THE IMPACT OF WOOD USE ON NORTH AMERICAN FORESTS

CAN SPECIFYING WOOD FOR BUILDINGS CONTRIBUTE TO FOREST SUSTAINABILITY?

Presented by: THINK WOOD®

Regenerating forest, Oregon. Photo: Ian Shive, courtesy of Plum Creek

LEARNING OBJECTIVES

At the end of this program, participants will be able to:

1. Evaluate the use of wood as a construction material in the context of long-term forest sustainability as well as attributes such as low embodied energy and light carbon footprint.
2. Discuss forest sustainability measures such as biodiversity, soil and water quality, and harvest vs. net growth.
3. Examine the concept that using wood in buildings provides an incentive to landowners to keep forested lands forested instead of converting them to uses such as urban development.
4. Compare the carbon benefits of an unmanaged forest vs. a managed forest where timber is used for wood buildings.

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
GBCI CREDIT: 1 CE HOUR

AIA COURSE NUMBER: ARMAY2016.2
GBCI COURSE NUMBER: 0920007603

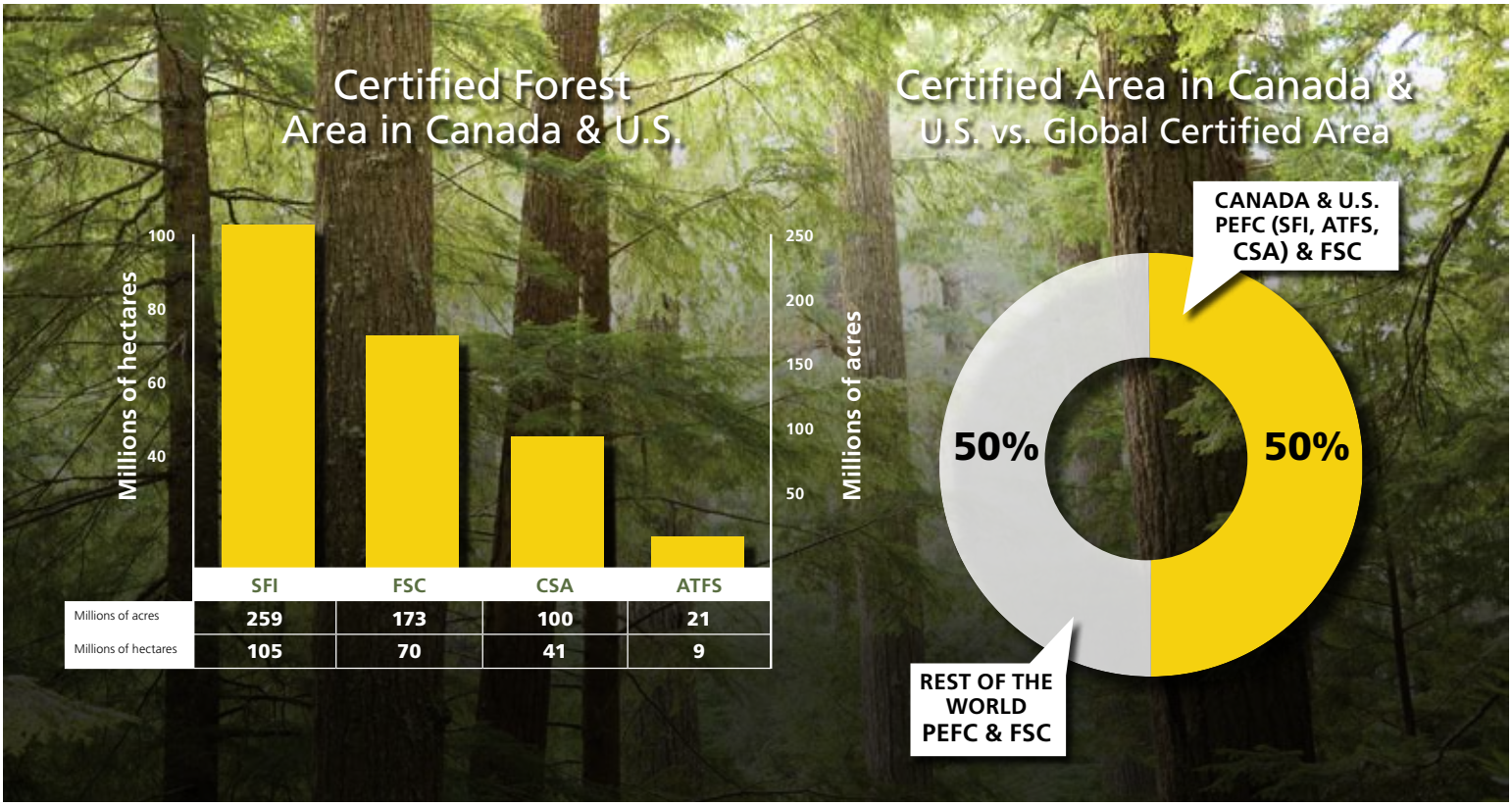
Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR516Course2 and complete the quiz for free as you read this article. If you are new to Hanley Wood University, create a free learner account; returning users log in as usual.

By Roxane Ward and Dave Patterson, RPF

As green building has evolved beyond its initial emphasis on energy efficiency, greater attention has been given to the choice of structural materials and the degree to which they influence a building's environmental footprint. Increasingly, wood from sustainably managed forests is viewed as a responsible choice—for a number of reasons. Wood grows naturally by harnessing energy from the sun, absorbing carbon dioxide and releasing oxygen. It is renewable and a carbon sink, and outperforms other materials in terms of embodied energy, air and water pollution, and other impact indicators.[1]

But what about the forest? The benefits above notwithstanding, how can building designers be sure that specifying wood doesn't negatively impact the North American forest resource?

As this course will demonstrate, the answer to that question has several elements. On one hand, North American forest practices are among the world's best and the amount of forested land, in both the U.S. and Canada, has been stable for decades. On the other, there are threats—such as climate change, increased wildfire, insect infestation and disease, and deforestation due to urban development—which are broader than the forest industry and must be addressed at a societal level. Drawing from a wide range of research publications, the following pages will examine the current state of North American forests, modern forest practices and criteria for sustainability, and consider some of the challenges that could profoundly impact the future of the forest resource. In this context, the course will also discuss why strong markets for wood products provide an incentive for landowners, not only to invest in forest management, but to keep forested land forested even though greater profit can often be made by converting it to other uses.



Forest certification credit: www.sfiprogram.org, www.pefc.org, www.fsc.org, www.forestfoundation.org. Photo: Frank Rosenstein, courtesy of Plum Creek

IS NORTH AMERICA RUNNING OUT OF FORESTS?

"On the whole, no evidence suggests that we are using up our forests. In fact, the total area of forests has been stable, and the volume of wood on them increasing."—National Report on Sustainable Forests–2010[2]

Until the early 1900s, settlers coming to North America cleared an average of 2.1 acres of forest per person to survive and grow food.[3] Since then, the establishment of industrial agriculture and other changes in land use have mitigated the need for forest clearing and forest acreage has been stable for close to a century.

The U.S. reported an annual increase in forest area of 0.12 percent in the 1990s and 0.05 percent from 2000 to 2005, while Canada reported no change.[4] In both countries, responsible forest management has resulted in more than 50 consecutive years of net forest growth that exceeds annual forest harvests.

United States

According to the National Report on Sustainable Forests–2010, the U.S. has approximately 751 million acres of forest area, which is about one third of the country's total land area. "This stability is in spite of a nearly three-fold increase in population over the same period and is in marked contrast with many countries where wide-scale deforestation remains a pressing concern."

> Deforestation is the permanent conversion of forest land to non-forest land uses. Around the world, it is a major issue and contributor to global warming. In the U.S. and Canada, the rate of deforestation has been virtually zero for decades[5]; however, the value of forest land in agriculture and real estate maintains pressure to convert.

Forty-four percent of U.S. forests are owned by entities such as national, state and local governments; the rest are owned by private landowners, including more than 22 million family forest owners. The fact that net forest growth has outpaced the amount of wood harvested for decades supports the idea that landowners who depend economically on the resource have a strong incentive for their sustainable management. This aligns with global forest data, which indicates that forest products and industrial roundwood demands provide the revenue and policy incentives to support sustainable forest management.[6] However, with urban development and other uses increasingly vying for land, an issue going forward will be making sure that landowners continue to have reasons to keep forested lands forested.

Canada

Canada has 860 million acres of forestland,[7] which is about 90 percent of the forested area it had before European settlement.[8] Ninety-four percent of the forest is publicly owned and managed by provincial, federal and territorial governments. The remaining 6 percent is on private property belonging to more than 450,000 private landowners.

Tree planters. Photo courtesy of www.naturallywood.com

Wood supply is the term used to describe the estimated volume of timber that can be harvested from an area while meeting environmental, economic and social objectives. Governments regulate harvest levels on public lands by specifying an annual allowable cut.

TOOLS FOR ACCOUNTABILITY

Although types of ownership vary, forest management in the U.S. and Canada operates under layers of federal, state/provincial and local regulations and guidelines that foresters and harvesting professionals must follow to protect water quality, wildlife habitat, soil and other resources. Laws addressing safety and workers' rights also govern forestry activities. Training, continuing education and certification for loggers and foresters support continuous improvement as well as the use of forestry best management practices (BMPs). Government agencies monitor forest management activities for compliance with regulations.

Forest Certification

While forestry is practiced in keeping with regulations and guidelines that consider environmental, economic and social values for that particular country, voluntary forest certification allows forest companies to demonstrate the effectiveness of their practices by having them independently assessed against sustainability standards.

Wood is the only building material that has third-party certification programs in place to demonstrate that products being sold have come from a responsibly managed resource. As of January 2015, more than 500 million acres of forest in the U.S. and Canada were certified under one of the four internationally recognized programs used in North America: the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), Canadian Standards Association's Sustainable Forest Management Standards (CSA), and American Tree Farm System (ATFS). This represents approximately half of the world's certified forests.[9]

According to the National Association of State Foresters, "credible forest certification programs include the following fundamental elements: independent governance, multi-stakeholder standard, independent certification, complaints/appeals process, open participation and transparency. While in different manners, the ATFS, FSC, and SFI systems include the fundamental elements of credibility and make positive contributions to forest sustainability."[10] Similarly, the World Business Council on Sustainable Development released a statement supporting an inclusive approach that recognizes these programs as well as CSA (and others).

The FSC, SFI, CSA and ATFS programs all depend on third-party audits where independent auditors measure the planning, procedures, systems and performance of on-the-ground forest operations against

Managed forest in the Southern U.S. Photo courtesy of Weyerhaeuser

the predetermined standard. The audits, performed by experienced, independent foresters, biologists, socio-economists or other professionals, are conducted by certification bodies accredited to award certificates under each of the programs. A certificate is issued if a forest operation is found to be in conformance with the specified forest certification standard.[11]

DEFINING FOREST SUSTAINABILITY

Forest sustainability was first described in the book Sylvicultura oeconomica by German author Hans Carl von Carlowitz, published in 1713—and, while our understanding of what constitutes sustainability has evolved significantly in 300 years, it has long been a cornerstone of forest management.

Von Carlowitz's work planted the seed for what we now know as sustainable development, defined in the landmark 1987 report of the World Commission on Environment and Development (the 'Brundtland Report') as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

The United Nations Food and Agriculture Organization (UNFAO) defines sustainable forest management as "the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biological diversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological economic and social functions, at local, national and global levels, and that does not cause damage on other ecosystems."

In the U.S. and Canada, forest sustainability is measured against criteria and indicators that represent the full range of forest values, including biodiversity, ecosystem condition and productivity, soil and water, global ecological cycles, economic and social benefits, and social responsibility. Sustainability criteria and indicators form the basis of individual country regulations as well as third-party sustainable forest certification programs.

THE ART AND SCIENCE OF FOREST MANAGEMENT

There is a good reason forestry is often described as a blending of art and science. Foresters must follow the laws, regulations and best practices of forestry and apply forest science and the results of ongoing research. They must also nurture the art of recognizing the unique features of a specific forest and site and develop the management design that will meet diverse environmental, economic and social interests, including the needs and objectives of the landowner.

The blending of art and science that occurs in forest management is similar to what occurs in a building project. Like the multi-disciplinary team that designs and constructs buildings, sustainable forest management involves a team that includes foresters, engineers, biologists, hydrologists, surveyors and loggers that plan and care for the forest. In both cases, members of the team must address the technical requirements and obligations of their profession while taking into consideration the tastes and desires of the project partners and owners. In the case of forestry, this includes caring for the forest while meeting the needs of landowners, the environment and their community.

PLANNING FORESTS OF THE FUTURE

Although approaches differ, effective multi-decade planning is a fundamental part of forest sustainability.

On national forests in the U.S., for example, conformance with the National Forest Management Act (NFMA) requires the development of a comprehensive plan, utilizing substantial public involvement and sound science to guide management decisions.

In Canada, where most forests are publicly owned, integrated land-use planning seeks to balance the economic, social and cultural opportunities in a forested area while maintaining the well-being of the forest. The public gets a say in decisions about how the land and its resources are managed; forest companies must solicit public input on their forest management plans, which must be approved by government agencies.

Through the use of diverse silviculture practices, foresters tend to the forest, ensuring regeneration, growth and forest health, and providing benefits that support a full range of forest values. For example, forest management practices are often selected to mimic natural disturbances and the cycles of nature that are associated with a specific region, forest type or species. Natural disturbances, including windstorms, hurricanes, ice storms, forest fires and insect or disease outbreaks, are a fact of life in the forest. To mimic these events, foresters may vary the size of the openings created by forest management, the intensity of management, the retention of wildlife reserve areas, and the frequency with which management occurs.

FOREST REGENERATION

Following harvest, forests can be regenerated either naturally or through planting or seeding. One is not inherently better than the other. Rather, the choice of method varies based on factors that include biology of the tree species, availability of on-site seed sources, site ecology, type of harvest system employed and objectives for the site.

In Canada, where forest regeneration is required on public lands, just under half of the total harvest area is regenerated naturally and the rest through planting or seeding.[12]

Douglas-fir working forest in Tillamook County, Oregon. Photo courtesy of the Oregon Forest Resources Institute

ENSURING HEALTHY FOREST GROWTH

After planting new trees, foresters use a variety of practices to support and encourage healthy forest growth, including understory thinning as well as understory planting and weeding. These treatments are applied to sustain ecosystem health and function, improve stand quality and produce desirable tree qualities that provide important economic and ecological values. They can also help to reduce the risk of wildfire in forests where previous fire prevention and other factors have resulted in an excess buildup of woody debris.

To control competing vegetation or brush, foresters use a variety of tools including chemical (e.g., herbicides), manual (e.g., saws and axes) and biological (e.g., sheep).

When properly used, herbicides can be an appropriate tool in a sustainably managed forest. In stands of pine and spruce, for example, pioneer plant species such as raspberry and trembling aspen thrive on disturbed sites with open growing conditions (i.e., following harvest), easily outcompeting newly planted seedlings for nutrients, light and water. Similar to a garden, weeds that are

Thinning treatments were used in this Southern U.S. forest to support and encourage healthy growth. Photo: Colin Hackley, courtesy of Plum Creek

not controlled will take over and prevent the growth of desired species.

According to the U.S. Environmental Protection Agency (EPA), commercial and government use of herbicides (which includes forestry) accounts for 9 percent of use nationwide, while home and garden use accounts for 13 percent and the agricultural sector accounts for 78 percent.[13]

All pesticides applied in the U.S. must be registered with the EPA and must carry federally approved labels describing permitted uses and appropriate protection measures. To be registered, pesticides must be tested for effects on humans and the environment, and applicators of pesticides on forest land must also comply with state laws. In Canada, the Pest Management Regulatory Agency (PMRA) of Health Canada reviews and regulates all pesticide use under the federal Pest Control Products Act. Such registration indicates that, based on extensive expert review of all available scientific evidence, registered products have no potential for significant effects on human or environmental health when used as directed.

IS THERE A NEED TO 'GREEN' THE FOREST SECTOR?

"Forestry is the art and science of creating, using and conserving forests. The forestry profession was a pioneer in developing techniques for sustainable management and, later, techniques for the multiple use of forests. More recently, broad holistic concepts such as ecosystem management and landscape management have been developed, tested and applied. These are all elements of the sustainability and sustainable management of a wide variety of renewable resources. Although the term "sustainable forest management" is synonymous with "good forestry," forestry and forest management are sometimes viewed as potentially damaging to the environment. This fear is justified where unscientific or illegal forest practices are used, but the argument that there is a need to "green the forest sector" appears to give too little credit to forestry's core concepts."

State of the World's Forests 2012, UNFAO

PROTECTING SOIL AND WATER QUALITY

Soil is made up of a complex mixture of minerals, organic matter, gases, liquids and micro-organisms. It's an obvious and essential component of forest ecosystems, providing both a base for trees, plants and organisms, and the minerals and nutrients needed for their growth. In a forest, soil is held together by the root structures of trees and plants, and protected from erosion by tree trunks, forest floor vegetation and woody and leafy debris.

In forestry (as in agriculture), soil is the base resource; the medium that supports the ecosystem. It is therefore essential that soil be protected from damage and erosion.

For example, to avoid compacting sensitive soil, foresters may use heavy equipment in the winter when the ground is frozen instead of summer when it's soft, or use cable logging techniques instead of ground-based equipment.

Protecting against erosion is necessary, not only for the forest, but to keep soil from entering water bodies where it could be detrimental to fish habitat. Strategies involve avoiding sensitive areas (such as unstable slopes) and road construction techniques that include seeding the road with grass, creating diversion ditches and adding water bars (diagonal channels that prevent water from flowing down the length of the road).

CONSERVING BIODIVERSITY

Biological diversity, or biodiversity, refers to the variety of species and ecosystems on earth and their ecological systems. An important indicator of forest sustainability, it enables organisms and ecosystems to respond to and adapt to environmental change.

Conserving biodiversity is an essential part of forest sustainability and involves strategies at different scales.

At the landscape level, networks of parks and protected areas conserve a range of biologically and ecologically diverse ecosystems. Tens of millions of acres of North America's forests are protected within wilderness areas and parks and through regional and local programs. Forests with special ecological attributes are also protected by established conservation easements developed through the work of local land trusts.[14]

Photo: Ian Shive, courtesy of Plum Creek

From a forest management perspective, conserving biodiversity involves strategies that create a diversity of ecosystem conditions through space and time, to provide diverse habitat for native species of plants and animals across the landscape. Among other things, this may include selecting harvest, renewal and tending treatments that maintain existing tree species diversity, maintaining mapped areas of standing trees within a harvested site, or planning harvest patterns based on wildlife habitat management objectives.

CHALLENGING PRECONCEPTIONS

This course has touched on a variety of criteria for forest sustainability. Another is public

discourse. Frank discussion regarding the status of North American forests, how they're managed and the challenges they face is necessary to maintaining the many values they provide. In that spirit, this section addresses some of the most common concerns about forests and the forest industry.

True or false: Leaving the forest alone has the greatest climate change benefit

False. There is growing awareness among building designers that using wood can reduce a building's carbon footprint, provided it comes from a sustainably managed forest. At the core of wood's carbon benefit is the fact that as trees grow they absorb carbon dioxide (CO_2) from the atmosphere, release the oxygen (O_2) and incorporate the carbon into their wood, leaves or needles, roots and surrounding soil. Young, vigorously growing trees take up carbon quickly, with the rate slowing as they reach maturity (typically 60–100 years, depending on species and environmental factors).

Over time, one of three things happens:

- When the trees get older, they start to decay and slowly release the stored carbon.
- The forest succumbs to wildfire, insects or disease and releases the carbon quickly.
- The trees are harvested and manufactured into products, which continue to store much of the carbon (Wood material is approximately 50 percent carbon by dry weight.) In the case of wood buildings, the carbon is kept out of the atmosphere for the lifetime of the structure—or longer if the wood is reclaimed at the end of the building's service life and either re-used or remanufactured into other products.

Unless the area is converted to another use, the cycle begins again as the forest regenerates and young seedlings once again begin absorbing CO_2.

The other important aspect to wood's relatively light carbon footprint is the fact that wood products require less energy to manufacture than other major building materials,[17] and most of that comes from renewable biomass (i.e., sawdust, bark and other residual fiber) instead of fossil fuels. In the U.S., biomass fuels provided 75 percent of the energy required at wood product facilities in 2010.[18]

In Canada, bioenergy accounts for 58 percent of the energy used by the entire forest industry.[19]

A great deal of research has been undertaken to determine how forests can be managed to maximize their carbon benefits. According to a report from the Society of American Foresters,[20] numerous studies of forest carbon relationships show that a policy of active and responsible forest management is more effective in capturing and storing atmospheric carbon than a policy of hands-off management that precludes periodic harvests and use of wood products.

While acknowledging that it is not appropriate to manage every forested acre with a sole focus on carbon mitigation, the report's authors conclude (among other things), that:

- Wood products used in place of more energy-intensive materials, such as metals, concrete and plastic reduce carbon emissions, store carbon, and can provide additional biomass that can be substituted for fossil fuels to produce energy.
- Sustainably managed forests can provide greater carbon mitigation benefits than unmanaged forests, while delivering a wide range of environmental and social benefits including timber and biomass resources, jobs and economic opportunities, clean water, wildlife habitat, and recreation.

As with all aspects of forestry, choosing not to manage also has consequences, and this also

THE WOOD IN A BUILDING IS 50 PERCENT CARBON BY DRY WEIGHT[15]

Architect: DesignARC. Photo: Lawrence Anderson, www.lawrenceanderson.net

To highlight the carbon benefit of wood buildings, U.S. WoodWorks and the Canadian Wood Council partnered with research organization FPInnovations to develop a carbon calculator (available at www.woodworks.org). Based on widely available research,[16] the calculator estimates the amount of carbon stored in a wood building, the greenhouse gas emissions avoided by not using steel or concrete, and how many minutes it takes North American forests to grow that volume of wood.

The Stella luxury development in Marina del Rey includes both a four-story Type V-A wood-frame building and five-story Type III-A wood-frame building over a shared concrete podium. With approximately 2.3 million board feet (equivalent) of wood, the calculator estimates the following:

Carbon stored in the wood: 4,495 metric tons of CO_2

Avoided greenhouse gas emissions: 9,554 metric tons of CO_2

Time it takes North American forests to grow this much wood: 16 minutes

Using the EPA's Greenhouse Gas Equivalencies Calculator, these carbon benefits equate to taking 2,683 cars off the road for a year or the energy to operate a home for 1,194 years.

Although useful as an illustration of wood's climate change mitigation potential, these results are estimates only, as a detailed life cycle assessment would be required to provide this analysis for a specific building.

Different age classes across the forest landscape. Photo courtesy of the Oregon Forest Resources Institute

impacts carbon. Young, healthy forests are carbon sinks because they're actively absorbing carbon dioxide as they grow. As forests mature, they generally become carbon cycle-neutral because primary productivity declines. Many continue to store substantial amounts of carbon indefinitely—old growth forests in the U.S. and Canada represent significant carbon sinks—but the probability of massive carbon loss also increases. Where forests are killed by large-scale natural disturbances (such as wildfires and insect or disease infestations), they emit their stored carbon without providing the benefits available through product and energy substitution.

According to the UNFAO, "Several aspects of the forest industry's activities are not adequately captured by looking at only the emissions and sequestration accomplished in the value chain. For example, the use of wood-based building materials avoids emissions of 483 million tonnes of CO_2 equivalent a year, via substitution effects. In addition, by displacing fossil fuels, the burning of used products at the end of the life cycle avoids the emission of more than 25 million tonnes of CO_2 equivalent per year, which could be increased to 135 million tonnes per year by diverting material from landfills.

"The Intergovernmental Panel on Climate Change (IPCC) estimates that forest biomass-derived energy could reduce global emissions by between 400 million and 4.4 billion tonnes of CO_2 equivalent per year, a goal that the forest products industry can help society to reach through its forest biotechnology research and forest biomass infrastructure. The market for wood encourages landowners to keep land under forest, helping to avoid large-scale losses of carbon to the atmosphere via land use change.

"IPCC has stated that 'In the long term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fibre or energy from the forest, will generate the largest sustained mitigation benefit.' The analysis contained in the present report gives strong support to IPCC's assertion that sustainable management of production forests represents an important mitigation option over the long term."[21]

True or false: The forest industry has seen its last days as a major employer. False. The forest industry is responsible for more than 1.4 million direct and indirect jobs in the U.S. and Canada. As with many resource industries, employment in both countries decreased in recent years for a variety of factors that include the recession and U.S. housing market crash. However, the industry is in many ways engineering its renewal.

Innovation in the forest—Recognizing that healthy, sustainable forests are the first prerequisite, forest companies continue to invest in advanced management technologies.

"Wood products are manufactured from renewable raw material; they are reusable and biodegradable, and they continue to store carbon throughout their lifetime. These characteristics make wood an excellent alternative to many of the materials that are now widely used in construction and consumer goods, which leave a much larger 'carbon footprint' and include concrete, steel, aluminium and plastic. Increasing production and consumption of wood products will therefore be part of a sustainable future."

State of the World's Forests 2012, UNFAO

For example, the latest inventory systems use light detection and ranging (LiDAR) technology to better predict fiber supply attributes, identify key habitat features and sensitive areas, and build more efficient and environmentally sound road systems.

Resource efficiency—According to a recent report on wood utilization,[22] "The term 'waste' is largely obsolete in the context of today's North American forest products industry. Logs

This forest in the northern Sierra Nevada mountains was clearcut to support the natural regeneration of Ponderosa Pine, Douglas-fir, Sugar Pine, California white fir, and Incense-cedar. Photo: Philip McDonald, USDA Forest Service, Bugwood.org

CLEARCUTTING: APPROPRIATE SILVICULTURAL TOOL OR 'ALL THAT IS WRONG' WITH THE FOREST INDUSTRY?

In many conversations about forestry, clearcutting is held up as the beacon signalling 'all that is wrong' with the industry. This negative social reaction is an important consideration for foresters, especially those managing public lands.

Clearcutting is used when the young trees of a species need an abundance of sunlight to germinate and to compete successfully with grasses and other plants. It is usually used to grow tree species that historically found open sunlight by following large natural disturbances such as windstorms or wildfire. It provides the direct sunlight needed to effectively grow some native species, while helping to create a mix of forest ages across the landscape, including the young forests preferred by certain wildlife.

brought to U.S. and Canadian sawmills and other wood product manufacturing centers are converted almost totally to useful products."

Expanded opportunities for wood use—The development of innovative new buildings systems (e.g., mass timber) is allowing wood to be used as a structural material in a wider range of building types, increasing the low-carbon options available to building designers.

New product categories—Recognizing that forest-based materials generally have advantages over materials that are non-renewable and/or require large amounts of fossil fuel energy to manufacture, the industry is increasing its R&D efforts in developing new products such as green energy, bio-plastics and bio-pharmaceuticals.

As these examples demonstrate, continual improvement is fundamental, not only to forest sustainability, but to the industry's own competitive future and its ability to provide jobs and contribute to forest-dependent communities.

True or false: If we use more wood, we'll have less forest. False. According to the USDA Forest Service, more than 44 million acres of private forestland could be converted to housing development in the next three decades.[23] In the U.S., where 56 percent of forests are privately owned, strong markets for wood products help to ensure that landowners derive value from their investment. This provides an incentive not only to keep lands forested, but to manage them sustainably for long-term health.

In Canada, where most forests are publicly owned, sustainable harvest levels are based on the biological and ecological capacity of the land. However, strong markets contribute to resource efficiency by ensuring that forest fiber is utilized for the highest value products.

THREATS TO FOREST SUSTAINABILITY

While North American forests have remained relatively stable for decades, they also face significant threats. Although by no means a comprehensive list, the following three were identified in the National Report on Sustainable Forests–2010 as crucial:

The loss of forest lands and working forests According to the report, "gross statistics on forest area mask substantial fragmentation and outright losses in forest land at the regional level, particularly in areas adjacent to growing urban areas or where recreational development is prominent. Fragmentation and loss is further compounded by the sale of forest lands to firms and individuals whose primary focus is not active forest management for timber production, forest conservation, or other purposes." Where profitable, forest management and the revenues it generates can serve as an incentive to landowners to keep lands forested and not convert them to other uses.

Climate change—Although forests and wood products have a significant role to play in climate change mitigation, the report says "We are already seeing altered patterns of forest disturbance associated with changes in temperature, precipitation and insect activity. The resulting changes in the distribution of forest cover and species distribution will play out over the coming decades." Climate change is already being incorporated into forest management planning with the objective of helping forests to remain resilient in the face of environmental stressors.[24]

Wildfire and insect infestation—Referred to in sustainability language as "changing disturbance patterns," this category has included a three-fold increase in insect-induced tree mortality in the last decade and a "marked increase" in forest fires, especially on public lands in the West. "This increase is tied to a complex set of natural and human-induced dynamics involving fire suppression, increasing stand densities, aging of certain tree species and warming temperatures. The result has been a dramatic increase in the area of forest affected by bark beetle infestations in the pine forests of the interior West and a general increase in forest fuel loadings and fire susceptibility.

THE NEXT 100 YEARS

The complexities associated with forests and their management don't lend themselves to easy generalization. As this course has shown, North American forests have been stable for decades. Modern forestry involves teams of dedicated professionals who rely on science and their experience of the forest to plan for and protect a wide range of forest values. Forests and wood products have carbon benefits that exceed the benefits of natural forests alone and strong markets for wood products provide incentives for landowners to keep lands forested. There are also profound threats to future forest sustainability.

However, while the threats may seem insurmountable, a report from Dovetail Partners Inc., *The Next 100 Years of Forests in the U.S.—Growing the Forests We Want and Need*, offers an interesting perspective: "It may help to remember that previous generations were able to [meet their forest management challenges] during an era that included The Great Depression, WWI and WWII, global energy crises, and many other social and economic upheavals. Our history shows that if we want healthy, abundant forests, we can have them. We just need to choose a vision for the future that includes abundant forests and take appropriate action to secure them." ■

Young, healthy forests are carbon sinks because they're actively absorbing carbon dioxide as they grow. As forests mature, the rate of carbon uptake slows. Photo courtesy of Weyerhaeuser

ENDNOTES

1. *A Synthesis of Research on Wood Products & Greenhouse Gas Impacts,* 2010, FPInnovations
2. *National Report on Sustainable Forests–2010*, USDA Forest Service
3. *American Forests: A History of Resiliency and Recovery,* Douglas W. McCleary, 1997, Forest History Society
4. *The State of America's Forests,* 2007, Society of American Foresters; State of the World's Forests, 2007, United Nations Food and Agriculture Organization
5. *Deforestation in Canada: What are the Facts,* Natural Resources Canada; *State of the World's Forests,* 2011, United Nations Food and Agriculture Organization (UNFAO)
6. Ince, Peter J., *Global sustainable timber supply and demand: Sustainable development in the forest products industry,* Chapter 2, Porto, Portugal: Universidade Fernando Pessoa, 2010
7. *State of Canada's Forests Annual Report 2014,* Natural Resources Canada
8. www.sfiprogram.org, www.pefc.org, www.fsc.org, www.forestfoundation.org
9. *A Guide to World Resources 2000-2001: People and ecosystems: The fraying web of life, Data Tables;* United Nations Development Programme, United Nations Environment Programme, World Bank and World Resources Institute, September 2000
10. *Forest Certification as it Contributes to Sustainable Forestry,* National Association of State Foresters, 2013, NASF-2013-2, www.stateforesters.org
11. http://www.naturallywood.com/sites/default/files/Third-Party-Certification.pdf; http://www.sfiprogram.org/sfi-standard/american-tree-farm-system/
12. *Natural Resources Canada;* State of Canada's Forests Annual Report 2014
13. 2006-2007 Pesticide Market Estimates, United States Environmental Protection Agency
14. *National Report on Sustainable Forests–2010*, USDA Forest Service; Natural Resources Canada
15. Extrapolated from FPInnovations research
16. Estimates by the Wood Carbon Calculator for Buildings are based on research by Sarthre, R. and J. O'Connor, 2010, *A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPInnovations*; references and notes are available at www.woodworks.org
17. *A Synthesis of Research on Wood Products & Greenhouse Gas Impacts, 2010, FPInnovations*
18. *Industry Progress Report: Environment, Energy, Safety*, American Wood Council; data applies to AWC member mills, which comprise more than 75% of the U.S. wood products industry
19. *The State of Canada's Forests, 2012*, Natural Resources Canada
20. *Managing Forests because Carbon Matters: Integrating Energy, Products, and Land Management Policy*, Journal of Forestry, 2011, American Society of Foresters
21. *Impact of the global forest industry on atmospheric greenhouse gases*, 2010, UNFAO
22. *Utilization of Harvested Wood by the North American Forest Products Industry, 2012*, Dovetail Partners Inc.
23. *USDA Forest Service, Forests on the Edge project, http://www.fs.fed.us/projects/four-threats/#space*
24. http://www.for.gov.bc.ca/het/climate/index.htm

RESEARCH LIBRARY

research.thinkwood.com

SEISMIC & FIRE

photo: naturallywood.com | KK Law

PERFORMANCE

photo: Skidmore, Owings & Merrill

DESIGN & SYSTEMS

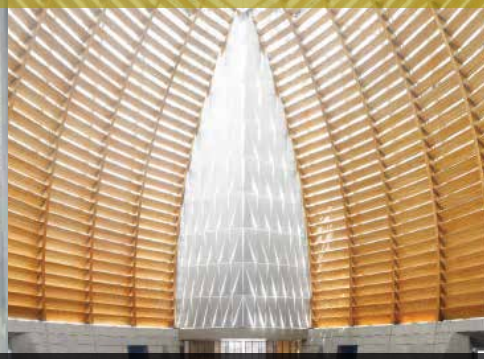


photo: Timothy Hursley & Cesar Rubio

For current mass timber research in the United States and worldwide, including CLT and tall wood buildings, the Think Wood website includes a library of studies, categorized by topic area and updated regularly.

DESIGN GUIDANCE AND RESOURCES

There are many resources available to architects and engineers designing mass timber projects.

- For general information, the Think Wood website (www.thinkwood.com) offers an expanding library of materials on mass timber products, research, building examples, and developments related to tall wood buildings.
- The National Design Specification (NDS) for Wood Construction (www.awc.org) is the IBC-referenced design standard for lumber, glulam, SCL, and CLT, including fire design, fasteners and connections, etc. A mass timber building in the United States cannot be designed without the NDS.
- The U.S. CLT Handbook (www.thinkwood.com) includes detailed technical information on the use of CLT. It should be used in conjunction with information provided by manufacturers since most CLT currently available in North America is propriety (i.e., lay-ups aren't standard across suppliers).
- APA Product Reports (www.apawood.org/product-reports) signify a product's compliance with relevant provisions of the model building codes. The L-Series covers products manufactured from lumber, veneer, or other wood base, such as glulam and structural composite lumber (SCL).

WoodWorks™
WOOD PRODUCTS COUNCIL

For one-on-one support (at no cost), technical experts at WoodWorks are available to provide free project assistance related to nonresidential and multifamily buildings in the United States, including those using mass timber. Designers have the option of contacting an expert in their region (www.woodworks.org/projectassistance) or emailing help@woodworks.org.

The American Institute of Architects
Collaboration Partner

QUIZ

1. In the U.S. and Canada, responsible forest management has resulted in forest growth that has exceeded annual forest harvests for how many years:

   a. 5
   b. 20
   c. 50
   d. Forest growth never exceeds forest harvest in the U.S. and Canada

2. The concept of forest sustainability was first introduced:

   a. In 1713, in the book *Slvicultura oeconomica*
   b. In the 1800s, when settlers coming to North America cleared an average of 2.1 acres of forest per person
   c. In 1987, by the World Commission on Environment and Development
   d. In 1992, as part of the United Nations Conference on Environment and Development

3. Which of the following is not used as a measure of forest sustainability:

   a. Ecosystem condition
   b. Biodiversity
   c. Economic and social values
   d. Forest ownership scenarios

4. Clearcutting is considered an appropriate silvicultural tool:

   a.When young trees of a species need an abundance of sunlight to germinate and compete successfully with other plants and species
   b. On private lands only
   c. When woody debris in the forest builds up and increases the risk of wildfire
   d. When the forest company is in a hurry to finish harvesting before winter

5. In the U.S., commercial and government use of herbicides (which includes forestry) accounts for what percent vs. the percentages used in home and garden and agriculture:

   a. 30 percent forest / 10 percent home and garden / 60 percent agriculture
   b. 43 percent forest / 12 percent home and garden / 45 percent agriculture
   c. 9 percent forest / 13 percent home and garden / 78 percent agriculture
   d. 18 percent forest / 28 percent home and garden / 54 percent agriculture

6. All of the following contribute to biodiversity except which one:

   a. Planning forest management to maintain habitat patterns
   b. Managing forests so they resemble forests established by natural disturbance (such as fire or wind)
   c. Creating parks and protected areas
   d. Adding diversion ditches and water bars to forest roads

7. Deforestation is defined as:

   a. Areas impacted by insects or wildfire prior to regeneration
   b. Harvested areas prior to regeneration
   c. Forested lands that have been permanently converted to other uses
   d. Areas that need additional treatments when the regenerating forests are young

8. The carbon benefits associated with forests include all of the following except which one:

   a. The use of carbon calculators
   b. Carbon absorbed from the atmosphere by forests
   c. Carbon stored in wood products
   d. Using wood instead of products that require large amounts of fossil fuels to manufacture
   e. The use of biomass energy

9. The latest forest inventory systems use light detection and ranging technology to do which of the following:

   a. Identify habitat and sensitive areas
   b. Determine the best intermediate treatment techniques
   c. Build more environmentally sound road systems
   d. Identify popular areas for backwoods camping
   e. A and B but not C or D
   f. A and C but not B or D

10. Threats to forest sustainability include:

   a. Forest fragmentation
   b. Urban development
   c. Increased wildfire and insect infestation
   d. All of the above

SPONSOR INFORMATION

THINK WOOD®

Think Wood is a leading education provider on the advantages of using softwood lumber in commercial, community and multifamily building applications. We identify and introduce innovators in the field to our community of architects, engineers, researchers, designers and developers. If you need additional support or resources, contact us at info@ThinkWood.com. For additional CEUs, visit ThinkWood.com/CEU.