on developing curricula on energy-efficient buildings has begun work, but significant additional development is needed.
- **Support conferences and workshops.** Federal, state, and provincial governments in North America have supported green building educational programs, including conferences, workshops, seminars, and lecture series. Agencies should provide continued (and increased) support of such programs, working, as appropriate, with organizations and educational institutions that are set up to effectively deliver such programs.

Motivating Occupants to Change Behavior

The environmental impacts of a building depend not just on technology but on the behavior of the occupant. For instance, a high-performance, energy-efficient building will not perform as expected if occupants don't make use of energy-saving features. Real-time measures of energy use provide instantaneous feedback to occupants, which, especially if the occupants are financially responsible, can bring about changes in behavior.

References for Readers

- US GBC education resources: <www.usgbc.com/education>
- High Performance Buildings Database: <http://www.eere.energy.gov/buildings/highperformance>
- New Buildings Institute: <http://www.newbuildings.org/>

International Agreements and Initiatives

While much can be done through local and national initiatives dedicated to green building, wider international agreements and initiatives can captivate public attention and strengthen the foundation for action. With global environmental problems and a globalized market, international agreements are critical both to help prevent a widespread "tragedy of the commons" and to facilitate appropriate market responses. International green building initiatives are supported by and support broader initiatives to tackle global challenges, including climate change, persistent bioaccumulative toxins, deforestation, and extreme poverty.

Ultimately, we need to set—and achieve—global goals for reducing environmentally damaging emissions and other harmful practices, while expanding the work to restore the damage that has already been done to ecosystems that provide critical services to humanity and the biosphere. The Montreal Protocol on Ozone-depleting Substances, signed, ratified, and implemented by both the United States and Canada, along with many other nations, provides an excellent example of the kind of international coordination that is needed around environmental issues. In particular, the need for widespread and substantial international action and coordination around climate change is becoming increasingly evident. In the same way that codes and standards have had to move from a limited, immediate life-safety focus to account for the broader impacts of buildings, nations must move from a limited view of national priorities to a wider, enlightened self-interest that recognizes the need for each and every nation to take responsibility for its global impacts.

Many important initiatives are underway that take a variety of approaches to tackling climate change. The breadth and depth of new initiatives that have been launched over the course of the writing of this report are a clear indication that we have reached a tipping point on concern over climate change, with buildings receiving a major focus.

Directly addressing buildings, The United Nations Environment Programme's (UNEP's) Sustainable Buildings and Construction Initiative (SBCI), launched in April 2006, recently produced the report *Buildings and Climate Change: Status, Challenges and Opportunities*. Without dismissing the need to dramatically increase the energy efficiency of new and existing buildings in all countries, the report points to the different challenges among nations: it

encourages more developed nations to reduce the energy use of the existing building stock but encourages rapidly growing parts of the world to leapfrog directly to more energy-efficient building solutions for new construction.

Addressing the challenge of existing buildings, former US President Bill Clinton announced in May 2007 the launch of a global energy efficiency building retrofit program. Partnering with nonprofits ASHRAE and USGBC, the Clinton Climate Initiative's (CCI's) C40 Large Buildings Retrofit Program brings together four of the world's largest energy service companies (ESCos), five of the world's largest banks, and fifteen of the world's largest cities, including six from the Americas: New York City, Chicago, Houston, Mexico City, Sao Paulo, and Toronto. Each bank has agreed to arrange for $1 billion in financing for retrofits to cities and building owners who will pay back loans with interest from the energy cost savings. The ESCo providers have agreed to guarantee the energy savings of their retrofits—should the projects fail to reach the savings promised, the companies will either cover the shortfall of the capital loan or make whatever improvements are needed in the buildings to achieve the promised savings.

There are a number of reasons to focus on dramatic improvements in new construction for rapidly growing areas. New technologies are more likely to be cost-effective where older technologies and supporting infrastructure are not already established. Rapidly growing areas are the source of the greatest potential for growth in emissions. Also, in areas of extreme poverty, where food, shelter, and sanitation cannot be assumed, the environment is also directly at risk. Meeting this challenge requires dramatically increasing the flow of both capital and technology between regions.

With global concerns such as climate change, it is in the best interest of all countries to ensure that international agreements are set up to enable technology-leapfrogging and regionally appropriate technology development. The Kyoto Protocol enables such transfers through the Clean Development Mechanism (CDM) and Joint Implementation (JI); however, details such as means to ensure "additionality" (that the project would not have otherwise been completed) have slowed the use of these mechanisms. The Asia-Pacific Partnership on Clean Development and Climate (APP), launched in January 2006 between the United States and six Asia-Pacific nations, also focuses on clean energy capacity building and market formation, but with no enforcement mechanisms. Supporters have called it a flexible complement to the Kyoto Protocol, while critics have called it an effort to undermine Kyoto. A variety of other bilateral and multilateral negotiations are in progress in addition to the recent G8 summit meeting in Germany and the September 2007 Asia-Pacific Economic Cooperation meeting in Australia.

The breadth of these negotiations is beyond the scope of this report and rapidly changing. If we are to succeed in tackling the climate challenge, however, we must insure that the details of whatever agreements are reached facilitate technology transfer at multiple scales (within and between countries) and the flow of capital toward building radically better buildings in all regions. We must move quickly from agreement to action—to which end, cooperation at any scale is beneficial, as is continually increasing the general knowledge base of what works and what doesn't. To achieve transformation at the scale required will involve creative responses at the political, financial, social, and technological levels. As has been discussed in this report: at smaller scales, the more that international policy is tied to results and designed to be regularly

revisited, the more quickly we will arrive at effective, streamlined mechanisms to achieve twin environmental and developmental goals. The recognized benefits and already rapid advance of green building make it an ideal platform to work out these mechanisms.

It must be clearly acknowledged that full international agreement is not a prerequisite for significant market transformation. In the same way that state or provincial action can spur a national response, the decision of a country or coalition can alter the market wordwide. For example, the European Union's ambitious new REACh legislation, which entered into force in June 2007, could have a widespread impact on product compositions and catalyze changes in chemicals policies in other countries. REACh stands for Registration, Evaluation, Authorisation, and Restriction of Chemicals. In the past it has generally been up to governments and watchdog groups to identify unsafe chemicals. REACh reverses the burden of proof and puts the responsibility on the producer and importer to show that substances are safe before they can be placed on the market. Canada has also recently launched a public database of 23,000 chemicals, searchable by chemical name and by toxic quality as part of the Canadian Environmental Protection Act (CEPA). CEPA regulates the use of hazardous materials, as well as dictates the use of environmental assessment for all projects that are undertaken or supported by the federal government.

Discussion and Recommendations

- **Cooperate on goals, standards, and markets:** International agreements on emission reduction targets and other goals can mobilize resources and facilitate cooperation at other levels. Cooperation on standards can reduce each country's required investment and ease the flow of trade. Balance this coordination with appropriate regional customization (such as climate-appropriate design and R&D as well as culturally appropriate regulations and standards)**.** Develop and adopt, with locally appropriate modification, increasingly flexible and stringent international codes and standards.

- **Ensure that wider agreements do not prevent stronger action at a smaller scale:** Environmental rulings at smaller levels of government frequently provide the impetus for change at a broader level. Ensure that trade agreements cannot be used to prevent countries from implementing higher environmental standards by calling them trade barriers. Remove country-specific barriers, such as those in some Canadian provinces restricting municipalities from requesting performance higher than code minimums, or those preventing states in the United States from raising product standards without adequate provisions for raising the bar on national standards.

- **Facilitate technology transfer via the following measures:**
  - **Cross-border loaning of expertise:** Each country has developed expertise that could be shared. For example, the United States could benefit from building-science expertise from Canada, while Mexico could benefit from heat-pump technologies in the United States, and the US Southwest, especially , could benefit from research into natural materials and bioclimatic building going on in Mexico.
  - **Development of climate-specific expertise:** While each country in North America encompasses a wide range of climates, there are still general climatic differences that

warrant localized expertise. Most building technologies should not simply be adopted, but instead be adapted.

- **Include the building sector in CDM:** While some large-scale building projects have been approved for CDM, buildings are typically considered small emitters, which are excluded in most trading schemes due to transactional difficulties. Finding ways to aggregate or otherwise incorporate building and other small-scale projects in trading mechanisms could release substantial energy and capital for these types of projects.

References for Readers

- UNEP Sustainable Buildings and Construction Initiative (SBCI): <www.unepsbci.org>
- Agenda 21: <www.un.org/esa/sustdev/documents/agenda21/english/agenda21chapter7.htm>
- Asia-Pacific Partnership on Clean Development and Climate: <www.asiapacificpartnership.org>
- C40 Cities Climate Leadership Group: <www.c40cities.org>
- CEPA Environmental Registry: <www.ec.gc.ca/ceparegistry/>
- EU REACH program: <http://ecb.jrc.it/reach/rip/>

Analysis and Recommendations

Almost daily, new reports and agendas come out about the impacts of climate change and the actions needed to mitigate and adapt to it. There is now widespread attention and acceptance of the human influence on the Earth's climate and the dangers of those impacts. It is significant that green building *already* makes good business sense, even without an economic structure that accounts for environmental factors. Even in the current market, the initial costs of most energy-saving, green-building features can be recovered through operating cost savings. Also, the health and productivity benefits—which often dwarf the already substantial operational cost benefits—are increasingly being recognized and quantified. The property development and management industry has begun to respond to the public demand for green buildings. Leading developers are investing in better, more efficient products. The market's ability to develop and measure the successes of these projects is expanding. However, the business case for accelerating the creation of green buildings continues to be debated.

High-performance buildings, although high in profile, remain the exception to conventional practice, spurred by developers and owners who wish to lead the market. While a green building agenda clearly makes economic, environmental and social sense, green buildings make up only about five percent of new construction. Those that have achieved the 2030 Challenge target of carbon-neutral comprise just a tiny fraction of that total. *The extent to which green building is being implemented now, or is likely to be implemented through the continued expansion of existing programs, is still far below the desirable level.*

Green building needs to be rapidly implemented at an ambitious performance level and on a huge market scale. It is in rapidly scaling up these efforts that institutional approaches can have the greatest benefit. In addition, a special effort must be made to improve existing buildings,

address occupant behavior, and institutionalize effective feedback and continuous improvement. Numerous suggestions for improvement are included throughout this report. This section first defines the major challenges to expanding the adoption of green building in Canada and the United States and then provides the most important strategies to address those barriers.

Principal Implementation Challenges and Solutions

Barriers	**Solutions**
1.INERTIA: Significant time and effort are required to implement change	Invest in strong, up-front investments to speed change - Build capacity - Lower the cost of change - Implement government purchasing programs
2. LACK OF CREDIBLE DATA: Consumers and decision makers lack the data to make good decisions	Measure performance and require labeling - Measure actual and real-time performance - Facilitate benchmarking - Require labeling of product and building performance - Develop national indicators
3. MARKET DISFUNCTIONS: There is a lack of full-cost accounting	Establish market signals that drive responsible decisions - Tax carbon through politically palatable tax shifting - Implement cap-and-trade programs for carbon - Explore other market approaches - Encourage innovative financing mechanisms
4. SHORT-TERMISM: Long-term risks and benefits are weak motivators for change	Set clear, aggressive, long-term targets, to be achieved by specific, incremental steps - Set ambitious national and international targets - Regularly raise the bar - Support research to continually advance the state of the art
5. SILOS: Historical divisions and territoriality inhibit change	Take an integrated approach and learn from others - Take an integrated approach to policy - Create teams and processes that cross traditional boundaries - Consider a wider scope - Cooperate on goals, standards, and markets - Ensure that broad agreements do not prevent stronger action at a smaller scale - Learn from others, and facilitate the transfer of knowledge and technology

Barrier 1: INERTIA—Significant time and effort are required to implement change

Despite an increasing array of cost-competitive, high-performance green building projects by experienced professionals, the perception that green buildings are more expensive than conventional ones remains, with some justification. For the multitude of architects, engineers, subcontractors, specifiers, and others who are new to green building, cost premiums may be an inevitable outcome of the learning process. In addition, the process of gaining awareness, learning, and developing approaches for green building takes time not only for the building professionals but also for developers, owners, financiers, code officials, and others. While the rewards are significant, the effort required by change can delay adoption.

Solution: Strong up-front investment

Green building will gain market share naturally as consumers and the trades become more familiar with its advantages and acquire the requisite skills. However, to ramp up green building to the level needed to meet today's challenges, we need to accept that change takes time and costs money. In addition to continuing to show that green building does not have to cost more, we need to remind developers, professionals, and tradespeople that it *may indeed* cost more while they're figuring it out, and we should provide targeted incentives to overcome this early-adoption cost obstacle. To speed up the pace of change, we need an integrated strategy to move the related trades through the learning curve as quickly as possible. This will require **strong up-front investment in the following**:

- **Capacity building:** Significant focus and investment is needed to raise the knowledge base of building professionals across-the-board. Education directed toward the design and building trades should occur in a number of important ways, including architecture and vocational-technical instruction; conferences, seminars and workshops that offer continuing-education credits for professionals; specialized and conventional trade publications; and public information. Each of these could benefit from federal and state or provincial support.

- **Lowering the cost of change:** While ultimately the market must reward, or government must mandate, green building for it to become mainstream, a variety of incentives can bridge the gap as the market adjusts. Financial incentives should be designed to reward performance and stimulate the market so that the benefits continue beyond the life of the incentive. In addition to providing incentives for individual projects, funding for major programs—such as a "rebuilding America" program for widespread, comprehensive energy retrofits of homes—could provide significant and rapid energy savings while building long-term capacity.

- **Government purchasing programs:** In addition to directly reducing environmental impacts, purchasing policies that specify environmentally friendly buildings and products can encourage manufacturers and distributors to supply green offerings and expand the market base for environmentally preferable buildings and products. While the potential direct impact of greening existing and new government building stock is substantial, it is dwarfed by the potential impact of using the government's purchasing power to strategically influence the availability of green alternatives in the market, and applying government experience to the development of educational resources and tools that other groups can use in exercising their purchasing power.

Barrier 2: LACK OF CREDIBLE INFORMATION—Consumers and decision makers lack the data to make good decisions

A well-functioning market economy requires adequately informed consumers. LEED, BOMA, Go Green, Energy Star, and other programs have proven the value of market differentiation. However, while voluntary certification programs and case study databases have helped, there is still a long way to go in providing decision makers with the information they need to make informed decisions that will advance green building. To date, there is no readily accessible information on the energy and water consumption of products or buildings in use, or on the embodied energy in building materials. In addition, there is rarely real-time feedback to building occupants on the energy intensity of their activities in the building. Few building developers, purchasers, owners, or users think about these implications, and those who do often cannot find

the information they need to make informed decisions. Further hindering matters, the predicted energy savings of green buildings is often greater than actual savings. There is also inadequate information about the economic benefits of building green and, conversely, about the long-term economic costs of conventional practice.

Solution: Measure performance and require labeling

If green building is to become the market norm, with competition providing the basis for continuous improvement, comparative performance information must be verifiable and persuasive. Additionally, to achieve the energy reductions called for, building occupants should be part of the loop—and they need feedback on how their behavior affects the energy performance of their buildings. Monitoring the results of actions is essential for quantifying results and achieving continuous improvement at any scale—from the behavior of one apartment dweller to the design of a building to the implementation of a government green-building program. Ideally, performance-based and real-time measures and monitoring processes will become standardized and integrated into a wide range of systems and programs. This can be aided by coordinated efforts on the part of government and voluntary standards developers. Such efforts should include the following:

- **Measure actual performance:** Full reporting of performance information, such as energy and water use, should be widely encouraged. Requirements for proof of performance could be incorporated into voluntary, mandatory, and tax-incentive systems. Streamlined measurement and verification systems should be developed. This could require new models, such as providing partial credit for modeled or prescriptive performance and additional credit for measured results.

- **Measure real-time performance**: Real-time measures of energy use provide instantaneous feedback to occupants, which, especially if they are financially responsible, can bring about changes in behavior.

- **Facilitate benchmarking:** Measured building performance information should be collected in a public database. This database can be used to inform research on building performance, to align modeled results with actual results, to instill confidence among building owners that green buildings work, and to establish benchmarks for labeling and incentive programs. In addition to normalized measures (energy use per spare foot or square meter), absolute measures are needed; without absolute measures of building energy consumption or emissions, it is difficult to notice and remedy the problem of increasingly large homes eclipsing energy efficiency improvements.

- **Require labeling:** Requiring reporting of a building's energy consumption when it is sold would affect purchaser decisions, and it could form the basis for energy-efficient mortgages and other incentives. Furthermore, to create a level playing field for both vendors and consumers, all sales and rental advertising and all sales and lease agreements should be required to display a label showing building performance. As with many of the recommendations presented here, this could be initiated on any scale—from local to national—and it could be mandatory or voluntary. As a ramp-up to eventually mandating consistent reporting, a program could provide an incentive for reporting energy consumption of a building on resale. However, if this information were standardized and easy to access—like the food nutrition labels required by the US Department of Agriculture—it would enable both markets and policies to adjust appropriately. Thus

government should develop a nationally consistent performance indicator for building performance labeling, preferably in conjunction with the organizations managing existing voluntary programs. To be effective, such labeling must be simple to implement, credible, and easy to understand.

- **Develop and use more comprehensive national indicators**: Just as the GDP currently provides a metric of economic activity, indicators valuing natural services (such as water and air purification or resource depletion) could be used to guide North American policies. While not directly targeting green building, the development, measurement, and use of indicators that better reflect the ecological, economic and social wellbeing of nations and states would help decision makers and the public assess priorities. There exists a large body of work on alternative indicators.

Barrier 3: MARKET DYSFUNCTIONS—There is a lack of full-cost accounting

Our economic system systematically overlooks many environmental costs and benefits. This happens on a variety of scales, from economy-wide undervaluing of ecosystem services to the separation between capital (first-cost) budgets and operating budgets. While some modest initiatives exist, there is currently no comprehensive process for calculating the environmental costs and benefits of products and practices and incorporating that information into the market.

Solution: Establish market signals that drive responsible decisions

Making explicit the environmental costs and benefits of more products in the market could tip the balance away from harmful practices and add incentives to develop more benign building practices. Including these environmental costs and benefits in the price of products would have an even greater impact. Owners and building managers are successful when they can deliver what the market demands at a competitive price. A clear and consistent market signal would add unambiguous financial consequence to poor energy performance in buildings. This would encourage the building of better buildings by solidifying the case for energy efficiency. A variety of mechanisms to improve these market signals are worthy of further exploration and adoption:

- **Tax shifting:** While any policy involving taxes is frequently a political show-stopper, a strong selling point for ecological tax reform is that taxes need not be added; rather, they can be shifted from things we want to encourage to things we want to discourage. In particular, shifting taxes from payroll and income to resource consumption and carbon emissions would encourage the development of energy-efficient practices. This principle could be expanded to taxing materials and pollution as well, while removing other taxes. Including rebates or applying tiered taxes could minimize the impact on lower-income people. Small tax-shifting programs are in place in Europe, but much more significant shifts are recommended.

- **Cap and trade:** By putting a price on carbon, the ingenuity of the market can be realized to provide the carbon reduction desired. Carbon markets are gaining traction around the world. However, the implementation details determine whether hoped-for benefits are achieved.

- **Other market-based approaches:** Public institutions use other market tools to influence business decisions. Standard Offer contracts, which provide fixed pricing for renewable energy, provide clarity and confidence for small-scale energy producers. Electric utilities can

also offer rebates for permanent demand reductions or for reducing electricity demand during peak hours.

- **Encourage innovative financing mechanisms:** Background Papers 2a, b and c, on "Towards Sustainable Financing and Strong Markets for Green Building," describe a variety of innovative financing mechanisms and improvements to building valuation that could greatly increase access to capital for green building projects in the three countries. However, in the current market, public institutions can offer revolving loans for energy retrofits or other additions to the public good. Private financing can be influenced by organizations such as the Canada and US Green Building Councils, which provide credible measures of green building performance. This facilitates the implementation of low-interest "green" loans offered by private financial institutions.

Barrier 4: SHORT-TERMISM—Long-term risks and benefits are weak motivators for change

Today's environmental problems do not fit well within our political cycles or economic assumptions. In general, they are long-term, diffuse, and interconnected, with long time lags between cause and result and sometimes even longer delays until scientific agreement is achieved. In the meantime, politics and economics tend to be short-term and territorial. It has, to date, been difficult to muster political capital to implement short-term transitional hardship for long-term delayed benefit, however substantial. In addition, information systems, including the mainstream media, are often equally short-term-focused. Solving this impasse requires long-term thinking and leadership.

Solution: Set clear, aggressive, long-term targets, to be achieved by specific, incremental steps

People are motivated by clear and ambitious challenges. A real vision, with well-articulated goals and endpoints, can energize citizens. These unambiguous goals, when supported by a framework (regulatory and voluntary) that consumers and companies believe will stand up to changing governments, will also spur competition, alter the market, and open the way for previously inconceivable allocation of resources. The Montreal Protocol to eliminate ozone-depleting substances is an example of such a successful process. Education created the political will to make change. The political will led to a long-term regulatory framework that companies were confident would remain in place, which led to investment in R&D, new product development, and changing building practices. Implementation of this sort of solution could include:

- **Set ambitious national and international targets:** Sweden's goal to become carbon-neutral by 2050 is challenging but also effecting dramatic change. In the United States, both the Manhattan Project in the 1940s and the Apollo Project in the 1960s created the collective desire for success that led to major investment around a rallying end-goal. The US Conference of Mayors, the AIA, the RAIC, and many others have already accepted the 2030 Challenge for producing carbon-neutral buildings, and such a goal is well suited to national adoption.

- **Regularly raise the bar:** A series of clearly stated, incremental steps that include a coordinated set of voluntary programs, incentives, and mandatory requirements would establish a predictable path to success upon which businesses could develop strategies. Such a virtuous cycle of incentive to mandatory requirements could include:

    - first, public investment in incentives to the private sector, leadership in the public sector, and education;
    - second, market development (influenced by the above incentives as well as labeling and carbon taxes); and
    - finally, increasingly stringent code requirements.

- **Fund research to continually advance the state of the art**: Many green building research priorities have not been broadly funded—especially those that do not have a manufacturer "constituency." Fully funding national laboratories along with setup and support for new national centers of excellence on such research areas as green roofs, battery technology, life-cycle assessment of materials, passive survivability, daylighting, and building science would greatly advance green building in North America. These efforts would ideally be coordinated through an in-depth scoping project for a massive R&D initiative that would include rapid and widespread technology transfer as a fundamental component.

Barrier 5: SILOS—Historical divisions and territoriality

Numerous historic divisions prevent significant progress. Historic divisions between sectors, agencies and disciplines hinder the integrated process required for green building to prosper. Different levels of government sometimes create conflicting policy. National divisions can impede needed transfer of technology and information. Strong allegiance to either market or government solutions can itself be a barrier to change.

Solution: Take an integrated approach

One major benefit to green building is the many different sectors it touches—governments and business alike are finding that building green requires an integrated approach. Green building efforts have required changing financial structures, building new communication lines among agencies and functions, and learning a systems approach to design and problem solving. If attempted through a checklist process of simply adding environmental features, green building can be quite expensive; undertaking green building through an *integrated* approach, however, can result in lower cost than through conventional practice. The same goes for policy: an integrated approach—in policy, as in design—can solve multiple problems at once, while lack of integration can create multiple problems at once. The increasing interconnectedness of problems calls for interconnected solutions, as follows:

- **Take an integrated approach to policy:** Policymakers and green building professionals alike need to recognize the complementary value of baseline-setting regulations, voluntary standards, national targets, and market-based policy. There are multiple ways to meet the same objectives, and they can be mutually enhancing. For instance, codes can continually raise the minimum acceptable energy performance of new buildings, while voluntary standards push the market toward a higher level. Meanwhile, efficiency-

labeling requirements can inform the market, and "feebates," carbon markets, and fiscal policy can improve the accuracy of pricing. Similarly, sprawl can be addressed through location-efficient mortgages, zoning regulation, and energy or carbon taxes.

- **Create teams or processes that cross traditional boundaries:** Green building touches a wide range of agencies and offices in government—from code officials to environmental management. Green building can benefit from clear communication, coordination, and collaboration among these entities.

- **Consider a wider scope:** The full potential of green building can be realized only by considering such seemingly tangential issues as land use, product manufacturing, and economic development. Addressing health, productivity, and ecosystem services can change priorities and open up new opportunities. Green building adoption could be significantly hastened by non-sectoral regulations, such as tax shifting or emissions trading, that enable the economy to account for environmental gains and losses.

- **Cooperate on goals, standards, and markets:** International agreements on emission reduction targets and other goals can mobilize resources and facilitate cooperation at various levels. Cooperation on standards can reduce each country's required investment and ease the flow of trade. This coordination should be balanced with appropriate regional customization (including climate-appropriate design and R&D, as well as culturally appropriate regulations and standards)**.** Flexible yet stringent international codes and standards**,** with locally appropriate modifications, should be adopted.

- **Ensure that broad agreements do not prevent stronger action at a smaller scale:** Environmental rulings at lower levels of government frequently provide the impetus for larger change. Policymakers should ensure that trade agreements are not used to prevent countries from implementing more stringent environmental standards by classifying those standards as trade barriers. Country-specific barriers—such as the restricting by provinces in Canada of municipalities from requesting performance higher than code minimums—should be prevented.

- **Learn from others—facilitate knowledge and technology transfer:** Much of the effort required for new programs, technologies, and practices has already been made somewhere. Facilitating knowledge sharing and technology transfer at many scales is critical to ensure that limited resources go toward implementation and new advances. From cross-border loaning of expertise to rapid commercialization of new technology to sharing of lessons learned between regional code officials, rapid and widespread sharing of knowledge needs to be facilitated. With global issues such as climate change, it is in the best interest of all countries to ensure that international agreements, such as emissions-trading programs, enable regionally appropriate technology development and technology-leapfrogging. New technologies are more likely to be cost-effective where older technologies are not already established, especially if supporting infrastructure is involved.

2030 Vision for Integrated Green Building Policy

In championing the 2030 goals, we must recall that 2030 is only 23 years away. The green building movement has advanced considerably since 1984, 23 years in the past, but the pace of that change since the mid-1980s has been far slower than what will be needed by 2030 to mitigate climate change; the faster we can rise to the challenge, the better. Each CEC background paper on green building explores the AIA/RAIC 2030 Challenge as a goal. Here we present a vision for the policy context that could be in place by 2030 if those goals were achieved.

A vision to strive for is one in which today's state-of-the-art green building has become the norm. Most, if not all, building codes include environmental considerations, provisions for natural building materials, and mechanisms to swiftly evaluate innovative designs. Building energy codes are regularly updated and used across North America, with modifications made to tune them to local climatic and cultural variations. Government green building programs are comprehensive; they include government purchasing requirements that regularly showcase best practice and an integrated set of incentives and disincentives to drive private-sector improvements. Voluntary standards and organizations continue to be important drivers, defining higher goals for green building, from net-energy-producing to toxic-free buildings. The way in which voluntary standards, codes, and other strategies work together to continuously improve the total stock is a widely recognized and consciously accelerated part of standard practice.

It is common wisdom that the market is a good servant but a bad leader, and that government shouldn't prescribe solutions but rather should establish targets—and set up systems to foster creative solutions. Along those lines, emissions trading—tied to international agreements that set ambitious and regularly reduced limits for carbon emissions—has become a normal part of business for large and small entities. Tax shifting is well underway throughout North America.

Political frameworks embody the principle, agreed to at the United Nations Conference on Environment and Development in 1992, that countries have a common but differentiated responsibility to protect and manage the global commons. Environmental agreements thus include all countries in some form but also specifically encourage trading and leapfrogging in technology. There is also a better understanding of where local, national, and international solutions and approaches to problems are most appropriate and complementary.

Final Considerations

Green building has garnered much attention for its potential contribution to solving the climate problem. While it is critical to implement strategies along these lines, it is also critical to recognize climate as just one example of the kinds of problems that increasingly confront us. We need to not just take a strong stand to address climate change but also learn our lessons from the climate problem, and recognize the importance of addressing issues early. Increased focus on issues such as water, toxics, and material use will help to keep them from reaching the level of concern of the climate problem (if they haven't already). In addition, while the focus here has been on the 2030 Challenge and means to achieve significant reductions in greenhouse gas emissions for the building sector, green building and land use practices and policies must increasingly incorporate strategies to adapt to the impacts of changing climate. Thankfully, in

many cases the strategies are complementary—but due attention must be paid to ensure that these wider benefits are realized.

In the United States and Canada green building is taking off. The continuation of current activities, more municipalities adopting green codes and requirements, and increased recognition of LEED and other voluntary certifications could go a long way toward transforming the building industry. However, much more work will be required in order to achieve the goals of The 2030 Challenge. The overarching recommendations above could greatly aid green building in all three North American countries. If the recommendations were carefully and ambitiously implemented in a coordinated fashion, the resulting transformation would be unprecedented. Ideally, these action items would be part of ambitious and active national and trinational energy and environmental strategies. However, as has been shown already, much can be done even in the absence of such strategies. Within the body of this report are recommendations for all scales—from simple improvements to existing systems to radical, economy-wide shifts. Given different priority issues, cultural and political norms, and existing levels of adoption of green building practices, the implementation strategies for these broader and more detailed recommendations may differ dramatically among the three countries. Canada and the United States have experience with a number of these strategies, but have used none to its potential. There are many opportunities for increased coordination and learning among Canada, the United States and Mexico.