

Green by Design:

RENEWABLE, DURABLE, SUSTAINABLE WOOD

Canadian
Wood
Council



Forest Products
Association of Canada

Green by Design: WOOD - THE BEST CHOICE FOR THE ENVIRONMENT

“WOOD MAKES A MAJOR CONTRIBUTION TO IMPROVING THE OVER-ALL ENVIRONMENTAL PERFORMANCE OF ANY COMMERCIAL OR RESIDENTIAL BUILDING BY REDUCING ENERGY USE, REDUCING RESOURCE USE, MINIMIZING POLLUTION AND REDUCING ENVIRONMENTAL IMPACT.”



Hinton Government Centre
Architect: Manasc Isaac Architects
Photo: Jim Dow

Front Cover
Photo (top left): David Owen Hawxhurst
Courtesy of Chesapeake Bay Foundation



Comfort. Security. Flexibility. North Americans enjoy the highest standard of housing in the world. This privilege is due in large part to wood frame construction. But the advantages of wood go a long way beyond home construction. In fact, wood is the best environmental choice for structures of all types – hockey arenas, libraries, offices, community centres and much more.

The versatility and enduring aesthetic appeal of wood has never been stronger than today. That's why designers and builders keep coming back to wood products including new engineered wood products that offer even more opportunities for wood construction.

But wood offers much more in today's environmentally conscious world.

As designers strive more and more to design green buildings that lessen the demand on the environment, the benefit of wood construction is becoming ever more apparent. Wood makes a major contribution to improving the overall environmental performance of any commercial or residential building by reducing energy use, reducing resource use, and reducing environmental impacts.

Best of all, wood is a renewable resource and Canada's makers of wood products are making sure that it is renewed. Sustainable forest management practices ensure that Canada's supply of wood is increasing. All producers must follow the strict provincial laws and forest practice codes that require that Canada's forests be managed sustainably. This means the Canadian wood products you buy come from forests that are being regenerated, where wildlife habitat is protected and the biodiversity of the forest is maintained. As a result, Canada has 90% of the original forest¹ cover that existed at the time Christopher Columbus landed in America.

In addition to adhering to the forest management requirements, many manufacturers are implementing forest certification and chain-of-custody tracking systems so they can demonstrate the origin of the products and adherence to sustainable forest management practices. Canada is a world leader in the development and implementation of third party forest certification programs. Canadian manufacturers want their customers to have proof that the products meet the sustainability standards.

Wood brings you the best of all worlds – proven construction benefits, along with sound environmental advantages – from the forest floor to the construction site. That makes wood the natural choice for today's designers and builders.

It's green by design.

Green by Design: BUILDING BETTER BUILDINGS

“WARM, NATURAL WOOD USES LESS ENERGY AND PRODUCES LESS AIR AND WATER POLLUTION THAN THE ENERGY INTENSIVE MANUFACTURE OF STEEL AND CONCRETE.”



Architect: Neale Staniszki Doll Adams Architects
Photo: Simon Scott



Everything we do affects the environment around us. It is impossible to construct a building without having some impact on the world's environment. Designers and builders are becoming more aware that the selection of materials, building systems and equipment can reduce the effect of construction on the world around us.

Designers and building owners in North America and elsewhere are embracing the concept of "Green Buildings" and are making choices that reduce energy use, reduce the use of non-renewable materials, and reduce the pollution caused by the manufacture of materials. In this way, they are able to minimize the impact or "environmental footprint" of a building.

As designers make conscious environmental choices, they are returning to the only building material that uses the sun's energy to renew itself in a continuous sustainable cycle – wood. Wood is the only major building material that is renewable. Warm, natural wood uses less energy and produces less air and water pollution than the energy intensive manufacture of steel and concrete. In addition, new technology is producing engineered wood systems that maximize the use of the material to reduce resource use. In looking at the scientific evidence, wood clearly makes the grade as the green building material of choice.

There are many claims of environmental performance, making it difficult for designers to determine the right choices. In order to assist designers, builders and building owners in these choices, criteria and methods to evaluate performance are being developed by the US and Canada. As the interest in "Green Building" grows, building rating systems such as Leadership in Energy and Environmental Design (LEED™) have emerged as one way to rate the environmental impact of construction. These rating systems are founded on the four guiding principles of green building.

Green by Design: THE FOUR GUIDING PRINCIPLES OF GREEN BUILDING

“WOOD IS THE BEST CHOICE FOR SATISFYING THE FOUR BASIC PRINCIPLES OF GREEN BUILDING.”

1. REDUCING ENERGY USE DURING THE BUILDING SERVICE LIFE

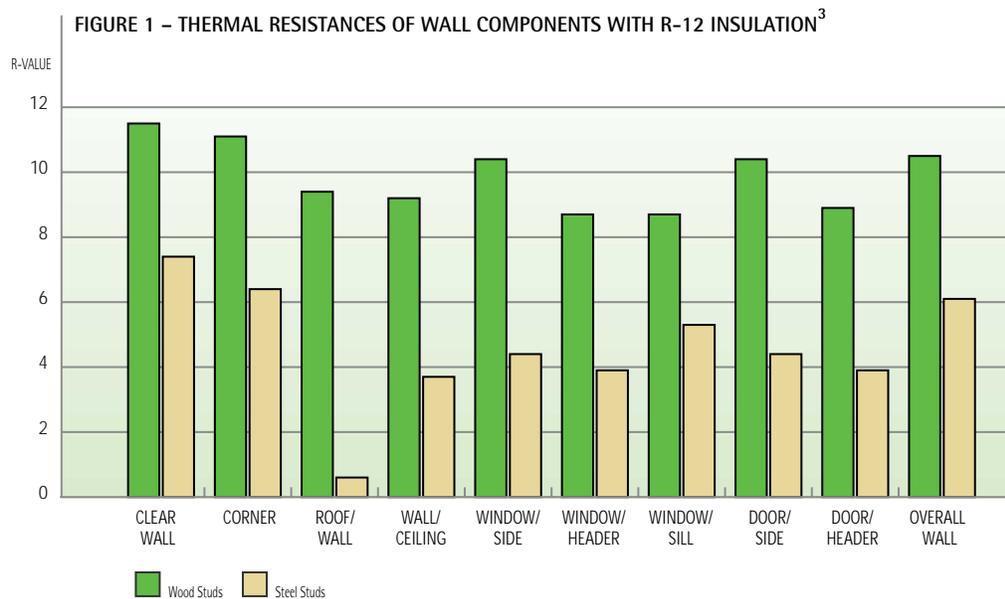
One third of the energy used in North America is used to heat, cool and operate the buildings we live and work in.² As most energy is produced from non-renewable fossil fuels that produce greenhouse gases, reducing energy use in a building will lower its environmental impact. This can be accomplished by low energy lighting, passive ventilation systems, and minimizing a building's heating and cooling needs. The materials and construction of a building have a significant impact on the last category: minimizing heating and cooling needs.

Wood has very good insulating value compared to other materials. Laboratory tests conducted at the National Research Council of Canada and the Oak Ridge National Laboratory show that light metal framing significantly reduces the effective thermal resistance, or R-value, of a wall assembly resulting in increased energy use (Figure 1). Wood-frame construction is easy to insulate to high standards. In fact, several wood-frame assemblies have been designed for the Arctic.

Wood-frame construction can easily be adapted to any energy code requirement. This means wood frame houses, offices, schools, and other commercial and industrial buildings can keep energy usage for heating and cooling low.



The Phillip Merrill Environmental Center, headquarters of the Chesapeake Bay Foundation, is a LEED™ Platinum project
Architect: SmithGroup
Photo: Dave Harp



For more detailed information on the energy efficiency advantages of wood, see *The Thermal Performance of Light-Frame Assemblies* at http://www.cwc.ca/publications/tech_bulletins/

2. MINIMIZING EXTERNAL POLLUTION AND ENVIRONMENTAL DAMAGE

In evaluating the environmental impact of building design, the impact on the quality of air, water and soil must be taken into consideration. This includes not only minimizing waste products from the building, such as wastewater, solid wastes and chemicals, but also minimizing the pollution caused by the manufacture of the materials used in the building.

It is difficult, however, for designers to determine whether the materials they choose cause air or water pollution during their extraction, manufacture and transportation to the site as these occur away from the project. Designers may be aware that concrete manufacture creates CO₂ emissions and that steel manufacture results in toxic chemicals being released into the water, but are not aware of a means to evaluate these effects. Life cycle analysis is an emerging science that evaluates and allows designers to compare the effect that materials have on the environment over their lifetime.

In Canada, the ATHENA™ Sustainable Materials Institute has developed databases and a computer program to evaluate the environmental impacts of whole buildings and building assemblies. In the US, the federal government has funded the first phase of a project, led by the ATHENA™ Sustainable Materials Institute, to develop a life-cycle inventory for a range of materials including building materials and products. The second phase of the project is now getting underway.

ATHENA™'s life-cycle research proved what designers knew intuitively, and what has been demonstrated in comparable work in Europe: when it comes to minimizing external pollution of air, water or soil, wood far surpasses other materials.

The research demonstrated that using wood results in:

- lower greenhouse gas emissions than steel or concrete
- lower air pollution than steel or concrete
- lower water pollution than steel or concrete
- lower solid waste by-products than steel or concrete

The next section, *A Life Cycle Approach to Building Design*, provides further explanation about life cycle analysis and how wood building products have the lowest environmental impact when compared to other major building materials.

3. REDUCING EMBODIED ENERGY AND RESOURCE DEPLETION

Embodied energy includes all energy, direct and indirect, used to extract, manufacture, transport and install materials. This principle aims to lower the energy used, not only during service life, which tends to be in the control of the designer, but also for producing the materials. This is another area where life-cycle analysis can provide the research required for informed choices.

The manufacture of wood uses very little energy so, even though it may be brought to the building site from outside the area, the embodied energy will normally be less than locally manufactured concrete. Life-cycle comparisons demonstrate that wood has low embodied energy and is an excellent choice to meet this principle.

This principle also encompasses reducing the depletion of resources by minimizing the amount of resources used and, in particular, the amount of non-renewable resources used.

Wood is the only major building material that is renewable. Canada's sustainably managed forests ensure that there is an ample supply (see *Canada's Sustainable Forest Resource*). New manufacturing technology allows every part of the tree to be used so that nothing is wasted. Advanced engineered wood products make use of fast growing species to produce high strength products without requiring large dimension timbers to meet building needs. In addition, engineered building systems, such as trusses, allow larger clear spans while reducing the amount of material required.

Wood is also durable which means that the materials will last for a long time and not need to be replaced. Churches in Norway and temples in Japan have lasted over a thousand years. In North America, there are many examples of historic wood

buildings from the 16th century that are still standing. Even the foundation of the Empire State Building rests on wood piles!

In fact, not only does wood last, but there are many examples of new buildings that have used wood reclaimed from decommissioned buildings. This is the ultimate in reducing the consumption of materials, but even the use of new wood gives it a significant advantage over other materials. Wood is the only major building material that is renewable – a reason why Canada's forest base is still abundant after 150 years of harvesting. Wood is natural, biodegradable, recyclable, and originates from Canada's sustainably managed forests.

4.

MINIMIZING INTERNAL POLLUTION AND DAMAGE TO HEALTH

This green building principle deals with the health of the indoor environment.

Wood is a natural material and wood construction has over a century of proven performance. It can serve a functional application (structural) and also often serves as a finish material because of its aesthetic appeal. For example, timber frame construction offers amazing architectural potential and wood flooring is renowned as a feature that wears well and minimizes the accumulation of dust and microbes. And the engineered wood products used for sheathing and for beams and joists are made with glues that don't contribute to allergies.

Green building rating systems are being applied more and more. Wood is a naturally occurring and renewable material that excels under the scrutiny of green building review. Canadian wood measures up to the requirements and comes out the winner in all aspects when compared to other materials. Wood reduces energy use, minimizes external and internal pollution and is the only material that comes from a sustainable resource. Wood is the natural choice for building environmentally safe and secure homes and buildings.

Interested in more information about the principles of green building? Visit:

Environmental Building News
www.buildinggreen.com

Canadian Wood Council
www.cwc.ca

LEED™ (Leadership in Energy and Environmental Design) Green Building Rating System
www.leadbuilding.org

Green by Design: A LIFE CYCLE APPROACH TO BUILDING DESIGN

“LCA IS BECOMING THE WORLD STANDARD FOR DEALING WITH COMPLEX ENVIRONMENTAL ISSUES AND IMPROVING ENVIRONMENTALLY BASED DECISION-MAKING. LCA OBJECTIVELY MEASURES THE IMPACT OF MATERIALS AND ALLOWS THEM TO BE COMPARED TO OTHER OPTIONS. WHEN EXAMINED BY LCA AND OTHER MEASURES, CANADA’S WOOD PRODUCTS ARE CLEAR WINNERS.”



Nicola Valley Institute of Technology
Architect: Busby + Associates Architects
Lead Designer + Photo: Alfred Waugh, MAIBC



We can only design greener buildings if we know how each of the component parts – such as concrete blocks, wood studs, nails, glass and paint – affect the environment over the long term. That's where life cycle analysis comes in.

Life Cycle Assessment or LCA is an internationally-recognized analytical method that quantifies energy and material usage, emissions to the air and water, as well as solid waste generated at each stage of a product's life cycle. LCA asks some basic questions – the same questions that more and more builders and designers are asking:

How is the environment affected at each stage of a building product's life-cycle – from resource extraction, through manufacturing, transportation, installation and eventual disposal?

How can the impacts on the environment be compared for one building design or choice of materials over another?

What is the cumulative impact of energy use over the life cycle of a building?

LCA is becoming the world standard for dealing with complex environmental issues and improving environmentally-based decision making. LCA objectively measures the impact of materials and allows them to be compared to other options. When examined by LCA and other measures, Canada's wood products are clear winners.



Architect: Bohlin Cywinski Jackson
Photo: Karl Backus

ATHENA™ HELPS THE WORLD MAKE GREEN DECISIONS

Assessing the environmental impact of buildings is a complex and daunting challenge. A Canadian leader in this area is the ATHENA™ Sustainable Materials Institute, a not-for-profit organization which has developed ATHENA™, an environmental assessment tool for the building, design and research communities.

Designers can use ATHENA™ to look at the life cycle environmental effects of a complete structure or of individual assemblies (a limited function version has been available free on the ATHENA™ website). Manufacturers can use the model to benchmark processes and assess the environmental effects of alternative technologies or production processes. Researchers can use it to better understand the environmental implications of the building sector, including related policies.

In recent comparative ATHENA™ studies against other building materials, wood ranks high in all aspects of environmental performance with the lowest overall environmental impact.

Interested in more information about life cycle analysis or ATHENA™? Visit:

Canadian Wood Council
www.cwc.ca

ATHENA™ Sustainable Materials Institute
www.athenasmi.ca

Forintek Canada Corp.
www.forintek.ca

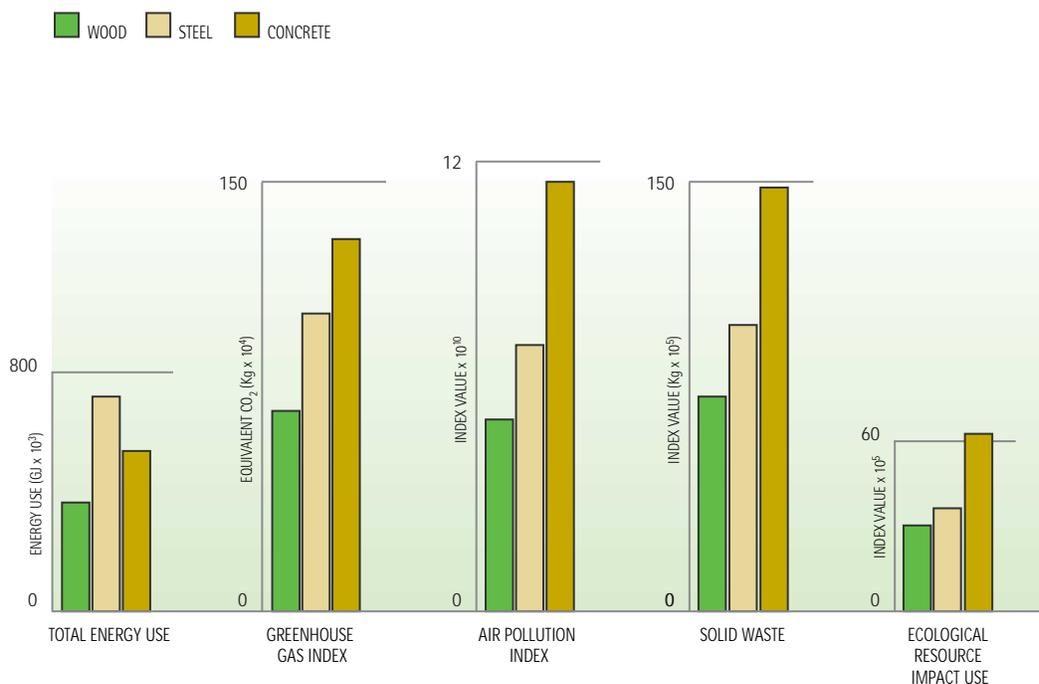


Photo: Dave Harp
Courtesy of Chesapeake Bay Foundation

A TALE OF THREE BUILDINGS

The ATHENA™ life cycle assessment software was used to compare the life cycle environmental effects of a 4,620 m² (50,000 ft²) office building constructed using wood, steel or concrete as the main structural materials. Now, consider the results (Figure 2):

FIGURE 2 – OFFICE BUILDING LIFE CYCLE COMPARISON CHART (1996)



TOTAL ENERGY USE: The wood building used the least energy. The concrete option required 1.7 times the energy for wood. The steel option required 2.4 times the energy. Wood simply does not require much energy to manufacture.

GREENHOUSE GASES: The wood building had the lowest greenhouse gas emissions. The steel building generated 1.45 times and the concrete building generated 1.81 times the greenhouse gases for wood.

AIR POLLUTION: The wood design had the lowest air pollution index. The steel building produced 1.42 times and the concrete building produced 1.67 times the air pollution index.

SOLID WASTE: The wood design had the lowest solid waste. This takes into account both manufacturing and on-site construction waste. Steel produced 1.36 times and the concrete produced 1.96 times the solid waste. This means there is virtually no waste during the manufacturing process and the use of engineered wood products has radically reduced the on-site construction waste.

ECOLOGICAL RESOURCE USE: The wood design had the lowest ecological resource use index. Steel was 1.16 times and concrete was 1.97 times the index for wood. This factor compares the long-term effects of resource extraction. Although forestry affects a large area, reforestation means the effects are short term. Sustainable forest management practices help ensure that disruption is minimized.

CONCLUSION: The office building built with wood had lower environmental impact for energy use, greenhouse gases, air and water pollution and ecological resource extraction than the steel or concrete building. A similar case study of residential buildings (comparing wood, steel and concrete construction) produced similar findings in terms of wood's superior environmental performance.

“The office building built with wood had lower environmental impact for energy use, greenhouse gases, air and water pollution and ecological resource extraction than the steel or concrete building.”



Architect: Salmela Architect



Engineered wood products allow long span capability while retaining the aesthetic appeal and environmental advantage of wood construction.

Interested in more information about the case study comparing the environmental effects of building systems or the life cycle analysis for residential buildings? Visit:

Canadian Wood Council

www.cwc.ca

Green by Design: CANADA'S SUSTAINABLE FOREST RESOURCE

“CANADA IS A WORLD LEADER IN FOREST CONSERVATION, PROTECTION AND SUSTAINABLE USE.”

There are two main attributes that make wood a good environmental choice. The first, as shown in the previous sections, is their low life-cycle environmental effect - wood products use less energy and cause less air and water pollution than other structural building products.

Canadian wood products also meet the second attribute: they come from sustainably managed forests.

Canada's storehouse for wood and wood products is the country's carefully managed and government-regulated commercial forests. Canada's forest land is vast and over 90% of the country's original forest cover has been maintained – more than any other country – despite the accommodation of a population of 30 million people (Figure 3).

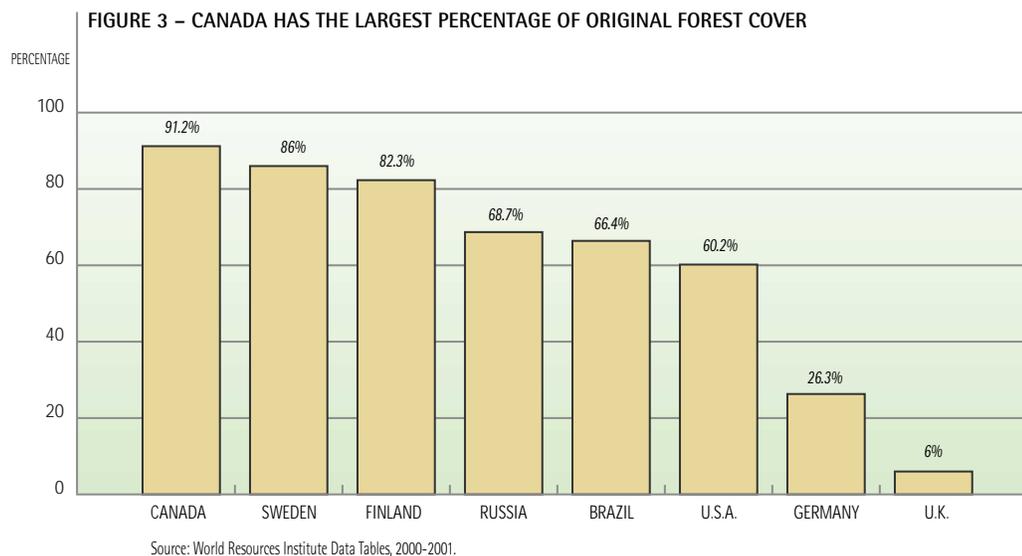
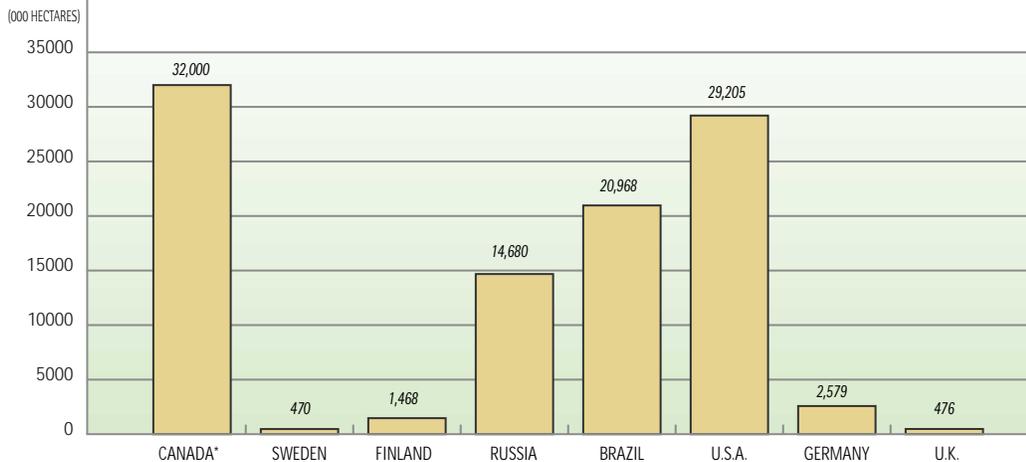




FIGURE 4 – CANADA HAS THE LARGEST AREA OF PROTECTED FORESTS



*[this does not include the massive additions since 1996] Source: World Resources Institute Data Tables, 2000-2001.

In fact, the forest that has been lost is due to clearing for agricultural and urbanization purposes. And, 94% of Canada's forests are publicly owned and strictly regulated to protect the environment. Annually, Canada harvests less than *one-quarter of 1%* of its public forests.

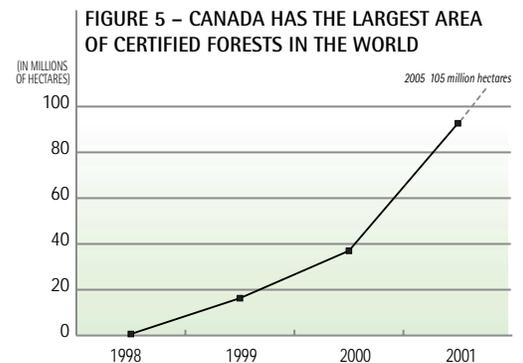
Canada is a world leader in forest conservation, protection and sustainable use. Canada's forest products come with the combined commitments of government and industry to harvest responsibly, to renew and to replenish:

- All forestry companies are required to respect provincial legislation that is intended to ensure that forests are sustainable and forest uses other than commercial harvesting are respected.
- Harvested areas are required by law to be promptly regenerated with species best suited for a particular site – species that mimic the original forest cover. Forest policies and regulations also safeguard biodiversity, soil and water quality and other ecological values.
- Canada has more than 32 million hectares (80.2 million acres) of protected forest (an area equivalent to the size of Germany). This is the largest area of protected forest of any country in the world (Figure 4).
- Canada has the largest area of certified forests in the world (Figure 5). The 93 million hectares now certified is about 40% of Canada's 234 million hectares of commercially productive forest.

Interested in more information about Canada's forests and forest management? Visit:

Natural Resources Canada
www.nrcan.gc.ca

Forest Products Association of Canada
www.fpac.ca



Source: FPAC survey, 2001.

Green by Design: BUILDING ON CANADA'S CERTIFICATION SUCCESS

“CANADA HAS THE LARGEST AREA OF INDEPENDENTLY-CERTIFIED FOREST IN THE WORLD.”

Certified forest products are materials that originate in forests that have been independently audited and certified by a credible third-party as being well managed according to nationally or internationally recognized principles. Certification embraces the following general objectives:

- conservation of the biodiversity (plant and animal species) and representative forests;
- conservation of soil and water quantity and quality;
- regulation of harvest levels with regard to long-term productivity;
- continual improvement of forest management and public involvement; and
- integration of timber and non-timber values.

Certification is a fairly new concept. As more companies become certified, Canadian wood products with a sustainable forestry pedigree will be available in the marketplace. In fact, wood is the only major building material that has embarked on environmental product certification programs. Makers of other materials like concrete and steel are encouraged to make the environmental performance of their products equally progressive and transparent.



“In fact, wood is the only major building material that has embarked on environmental product certification programs.”

Hilton Government Centre
Architect: Manasc Isaac Architects
Photo: Jim Dow



Like financial audits, forest management certification is a new way of holding a company accountable. Canadian forest product companies are continuing their world-leading pace of implementing forest management certification.

That's why Canada has the largest area of forest management certified of any country in the world (Figure 5).

The practice provides designers, builders, policy makers and customers assurances that their wood products come from sustainable forests. Canada now has forest management on more than 93 million hectares certified to one or more of the four leading standards used in North America. This is 40% of the Canadian commercial forest.

The four voluntary certification systems being used are:

- Internationally recognized ISO 14001 Environmental Management System. This is a generic environmental standard which, when applied to forest management, provides a sound foundation for moving on to any three of the following forestry-specific certification standards
- Canada's National Sustainable Forest Management Standard (CSA)
- American Forest & Paper Association's Sustainable Forestry Initiative (SFI)
- Forest Stewardship Council's Principles (FSC)

Interested in more information about certification and Canada's forests? Visit:

Canada's National Sustainable Forest Management Standard (CSA)

www.csa-international.org/certification/forestry/

Forest Stewardship Council's Principles (FSC)

www.fsccanada.org

Sustainable Forestry Initiative (SFI)

www.aboutsfi.org

International Standards Organization (ISO)

www.iso.ch

Canadian Sustainable Forestry Certification Coalition

www.CertificationCanada.org

REFERENCES:

1. The State of Canada's Forests, 2000-2001, Natural Resources Canada, 2001.
2. Howard, N. & Sutcliffe, H., Precious Joules, Building pp 48-50, March 1994.
3. Kosny, Jan, Comparison of Thermal Performance of Wood Stud and Metal Frame Wall Systems, Oak Ridge National Laboratory, Journal of Thermal Insulation and Envelopes, Volume 19 – July 1995.

Green by Design:
**ASK FOR CANADIAN WOOD AND GET
THE BEST ENVIRONMENTAL CHOICE**

“ANY WAY YOU CUT IT, CANADIAN WOOD PRODUCTS OFFER EXCEL-
LENT VERSATILITY AND VALUE – BOTH AS A BUILDING MATERIAL
AND AN ENVIRONMENTAL CHOICE.”



CANADIAN WOOD COUNCIL

1400 Blair Place, Suite 210
Ottawa, Ontario K1J 9B8
Tel: (613) 747-5544
Fax: (613) 747-6264
www.cwc.ca

FOREST PRODUCTS ASSOCIATION OF CANADA

55 Metcalfe Street, Suite 1380
Ottawa, Ontario K1P 6L5
Tel: (613) 563-1441
Fax: (613) 563-4720
www.fpac.ca