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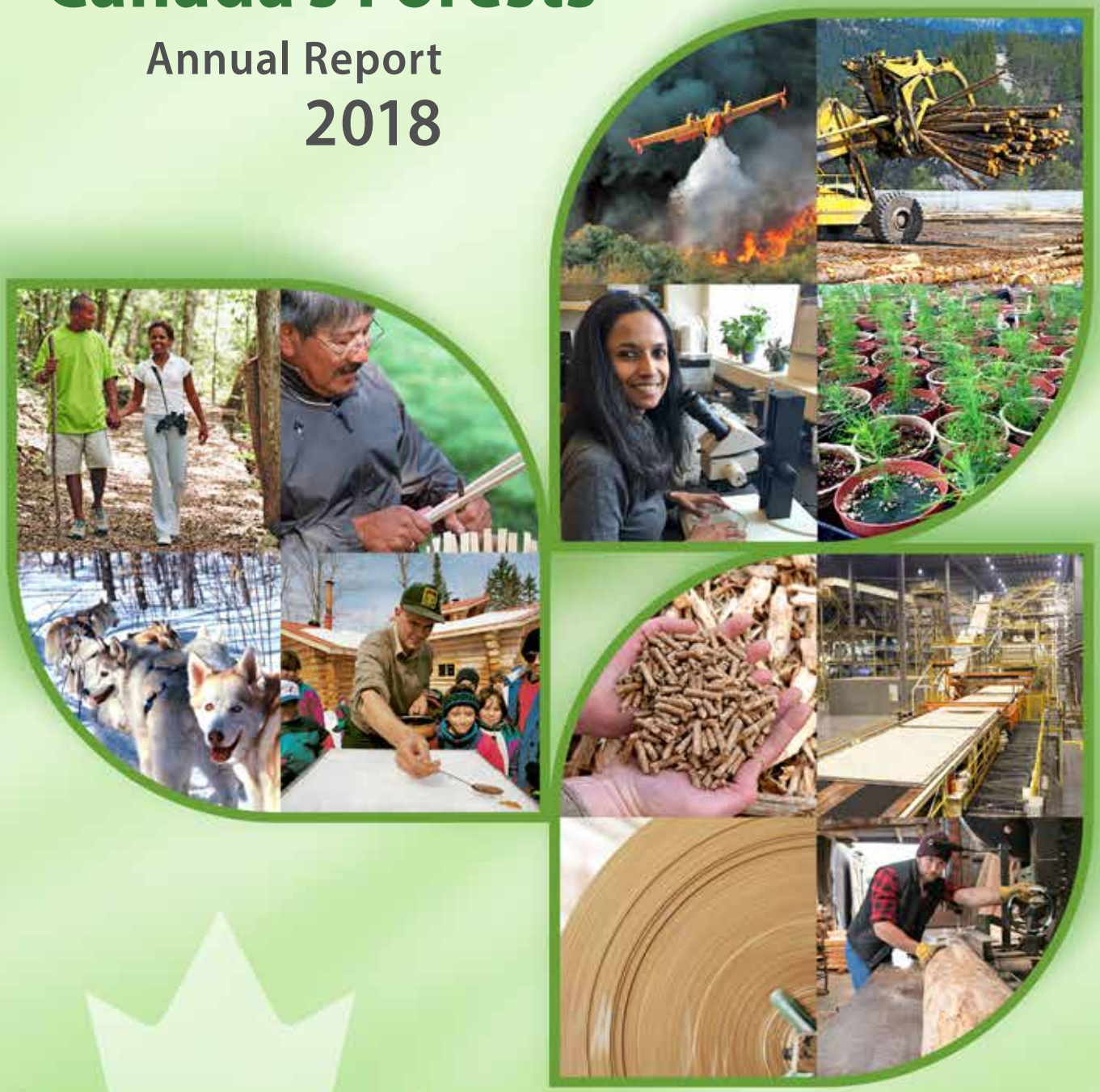
The State of Canada's Forests

Annual Report 2018



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Message from the Minister of Natural Resources

Meet some of the *Faces of Forestry* featured in this year's *State of Canada's Forests* report, where we highlight the innovative ways people work and study in our forests. We feature a fourth-generation logger, a mass timber construction champion, a researcher studying caribou reproduction and several entrepreneurs at the forefront of the global bioeconomy.

Forestry is now *leading* the way in the burgeoning bioeconomy; helping to reduce greenhouse gas emissions and transition Canada to a low-carbon economy. For example, Montreal-based Anomera converts forestry biomass into biodegradable cosmetic ingredients as an alternative to harmful micro-plastics, in the process opening up access to the multi-billion dollar cosmetics industry.

Forestry is also presenting more and more opportunities for rural and Indigenous communities such as the Pacheedaht First Nation of British Columbia. In this report, you can read how they recently formed key partnerships within the forest industry to manage their traditional forest land, while also creating jobs.

Increasingly diverse — and resilient — the forest industry has weathered some serious storms of late, which have compelled it to evolve. Today, non-traditional forest products have become more important to the industry and are fostering new clean-tech development opportunities. Just ask Lambos Tsaousidis — another of our *Faces of Forestry* — a Toronto-based entrepreneur who uses reclaimed, local wood to produce artisanal flooring, furniture and cabinetry.

In fact, the popularity of building materials that come from renewable resources such as wood is increasing worldwide — for many reasons. Using sustainably harvested wood can reduce a building's carbon footprint, while lowering greenhouse gas emissions by storing carbon in the wood itself. This, in turn, increases our international competitiveness in emerging markets such as Asia.

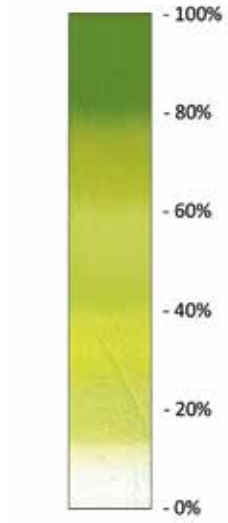
Historically, forestry is one of Canada's most important manufacturing industries, accounting for 7.2 percent of all exports, injecting roughly $24.6 billion into the economy and employing more than 200,000 people across the country.

But with the bioeconomy market expected to grow to as much as $5 trillion by 2030, clearly the *Faces of Forestry* themselves are changing. You'll still find loggers, sawmill operators, biologists and tree planters. But increasingly, you will also find Indigenous-led companies, biochemists, engineers, physicists, architects and computer programmers — as the face of forestry evolves to mirror the diversity of Canada itself and the potential of our forests.

The Honourable Amarjeet Sohi,
Minister of Natural Resources

Treed land in Canada

Proportion of area covered by trees



What is treed land?

Land is classified as treed if at least 10% of it is covered by trees.

Note that land that is temporarily treeless because of recent disturbance—such as forest fire or timber harvesting—does not show as treed land on this map.

For a definition of “forest land” please see page 22.

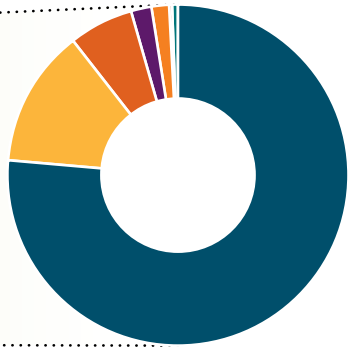
Canada's forests by the numbers

CANADA HAS: 347,069,000 HECTARES OF FOREST LAND

How much of Canada is forest?

Freshwater area	9%
Forest area	35%
Non forest land	56%

Who owns Canada's forests?



Provincial	76.6%	Federal	1.6%
Territorial	12.9%	Municipal	0.3%
Private	6.2%	Other	0.4%
Indigenous	2.0%		

What's the leading cause of disturbance in Canada's forests?

Area impacted by insects (2016): **15,489,117 ha (4.5%)**

Area burned by fire (2017): **3,371,833 ha (<1%)**

Area harvested (2016): **766,659 ha (<0.5%)**

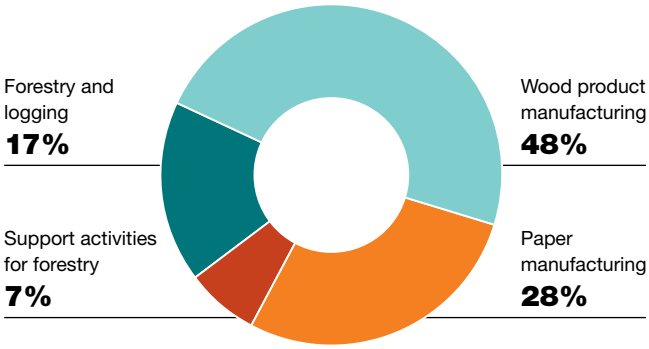
Area deforested (2016): **37,000 ha (0.01%)**

The forest industry contributed **$24.6 BILLION** (1.6%) to Canada's gross domestic product (GDP). (2017)

The forest industry directly employed **209,940** people (1.1% of total employment). (2017)

6% of those employed in the forest industry were **INDIGENOUS**. (2016)

Where do people work in the forest industry?



Women in the forest industry (2016)

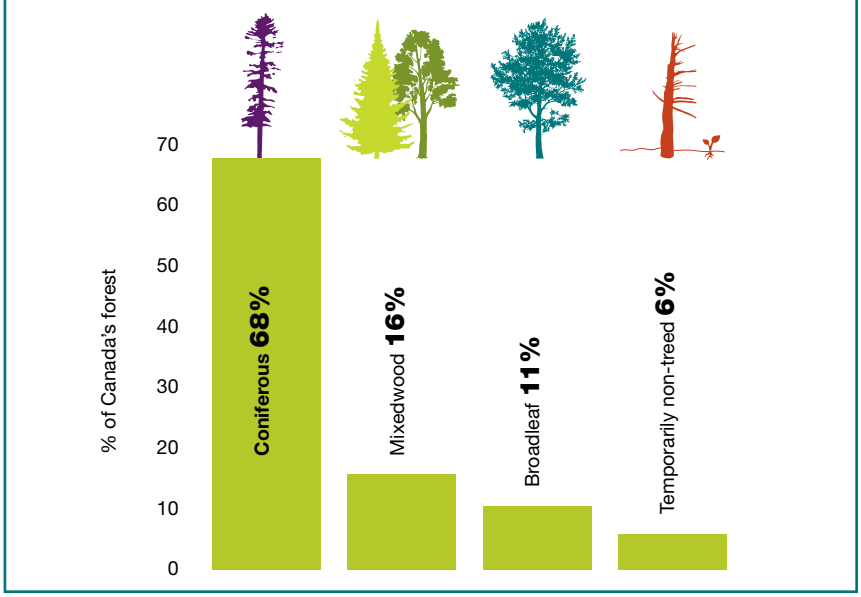
17% of people employed within the forest industry were women.

Of this:

23% of women worked in the forest—in logging, forestry, and forestry support activities.

77% of women worked in wood product manufacturing and the pulp and paper industry.

What types of forest does Canada have?



THE MOST COMMON TREE SPECIES in Canada is the black spruce.

2/3 OF ALL SPECIES in Canada are found in forest ecosystems.

49% OF CANADA'S FORESTS were certified to third party standards of sustainable forest management. (2017)

Over **615 MILLION SEEDLINGS** were planted on 410 thousand ha in Canada's forests. (2016)

Over **1,000 SPECIES** of invertebrates may be found in a single square metre of forest soil.

From planning to production: Faces in the forestry supply chain

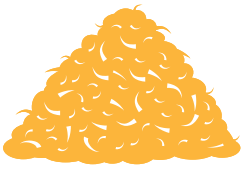
Across Canada, hundreds of thousands of diverse Canadians work hard to bring us the paper cups for our offices, the wood we use to build our decks, or the screen of our smart phones. All parts of the trees, even that which was traditionally considered waste, are used in the process. Below we follow the path wood takes before it gets to consumers and some of the many people that make it possible from the management of forests to the conversion of timber into high value products in a car.

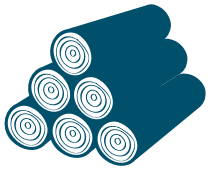
SITE RECONAISSANCE

As a forestry student in Vancouver at the University of British Columbia, Michael Vela did a co-op with Interfor Corporation, assisting logging engineers with cut-block layout and road location/design. Logging engineers are integral in the planning stages of harvesting, working with people and complex technology to ensure that soil, water, and other natural resources are protected during harvesting.

HARVESTING

John Fleming is a fourth generation logger and current vice-president of Fleming's Trucking and Logging in St. Joseph Island, Ontario. His company uses a "cut-to-length" technique, where trees are de-limbed and cut to length directly at the stump, as opposed to dragging the felled tree through the forest, to increase efficiency and reduce environmental impact. Multi-generation logging families have a unique perspective and a wealth of historical knowledge that they can incorporate into sustainable harvesting.





SAWMILL

Wade Lariviere is a member of the Canoe Lake Cree First Nation in Meadow Lake, Saskatchewan. Wade started in various entry level jobs at the local NorSask Forest Products sawmill before passing the annual NorSask trade appreticeship exam. Now Wade is a fourth-year Industral Mechanic apprentice at the same sawmill. The growing bioeconomy can create additional opportunities for Indigenous communities – for example, the NorSask sawmill is owned by the Meadow Lake Tribal Council, and is one of the largest First Nations-owned sawmills in Canada.

PULP MILL

Starting out as a nurse, Kathy Stull decided to change her career in her thirties and went back to university, with the goal of finding a career that would allow her to remain in St. John, New Brunswick. Kathy now works at JD Irving Pulp and Paper in Saint John as a certified power engineer. Power engineers complete rigorous technical training and are responsible for the safe operation, maintenance, and repairs of critical process machinery at the mill.

BIOREFINERY

Dr. Minh Tan Ton-That is a scientist at the National Research Council Canada in Boucherville, Québec. He and his team of researchers and technicians have developed a number of innovative and patented technologies for using lignin and wood fibres from the pulp and paper industry to create bio-based plastics and biocomposites. These innovative products are used for the manufacturing and transportation industry, among others, and help Canadian forest companies establish a strong and competitive foothold in emerging markets.

BIOFUELS

BIOCOMPOSITES

BIOCHEMICALS

Did you know that your own car likely contains wood products? Cellulose nanocrystals are currently used in electronic displays, paints, abrasion-resistant transparencies, and bioplastic interior components such as dashboards and door panels. Lignin is used in carbon fibre panels and replaces carbon black to make lighter tires, improving fuel efficiency. And biomethanol is a fuel additive created using waste from pulp mills.

Meet some of Canada's leaders in the forest bioeconomy

The growing forest bioeconomy is offering new economic opportunities for Canadians and helping to advance Canada's sustainable development goals (particularly Goal 7, Affordable and Clean Energy, and Goal 15, Life on Land—see the Sustainability indicators section for more details about the Sustainable Development Goals). In addition to growing revenues, the forest bioeconomy can generate relatively more new jobs than other knowledge-driven, technology-based sectors such as finance or aerospace.

Among the leaders in the bioeconomy are entrepreneurial pioneers who have set out to find local solutions to global problems. Here are three examples of Canadian entrepreneurs who are developing innovative bio-based solutions.

Mass timber construction: The sky is the limit

"Wood is the material that I love the most," says Vancouver-based architect Michael Green in his 2013 TED Talk, *Why We Should Build Wooden Skyscrapers*.

Green has long advocated for greater use of wood in large building construction, also referred to as mass timber construction. "I choose to build in wood as it is the most environmentally sound and carbon-neutral way to build large structures and buildings," says Green.

Wood has an "amazing capacity to store carbon" and if you use the wood for something like a building, you are storing the carbon for as long as the building exists, Green says, adding that the use of sustainable forest practices is a given.

Green designed the Wood Innovation and Design Centre (WIDC), in Prince George, British Columbia, which, at six storeys, was the tallest contemporary wood building in North America when it opened in 2014. As a result of Green's innovative work, mass timber construction reached new heights with the design and construction of the 18-storey Brock Commons Tallwood House at the University of British Columbia — the tallest wood building in the world when it was constructed in 2017. Green's current projects, in cities including New York, Chicago and Paris, involve buildings of 12, 18 and even 34 storeys, built mostly with wood, of course.

Mass timber construction relies on engineered wood products that usually involve lamination and compression of multiple layers of smaller pieces of wood to create large panels. The process creates a very strong panel that meets the safety and strength requirements needed to build tall structures.

What is the bioeconomy?

In the bioeconomy, renewable and sustainably sourced biomass resources such as trees, agricultural crops and organic residuals from harvesting and timber processing are used to provide a greater range of consumer and industrial products to society. Potential products range from food additives and textiles to construction materials, auto parts, bioplastics, biochemicals and fuel for vehicles and planes.

Bioplastic: Replacing traditional plastic

The environmental impacts of plastic microbeads – for instance, in cosmetics and skin-care products – are a source of growing concern among scientists and consumers. Montreal-based Anomera Inc. has come up with a sustainable alternative.

Construction of the 13-storey Origine tall wood building in Quebec City, using mass timber.

Founded by Mark Andrews, Tim Morse, Monika Rak and Nathan Hordy, all from the McGill University chemistry department, the company has found a way to convert cellulose from wood waste and paper industry pulp into biodegradable, environmentally friendly, high-performance ingredients that can outperform microplastics, thus opening up access to the multi-billion dollar cosmetics and skin-care industries.

"We have been able to use Canadian forest industry cellulose to make game-changing cosmetic ingredients that can outperform microplastics," says Andrews, a chemistry professor and the company's chief technology officer. "We really have a natural alternative to mineral, ceramic and artificial ingredients."

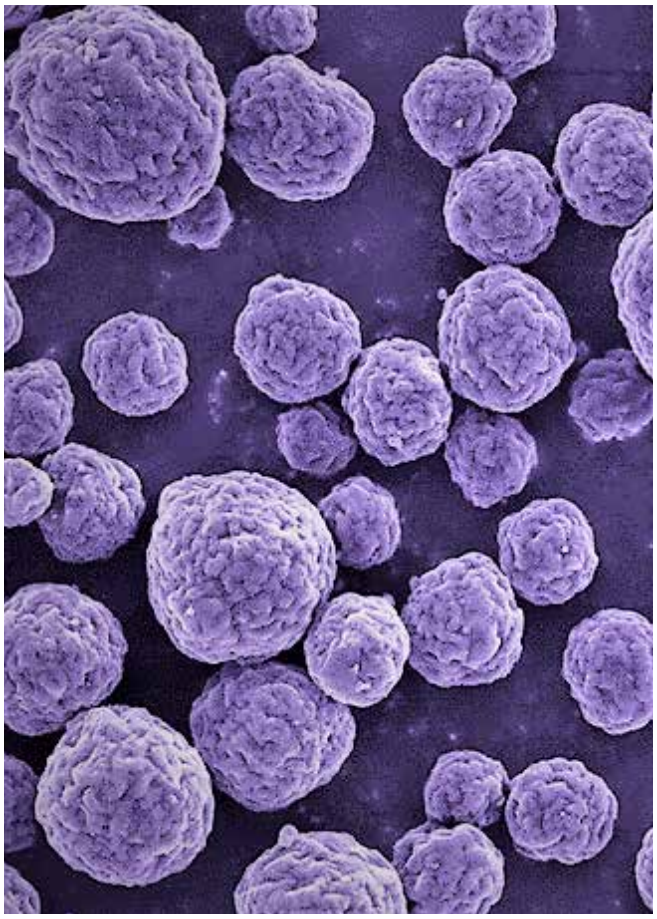
Private investors are recognizing the company's entrepreneurial vision and potential, as demonstrated by the US$3 million in seed funding that it raised in recent months. Anomera will use the funds to recruit additional talent and to accelerate product development, manufacturing scale-up and commercial distribution of its ingredients worldwide.

The urban forest: Keeping it local

When you think of forestry and forest products, Canada's largest city, Toronto, probably doesn't come to mind. However, with some 10.2 million trees providing a leafy canopy for almost 30% of the city, Toronto's urban forests are vital to more than 5,000 small businesses, employing 25,000 people, that specialize in urban wood-related products and services.

In 2015, the City of Toronto received the Ontario Wood Award for its initiatives to support entrepreneurial businesses that promote urban forestry services and locally produced wood products. Key among those initiatives is the Urban Wood Directory, a resource aimed at connecting Toronto residents and businesses with a wide range of local urban forest management services and wood producers, from arborists to furniture designers.

Canadian Salvaged Timber's live-edge slabs are primarily salvaged from the Toronto area, then cut by hand and air-dried. Heavy timbers are sourced from old factories and warehouses in Toronto and from barns from across Ontario.



False color image scanning electron micrograph of cellulose microbeads assembled from carboxylated crystalline nanocellulose produced by Anomera Inc.'s patented process.

The directory features innovative businesses like Canadian Salvaged Timber, which uses reclaimed local wood – whether from trees or salvaged from older buildings – to produce timbers, milled lumber, slabs, flooring, furniture and cabinetry. The company, founded by Lambos Tsaousidis more than 20 years ago, has a clientele ranging from architects and designers to restaurant and home owners.

"The vast majority of our lumber supply is reclaimed," Tsaousidis says. "We aim to keep our environmental footprint low by sourcing reclaimed wood from the City of Toronto and surrounding areas in Southern Ontario. We strive to source as close to home as possible."

Translating technical solutions into socio-economic benefits

Canadian entrepreneurs and their innovative ideas are powering Canada's growing forest bioeconomy. The designs, processes and products developed by these innovators are creating good jobs, in both urban and rural Canadian communities, which in turn support economic diversification. A win-win for everyone.

Successful Indigenous-industry partnerships in the forest sector: The People of the Seafoam

Along the southwest edge of Vancouver Island, British Columbia (BC), lies the traditional territory of the Pacheedaht First Nation with a population of 287, of which about a third live within the territory. Due to the historic low prospects of employment, the majority of people have been forced to seek livelihoods outside of their traditional territory. The forests on the 163,000 terrestrial hectares of this territory contain fir, hemlock, red cedar, yellow cedar and other tree species that the Pacheedaht people have valued and used for thousands of years.

Just ten years ago the forested area was entirely allocated through forest tenures and licence areas to third parties. None of these were held by the Pacheedaht. Since then, the Nation has forged ahead with proactive changes. Despite its small population, the Pacheedaht Nation has gone from not having any of the allowable cut of trees on its territory to managing or co-managing forest areas that yield about 140,000 cubic metres of annual cut, operating a sawmill and planning future forestry-related projects.

In British Columbia, approximately 95% of the province's timber is publicly owned. The BC government authorizes the rights to harvest Crown timber through forest tenures. A tree farm licence (TFL) is an area-based forest tenure that grants virtually exclusive rights to harvest timber, as well as to manage and conserve forests and recreational and cultural heritage resources, on a specified area of land.

Thinking of the future

The Pacheedaht were very concerned with the long-term supply of cedar and their access to it for cultural purposes. In 2005, the Pacheedaht initiated development of the Pacheedaht Cedar Conservation Strategy through which they identified the volume and size of cedar they needed to revitalize and support their cultural practices, which require a supply of large, old-growth cedar trees. Rather than looking simply at current needs, the Nation took a long-term view – specifically, a 400-year view. This is the length of time it takes a red cedar to grow to a useable size for certain cultural items (such as large ocean-going canoes and totem poles) so it was the appropriate timeframe to consider when developing a strategy involving these long-lived trees. The Province and all major forest licensees within the territory have recognized the strategy and are part of its implementation. To date, the Pacheedaht have identified about 60% of the cedar needed to fulfil the cultural needs plan contained within the strategy. In 2010 the Pacheedaht were direct awarded Woodlot Licence 1957, located in close proximity to the community. Although the allowable annual cut is only 1,500 cubic metres per year, it provides opportunity for the First Nation to manage the tenure for community interests while providing some economic benefit.

This is a Culturally Modified Tree (CMT) protected from harvest. The Pacheedaht consider their history recorded in CMTs, and conserve small areas of large cedars, such as this one, for future cultural uses. All proposed harvest areas are field-reviewed by the Pacheedaht.

Mariyah Dunn-Jones stripping bark from a cedar tree within the Pacheedaht traditional territory. The bark is used for weaving to create gifts and to barter.

Partnering with industry

The next achievement came when Pacheedaht First Nation and family-owned Andersen Timber Ltd. entered a 50/50 partnership in 2010 to purchase the Jordan River portion of TFL 25. Pacheedaht First Nation and Andersen Timber formed two jointly owned companies: one to own the TFL tenure and one to manage it. Now identified as TFL 61, the tenure covers 20,240 hectares of Pacheedaht traditional territory and provides an important income stream to the Nation. Not only are the Pacheedaht now realizing income from co-ownership of TFL 61, but they are also in a position that permits them greater influence over how the land base is managed.

The Pacheedaht now also have a second income stream from the forested land base within their territory as a result of a Forest Consultation and Revenue Sharing Agreement (FCRSA) signed between the Pacheedaht and the Province of BC in 2017. Under this agreement, the Pacheedaht obtained a forest licence with a 20-year term that is renewable, authorizing a 7,300-cubic-metre annual cut. Pacheedaht Nation receives a percentage of the stumpage revenue generated from the timber cut by all tenure holders operating on the Nation's traditional territory. In addition, the Pacheedaht are also nearing completion of an application process for a Community Forest Agreement tenure that will authorize management rights and an annual cut of approximately 30,000 cubic metres to a company co-owned by the Pacheedaht First Nation and the Cowichan Lake Community Forest Co-op. BC Timber Sales is also involved in this initiative.

These forestry income streams and land base management responsibilities have and will continue to allow the Pacheedaht to act on their vision of creating meaningful forestry jobs for their people on their lands. A component of each partnership is to encourage education by offering bursaries to prospective students.

Owning and operating forestry facilities

To date, the Pacheedaht own and operate two forestry facilities, and they have a third on the horizon. First, at TFL 61, a log sorting facility scales, grades, sorts and ships the cut timber from the TFL. Of the 12 people on the sort crew, two are Pacheedaht Band Members. Second, in 2017 the Pacheedaht built a sawmill on traditional lands in the community of Port Renfrew to process cedar logs. The small mill employs eight people, six of whom are Pacheedaht, and as Tom Jones, Forest Program Manager, says, the mill "processes a small volume (10,000 cubic metres) of high-quality logs that produce high-value, specialty cedar products." Lastly – for now, anyway – the Pacheedaht have plans to open a chipping facility, which will create more jobs, within the next two years.

As well as direct jobs from the Pacheedaht's forestry initiatives, a whole range of other jobs are associated with the increased activity. Where there are logging operations, there's a need for cut-block planning and layout, timber cruising, cut-block management and tree planting, to name only a few. One of the Nation's hurdles is having enough of their people living in the area trained to fill the positions and help build their resources. Tom Jones is optimistic that more Pacheedaht people will move back to the area as the forestry activities and other ventures grow and the Nation prospers.

"Pacheedaht for a long time has been shut out from the financial benefits that the resources extracted from our Traditional Territory have bestowed upon corporations and the government of BC," says Chief Jeff Jones. "We are pleased with the steps BC has taken to partially address this and with our progress to date to acquire forest tenure rights within our Territory. All will lead to the self reliance and well-being of our people once again."

Workers in the sawmill on the Pacheedaht First Nation reserve in Port Renfrew, British Columbia. The sawmill produces small quantities of specialty products from cedar trees harvested in Pacheedaht traditional territory.

Collaboration in the complex case of the woodland caribou

While provincial and territorial governments finalize range plans for the woodland caribou, diverse groups of Canadians are contributing to caribou management through research and conservation.

You can find the shy woodland caribou across Canada. Woodland caribou consists of both boreal caribou, found in the Boreal forest from the Yukon to Newfoundland and Labrador and as far south as Lake Superior in Ontario, and southern mountain caribou, which are found in the mountainous regions of British Columbia and Alberta. Woodland caribou herds need large areas of habitat to reduce their risk of predation. Natural and human-caused habitat loss, degradation and fragmentation have reduced some herds to numbers too small to sustain their population without management intervention. As a result, some caribou types are now listed as endangered or threatened under the federal *Species at Risk Act*. To help tackle the complex issues related to caribou management, groups of Canadians across Canada are forging strategic cross-sector collaborations to help conserve woodland caribou populations.

Building on previous research

Technology can play a large role in understanding caribou population patterns. University of Alberta scientist Craig Demars used geospatial data to develop an innovative way to both detect calving among female woodland caribou and to determine calf survival rates, based on their movements across the landscape. Working with four herds in northeastern British Columbia, he captured female caribou in the spring to fit them with GPS collars, at the same time testing them to find out which ones were pregnant.

Demars then flew over the area in a helicopter during summer to verify that the caribou had given birth and find out which calves had survived. The field survey confirmed the GPS data: when an adult female suddenly stops moving and then gradually resumes her normal pace, she has given birth and the calf has survived. When she stops moving and then quickly resumes her normal pace, the calf has likely died.

Woodland caribou consist of both boreal caribou and southern mountain caribou.

Technicians equipping a tranquilized caribou with a GPS collar.

Maternal penning programs protect caribou mothers and calves in an area secure from predators.

More recently, Barry Nobert and a team of researchers from the Foothills Research Institute adapted Demars' methodology with two herds in west-central Alberta. Partners in the Alberta government and in the forestry company Weyerhaeuser had previously collared 81 female caribou in the Rocky Mountains and Nobert had 16 years' worth of geospatial data to analyze. By building on Demars' research, Nobert's team was able not only to determine the herds' reproductive and calf survival rates, but also to identify the habitats that the mothers chose for calving. Forestry companies such as Weyerhaeuser can integrate this information into cutblock design and management to mitigate the effects of harvesting on caribou herds.

Taking the initiative

The Revelstoke Caribou Rearing in the Wild (RCRW) Society of Revelstoke, British Columbia also built on previous success. The community-based partnership – which includes the Splatsin Indian Band, the non-profit Alberta Biodiversity Monitoring Institute, and the local snowmobile club, among others – looked to other ongoing western Canada maternal penning programs and applied the same principles to their local Columbia North caribou herd.

Maternal penning projects capture and protect pregnant caribou until the mother and calf can be released back into the wild. This gives the calf extra time to become bigger and stronger and, hopefully, less susceptible to predation. After the RCRW caribou cows and calves are released, they are monitored using GPS collars to track their survival until March, when calves are 10 months old and considered "recruited" into the local population.

The RCRW maternal penning program started in 2014. Now in its fourth year, RCRW wildlife technician Kelsey Furk says, "the herd right now is stable and has been stable since 2013, which is an improvement over a number of other herds in the region that continue to decline."

An integrated way forward

Canadians in academia, Indigenous communities, consulting firms, government and industry each have an important role to play in understanding the complex reality of caribou management. Sharing knowledge and collaborating on projects provides all orders of government, from municipal to federal, the evidence base to guide strategic policy and decision-making.

The forest as a classroom

For tots to teens across Canada, forest-based learning programs are increasingly popular.

Forest schools started in Sweden and Denmark in the 1950s. Using nature as a classroom, youth are encouraged to engage in open-ended play to enhance curiosity, teamwork and problem-solving skills. Proponents of forest schools, also called nature schools, say that youth show greater self-confidence, concentration and motivation, skills that benefit academic performance. By incorporating forest-based learning from preschool to high school, numerous students across Canada are learning to appreciate the complexity and value of Canada's forests.

Benefits in early education through an integrated approach

Chelsea Forest School in Chelsea, Quebec, offers outdoor, play-based, child-led learning throughout the year, regardless of the weather. Children ages three to ten participate in diverse activities such as building and floating stick boats, following animal tracks and measuring the circumference of tree trunks with ropes. These activities are designed to promote stewardship for the environment as well as stimulate critical thinking and develop leadership and risk-management skills, which translate into self-confidence and curiosity in the classroom. "I am a strong believer in Forest School for my son's development," says Sherida McKean, mother of a six-year-old. "I believe that the time he spends at Forest School is essential to his emotional and physical health. It gives him the platform he needs to thrive in the mainstream classroom."

This holistic approach to early learning is also used at the Alpenglow School in Canmore, Alberta. Alpenglow School blends the provincial curriculum with the Waldorf education principles of integrated intellectual, practical and artistic development of children – in this case from kindergarten to grade six. Ronna Schneberger is the founder and director of Alpenglow School. She explains that by developing enthusiasm for nature and learning through hands-on outdoor activities, students "learn how to problem solve and build social skills," which complement the traditional public school curriculum subjects while reinforcing the concepts of conservation and responsible use of natural resources.

Rewarding for youth, teachers and volunteers

Not just young children benefit from incorporating forest-based learning into the traditional school curriculum. Through its Forestry in the Classroom program, the non-profit organization Forests Ontario connects volunteers with local schools and community so students can learn what it's like to make a career in forestry. As of spring 2018, more than 13,000 students have participated in a Forestry in the Classroom program. Craig Robinson, Principal with ArborData Consulting in Waterloo, Ontario, regularly volunteers with Forestry in the Classroom. He says the program helps students "see the connections between the environment, the climate, forests, trees, wildlife and forest products," which reinforces the concept of sustainable resource development. Robinson adds that he considers volunteering with youth a personally rewarding part of his career.

Across the country in Lumby, British Columbia, Martin Tooms is equally passionate about his work with youth. As the coordinator for the Forestry Program at Charles Bloom Secondary School, he oversees students learning practical skills like carpentry, welding, logging and forest management in the school's woodlot.

In forest schools, children use natural objects found in the forest – such as spruce cones or pebbles – to learn basic skills such as counting.

Forest schools encourage curiosity about the natural environment, and place emphasis on soft skills such as working in a team.

The school's Forestry Program allows students in grades 11 and 12 to earn up to 28 credits toward high school graduation while learning about work ethic, initiative, reliability, teamwork skills, problem solving, respect, confidence and character building. "These valuable skills focus on future employment, no matter what field," says Tooms.

Like the Forestry Program at Charles Bloom Secondary School, the Alberta Junior Forest Rangers program also focuses on teamwork and leadership, as well as actively incorporating traditional ecological knowledge. The Junior Forest Rangers engage with Elders and community leaders to learn about traditional practices, history and land uses, and to appreciate the value of this knowledge as it relates to natural resource management. Joda Snyder, who participated in the Junior Forest Rangers program in 2017, says that during the program his crew drove out to the Kainai reserve and spent three days learning about traditional Indigenous culture with an Elder from the Blood Tribe. Joda calls the experience, which typically includes traditional medicine harvesting, ceremonies and protocols, "unforgettable."

Appreciating the value of forests

Canada's forests provide children and youth with a unique learning opportunity. Whether it's counting ferns, learning about Indigenous history or operating a chainsaw, youth learn to recognize and appreciate the importance and value of one of Canada's greatest resources.

Sustainability indicators

Canadians have a deep commitment to sustainably managing the nation's forest resources because Canada's rich forest ecosystems offer significant environmental, social and cultural benefits, as well as opportunities for responsible economic development. Sustainable forest management ensures that these benefits are maintained for both present and future generations.

Sustainability indicators measure progress toward sustainable forest management

Science-based measures called sustainability indicators are helpful tools for understanding the overall condition or state of Canada's forests. Indicators provide a way to consistently define, assess, monitor and report progress toward sustainable forest management. Government, industry, researchers and the public all use indicators in addition to an extensive framework of federal, provincial and territorial laws and regulations.

Through the collection of data over time, sustainability indicators:

- provide essential information about the state of and trends in Canada's forests
- highlight any needs for improvement in forest management policies and practices
- supply reliable information for discussions and initiatives related to environmental performance and trade

Along with other United Nations member states, Canada has adoped the United Nations' 17 Sustainable Development Goals identified in the 2030 Agenda for Sustainable Development.

Canada uses internationally agreed-upon indicators of sustainable forest management

Along with 11 other countries, Canada is a member of the Montréal Process, an international working group of northern and southern hemisphere nations committed to sustainable forest management. Since 1995, the Montréal Process member countries have used a common set of science-based criteria and indicators to measure progress toward the conservation and sustainable management of 90% of the world's boreal and temperate forests.

The indicators presented in this section address today's most pressing questions about forests and forestry in Canada. Together with information in the *Statistical profiles* section, these indicators reveal trends in Canada's forests and forest practices over time and are comparable to sustainability indicators published by other countries participating in the Montréal Process.

Sustainably managed forests contribute to global sustainable development goals

The United Nations identified 17 Sustainable Development Goals in the 2030 Agenda for Sustainable Development, which was adopted by United Nations member states, including Canada, in September 2015. In addition to the 17 Sustainable Development Goals, the Agenda includes 169 associated targets aimed at improving global sustainable development across social, economic and environmental dimensions as well as peace, governance and justice.

Forests cover more than 30% of Earth's land area and contribute directly to several of the Sustainable Development Goals. Forests provide such benefits as: purifying water and air; providing food, shelter, renewable energy, timber and economic development; and offering recreational and cultural opportunities. Improving global sustainable forest management can thus help in achieving the Sustainable Development Goals faster.

Sustainability indicator reporting helps ensure that benefits flow to future generations

The many demands placed on global forests need to be balanced so that current and future generations can benefit from the economic, environmental and cultural benefits of forests. Therefore, with implementation of the United Nations' Sustainable Development Goals underway, it's critical to measure and report accurately on forest-related sustainability indicators. Reporting on the global Sustainable Development Goals is a step toward a shared understanding of the value of forests.

Indicators illustrate the benefits of forests in a changing world

This section presents 19 sustainability indicators that illustrate how Canada's forests and society interact over time. The indicators also show the complexity of sustainable forest management, particularly in the face of such challenges as climate change and other emerging issues.

Nevertheless, Canada is a nation with decades of experience in sustainable forest management, so Canadians can feel confident that sound management practices and the many benefits from Canada's forests will continue. Canada's trading partners can also be assured that Canadian forest products are sourced from sustainably managed forests.

Sources and additional information for the sustainability indicators are provided in the *Sources and information* section at the end of this report.

How much forest does Canada have?

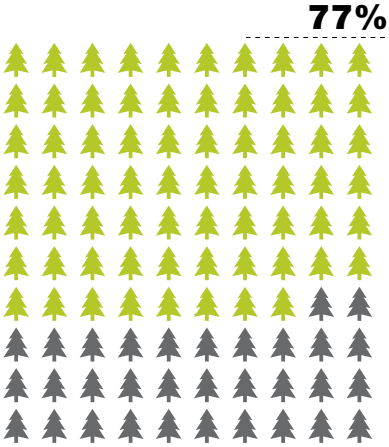
Canada's 347 million hectares (ha) of forest make up 9% of the world's forests. Twenty-four percent of the world's boreal forests are found within Canada's borders. Much of Canada's forest land is in remote, sparsely populated areas and is not under the same pressure to be cleared for agriculture or urban development as forests in many other countries. Canada has nearly 10 ha of forest land per person, more than 17 times the world average.

What is a forest?

In order to measure Canada's forest, we need to define "forest." Canada uses the Food and Agriculture Organization of the United Nations' definition of forest:

- land spanning more than 0.5 ha
- tree canopy covering more than 10% of the total land area
- trees growing to a height of more than 5 metres

This forest definition does not include land that is predominantly urban or used for agricultural purposes.



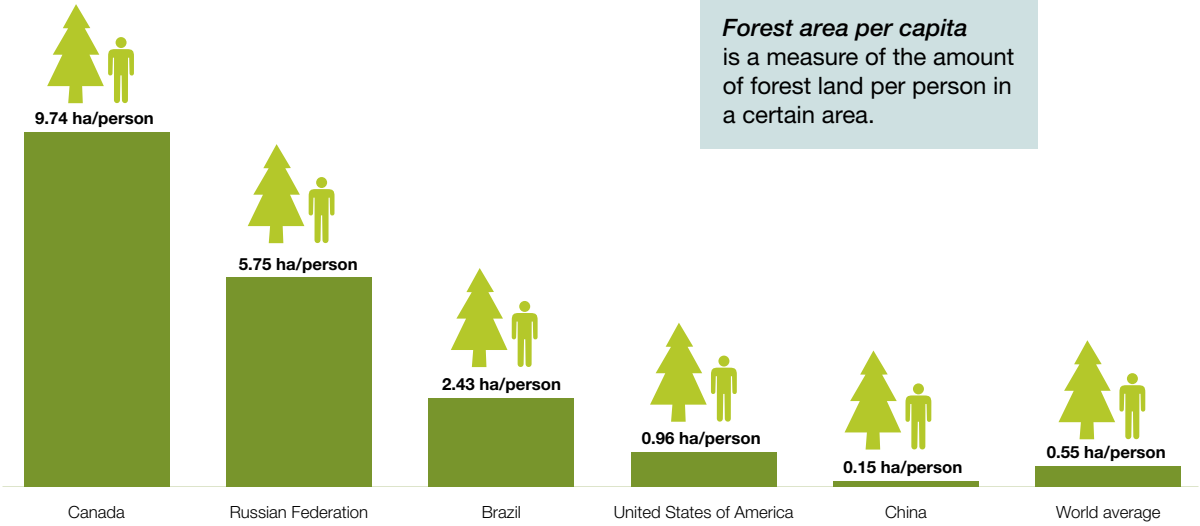
A forest that has been harvested is still a forest

Forest land that temporarily has no trees – for example, after a natural disturbance like fire or after harvesting – is still considered forest, because trees grow back.

Deforestation occurs when forest is converted to a different land use, such as urban development or agriculture. Afforestation is the opposite of deforestation. It means that new forest is created through planting and/or seeding on land that was previously agricultural, urban, or some other non-forested land use. Between them, afforestation and deforestation are drivers of forest area changes.

FOREST AREA PER CAPITA (HECTARES/PERSON) OF THE FIVE COUNTRIES WITH THE LARGEST FOREST AREA

Forest area per capita is a measure of the amount of forest land per person in a certain area.



Source: Food and Agriculture Organization of the United Nations; National Forest Inventory. See *Sources and information* for more detail.

Indicator: Forest area

Of Canada's 909 million hectares (ha) of land, 347 million ha is forest land.

- Canada's forest area has been quite stable over the past 25 years.
- Between 1990 and 2016, Canada's forest area decreased by 1.3 million ha (less than half of 1%).
- Those forests were deforested for other land uses, such as agriculture, roads and hydroelectric and urban developments.

While forest area is relatively constant, forest cover within that area is more dynamic. Forest fires, insect infestations, timber harvesting, growth and regeneration contribute to the continually changing mosaic of forest cover within Canada's forest area.

Table.1 Estimated area (millions of hectares) of forest in Canada

YEAR	1990	1995	2000	2005	2010	2015
Forest area	348.3	348.0	347.8	347.6	347.3	347.1

Why is this indicator important?

- Permanent losses and gains in forest area affect the stability and sustainability of forest resources, biodiversity, wildlife habitat and ecosystem services, such as air and water purification and carbon sequestration.

What is the outlook?

- Given Canada's low rate of deforestation and its commitment to sustainable forest management practices, Canada's overall forest area is likely to remain stable over the near term.
- Climate change is altering environments and, over the longer term, could change the extent of Canada's forest area.
- Canada's federal, provincial and territorial governments continue to work together to monitor our forest resources to understand how and where they are changing over time.

Source: Food and Agriculture Organization of the United Nations; National Forest Inventory. See *Sources and information* for more detail.

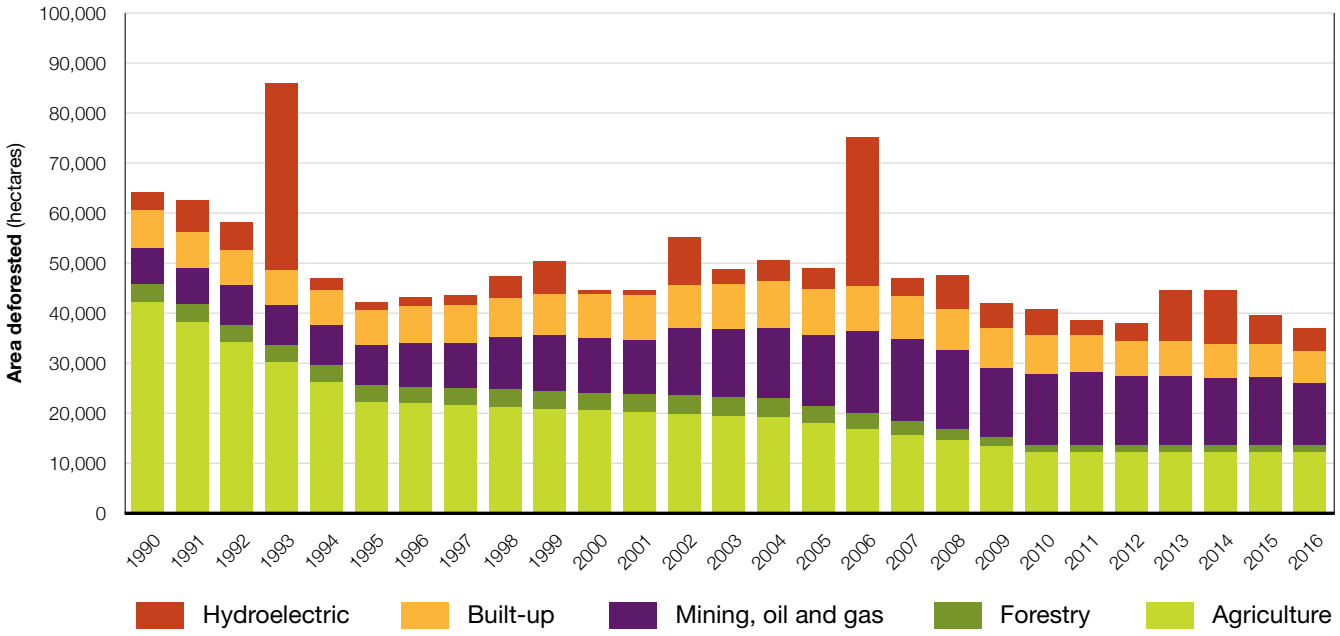
Indicator: Deforestation and afforestation

Canada's low annual deforestation rate has declined even further over the last 26 years, dropping from 64,000 hectares per year (ha/yr) in 1990 to about 37,000 ha/yr in 2016.

- Between 1990 and 2016, less than half of 1% of Canada's total forest area was converted to other land uses.
- Conversion of forest to agriculture and hydroelectric development has declined in recent years.
- Forest flooded during hydroelectric reservoir development produces large annual spikes in deforestation, as seen in 1993 and 2006 (see graph).
- Although urban and rural planting initiatives are underway in many regions of Canada, the annual land area afforested has been very small relative to the total forest area in the country and is currently not tracked.

The National Deforestation Monitoring System (NDMS) tracks changes from forest land to other land uses across Canada. The NDMS can show trends by time, region and industry sector type.

Estimated area (hectares) of annual deforestation in Canada, by industrial sector, 1990–2016



Why is this indicator important?

- Forest loss impacts biodiversity, soil, air and water quality, and wildlife habitat.
- Forests store more carbon than other ecosystem types and can be managed to mitigate climate change.

What is the outlook?

- Canada's overall deforestation rate is expected to decline further over time.
- Deforestation resulting from activity in Canada's oil and gas sector has increased since 1990, but conversion of forest to agricultural land uses will likely remain the largest cause of deforestation in Canada. These conversions are small relative to the overall size of Canada's forests.

Source: Dyk, A., Leckie, D., et al. 2015; Environment and Climate Change Canada; United Nations Framework Convention on Climate Change. See *Sources and information* for more detail.

Indicator: Wood volume

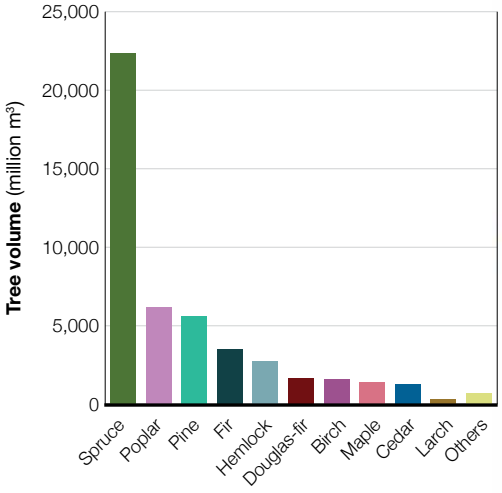
Canada's forests contain about 47 billion cubic metres (m^3) of wood – enough wood to build over 1 billion average single-family homes.

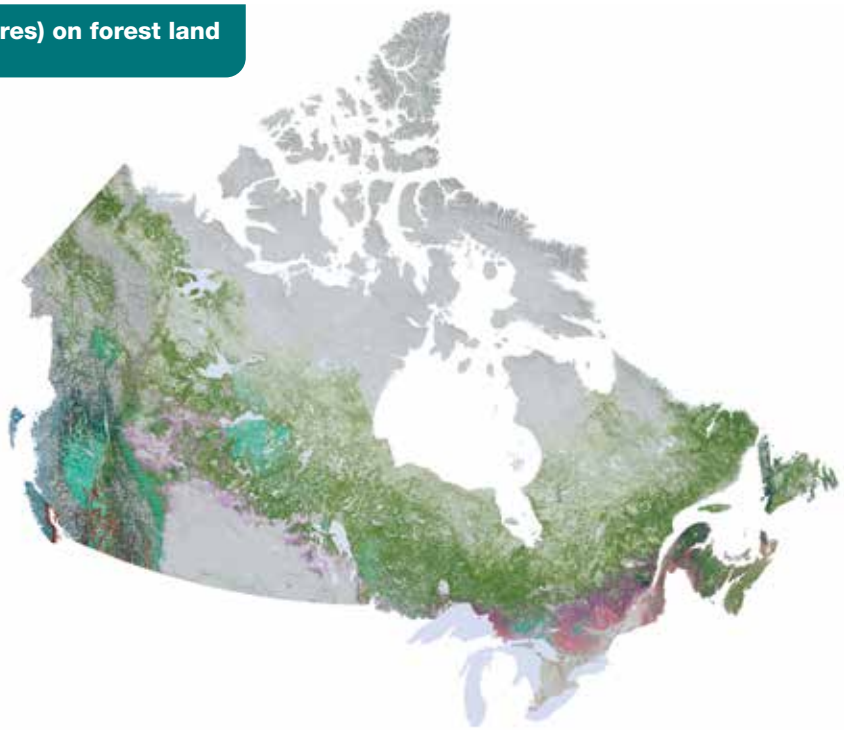
- A number of factors influence tree growth, including climate, genetics, age, health, herbivory and availability of light, water and nutrients.
- Averaging 432 cubic metres per hectare (m^3/ha), the forests along Canada's west coast have the highest density of wood volume, more than three times the national average of 136 m^3/ha.
- Spruce trees dominate Canada's landscape, accounting for 47% of Canada's total wood volume.

Tree volume is the volume inside the bark of the main tree stem, including stump and top as well as defective and decayed wood.

The wood volume estimate for Canada includes the volume of all forest stands within Canada's forest area, regardless of age, ownership, protection status, accessibility or management.

Canada's tree volume (million cubic metres) on forest land by species group





Why is this indicator important?

- Wood volume production rate (or productivity) is one of the inputs used by professional foresters to determine sustainable harvest levels on land managed for timber production.
- Wood volume, along with other information, is used to calculate forest biomass and carbon stocks.

What is the outlook?

- Wood volume will remain stable as long as volume losses from human-caused disturbances (such as harvesting) and natural disturbances (such as insect infestations, diseases and forest fires) are offset by gains from forest growth and regeneration. In regions affected by disturbances, wood volume may take years or decades to recover, depending on the extent of mortality caused by the disturbance as well as the regeneration and growth rates of the new forest. At a national level, losses in one region are often offset by gains in others.
- Scientists are finding evidence that tree growth, forest fires, drought and insects are being impacted by climate change. It is important to consider these complex factors to ensure a sustainable wood supply for future generations.

Source: McKeever, D.B., and Howard, J.L. 2011; National Forest Inventory. See *Sources and information* for more detail.

Is timber being harvested sustainably?

Canada's sustainable forest management regime ensures that our forests remain healthy and that the forest industry continues to provide Canadians with a steady stream of benefits.

From Powell River, British Columbia, to Corner Brook, Newfoundland and Labrador, all levels of government in Canada recognize the importance of keeping forests healthy so they continue to contribute to Canadians' well-being and wealth. For example, the governments of British Columbia and Canada, through the Low Carbon Economy Fund, co-funded BC's Forest Carbon Initiative, which is working to restore forests impacted by the mountain pine beetle infestation and wildfires. The initiative aims to enhance the carbon storage potential of BC's public forests through a range of activities, including rehabilitation, fertilization, increased planting density and improved utilization.

Timber harvesting is sustainable in Canada thanks to strong laws, oversight and management, and the requirement that all harvested public lands be regenerated.

Most of Canada's forests are publicly owned

About 90% of Canada's forests are located on provincial and territorial Crown lands. The provincial and territorial governments are therefore responsible for forest management. They specify an allowable annual cut, which includes both the annual level of harvest allowed on a particular area of Crown land and the minimum forest age at the time of harvest. Regulating harvest levels in this way helps to ensure sustainability over the long term.

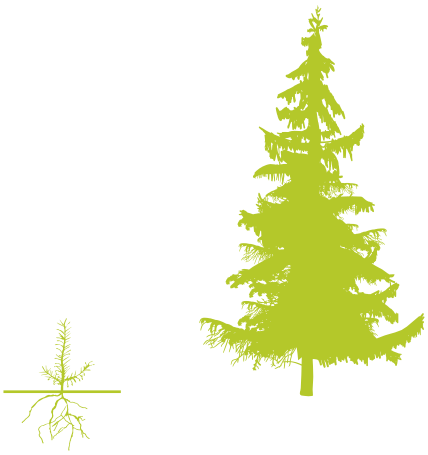
Harvesting is not deforestation

Whether through natural or artificial regeneration, harvested forests grow back. Regeneration ensures that Canada's forests continue to produce wood fibre for commercial uses, offer recreational opportunities and provide ecosystem services, such as storing carbon, regulating water quality and quantity, and creating wildlife habitat.

Regeneration is required after harvesting

All provincial and territorial lands that are harvested for commercial timber must be regenerated either naturally or by planting and seeding, or by a combination of these methods.

BY LAW, ALL FORESTS HARVESTED ON PUBLIC LANDS MUST BE REGENERATED



Each province and territory has its own regeneration standards and regulations, addressing such areas as species composition, density and stocking levels, and distribution of various forest types across the landscape.

The benefits of natural regeneration include the need for minimal human assistance and generally lower costs than for artificial regeneration. But planting and seeding provide more control over what grows, so they are often used to ensure that provincial and territorial regeneration standards and forest management objectives are met. More than half of Canada's harvested areas are regenerated through planting and seeding activities.

In 2016, about 155 million cubic metres (m^3) of industrial roundwood – or approximately 0.3% of Canada's total standing wood volume (47 billion m^3) – were harvested in Canada.

British Columbia accounted for nearly half (43%) of Canada's industrial roundwood harvest on provincial crown land (by volume), followed by Quebec and Alberta.

Source: National Forest Inventory; National Forestry Database. See *Sources and information* for more detail.

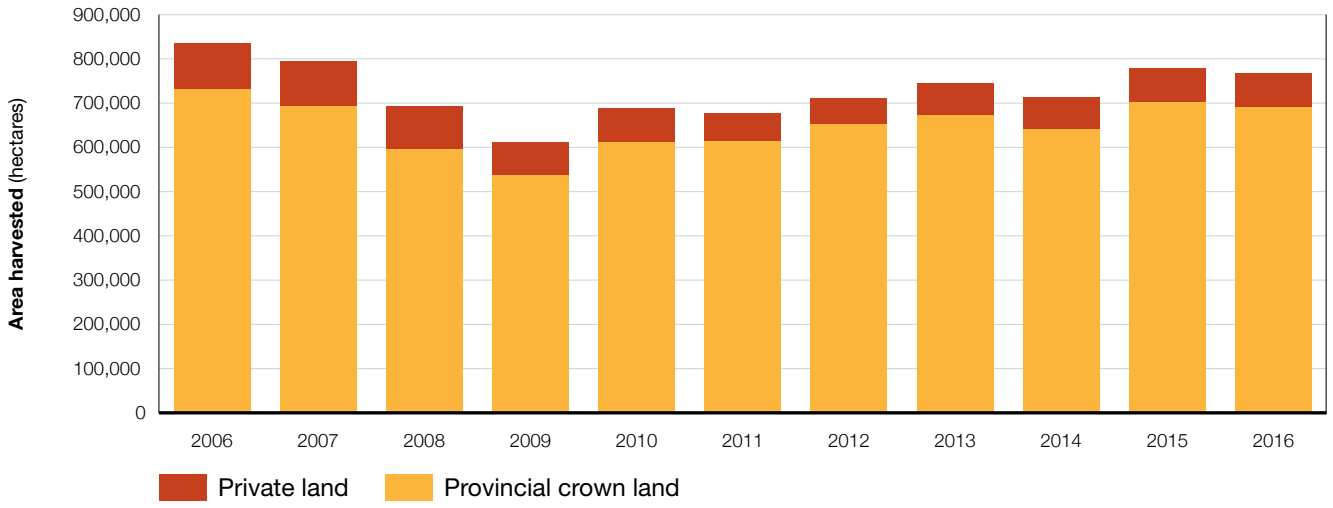
Indicator: Area harvested

The area of forest harvested each year is monitored to ensure that the level of industrial activity in Canada's forests is sustainable over the long term. In 2016, an estimated 767,000 hectares (ha) of forest were harvested.

- This is a 1.7% decrease from 2015 levels, when 780,000 ha were harvested, and is well below the average area harvested each year during the peak period of 1995 to 2005 (1 million ha).
- The decline is largely due to a decrease in the area of public forest land harvested, primarily in British Columbia as harvesting was reduced in mountain pine beetle-impacted areas.

The **area harvested** each year is less than half of 1% of Canada's 347 million hectares of forest, significantly smaller than the areas impacted by insects and burned by fires each year.

Forest area harvested on private and Crown lands in Canada, 2006–2016



Why is this indicator important?

- Commercial timber harvesting is one of several indicators of the level of industrial activity in the forest sector.
- Harvesting of forests on Crown land, the source of most commercial timber, is regulated to provide a sustainable level of wood supply.

What is the outlook?

- The area harvested will vary as the demand for Canadian forest products varies and forest managers adjust their management objectives.
- The demand for Canadian wood products is expected to remain strong over the near term, as US housing starts and expenditures on repair and remodelling increase, and offshore exports, particularly to Asia, rise.
- The area of forest harvested, however, is not expected to increase above pre-recession levels.

Source: National Forestry Database. See *Sources and information* for more detail.

Indicator: Regeneration

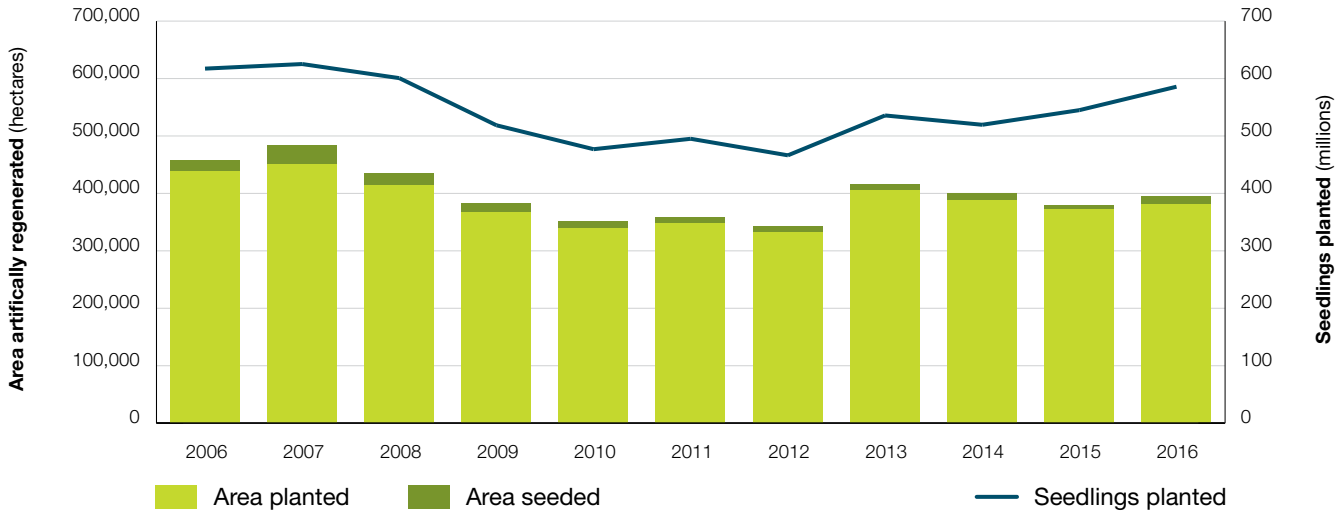
In 2016, 586 million seedlings were planted on 380,000 hectares (ha) of provincial forest lands in Canada. Seeding was used to re-establish forests on an additional 15,000 ha.

- More seedlings were planted in 2016 than in the previous seven years – only 3% fewer than in the pre-recession 10-year average (1999–2008).
- Area planted increased by 2% but was 10% below the pre-recession 10-year average.
- Seeding is less favoured than planting, typically accounting for less than 5% of the area artificially regenerated.

Successful regeneration is required following forest harvesting on public lands. The type of forest, harvesting method and desired composition of the new forest determine the regeneration method.

Regeneration is achieved through natural or artificial (planting or seeding) means. Artificial regeneration is applied to about 55% of the total area harvested.

Area artificially regenerated and number of seedlings planted on provincial Crown lands in Canada, 2006–2016



Why is this indicator important?

- Regeneration activities ensure that harvested areas regrow as forests and continue to produce timber and maintain ecosystem services, such as storing carbon, regulating water quality and providing habitat.
- The method used for regenerating forests can influence forest composition over time.

What is the outlook?

- Regeneration is required on all Crown (public) lands in Canada, so virtually all harvested lands will continue to be regenerated.
- The area regenerated is related to recent harvest levels, which are influenced by market conditions for wood products but are always within the bounds of sustainable forest management.
- The proportions of natural and artificial regeneration are unlikely to deviate from recent trends.

Source: National Forestry Database. See *Sources and information* for more detail.

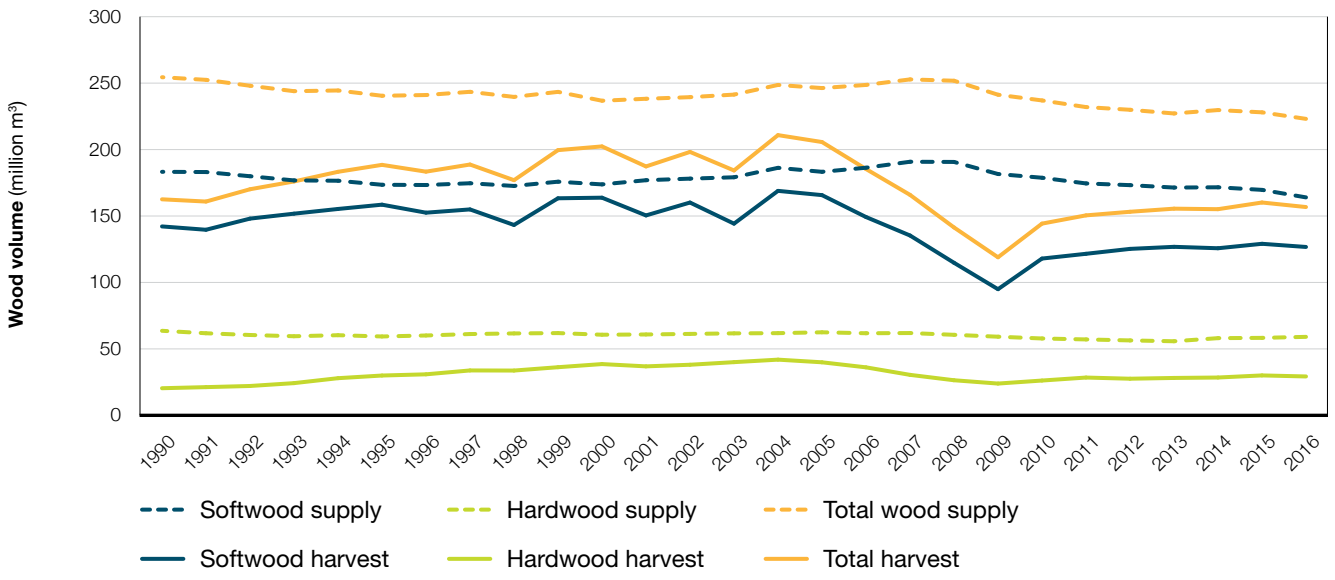
Indicator: Volume harvested relative to the sustainable wood supply

In 2016, Canada harvested nearly 155 million cubic metres (m^3) of industrial roundwood, well below the estimated sustainable wood supply level of 223 million m^3.

- This is a decrease of about 1 million m^3 from 2015 levels, when 156 million m^3 of industrial roundwood was harvested.
- This decline is largely due to a decrease in the volume of softwood timber harvested in British Columbia and Alberta, as salvage logging of dead mountain pine beetle-killed timber was reduced.
- At the same time, the estimated volume of wood supply deemed to be sustainable decreased by nearly 5 million m^3.
- Since the sustainable wood supply declined at a faster rate than the volume harvested, the gap between them was slightly less than in 2015.

Sustainable wood supply refers to the volume of timber that can be harvested from federal, provincial, territorial and private lands while meeting environmental, economic and social objectives.

Annual harvest versus supply deemed sustainable for harvest, 1990–2016



Why is this indicator important?

- Forest managers track the volume of industrial roundwood harvested each year to ensure it falls within sustainable levels.
- Harvests from provincial Crown lands are regulated by allowable annual cuts (AACs).
- While there is no AAC calculation for Canada as a whole, it is possible to compare the combined provincial AACs with the combined harvest totals from the same Crown land base.

What is the outlook?

- Harvest levels are expected to remain below the sustainable wood supply, given the strong provincial and territorial regulatory regimes in place.
- The gap between harvest and supply will likely narrow further as some provinces, notably BC, lower their AACs while global demand for Canadian wood products remains strong.

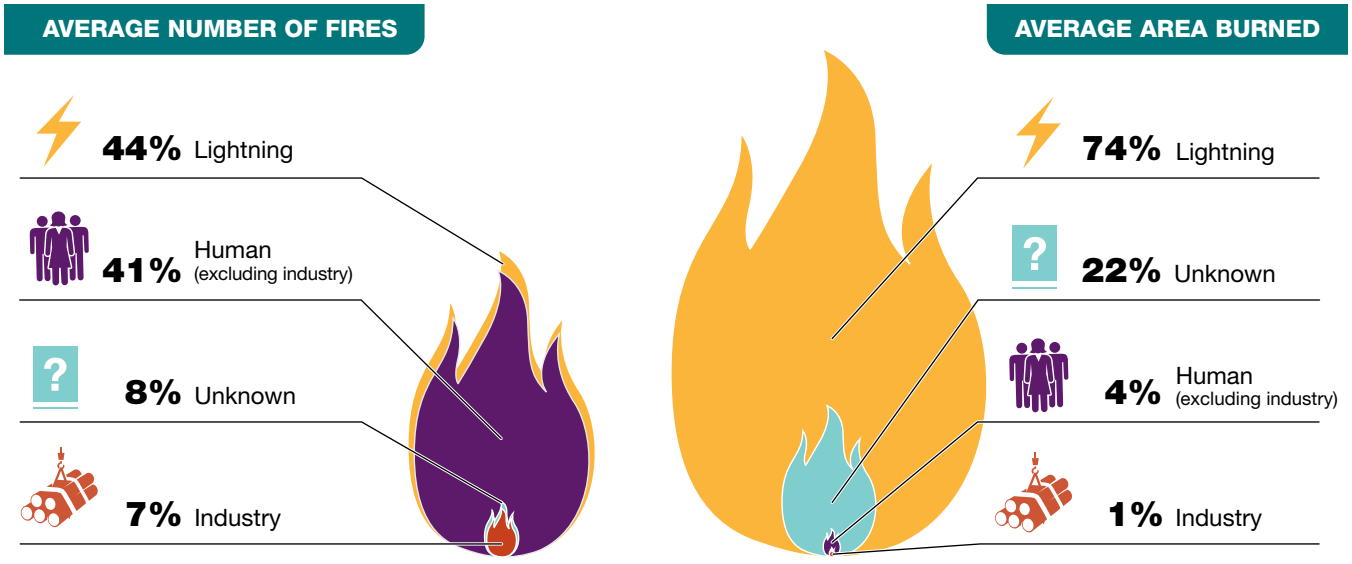
Source: National Forestry Database. See *Sources and information* for more detail.

How does disturbance shape Canada's forests?

Canada's forests are continually affected by fire, insects and disease. These natural disturbances – and others including drought, floods and windstorms – can renew whole forest landscapes and, over time, shape forest composition, structure and habitat diversity.

Natural disturbances vary in severity, extent and frequency, and their relative importance varies from region to region. The result is that Canada's forests are in a constant state of change and are part of a dynamic landscape.

FOREST FIRE CAUSES IN CANADA (2007–2017)



Natural disturbances bring renewal

Natural disturbances like fire, insect outbreaks and disease are an important component of the natural life cycle of forests, especially Canada's boreal forests.

In the boreal zone, fire is the primary agent of change and renewal, not only releasing nutrients and allowing sunlight to reach the forest floor, but even releasing the seeds of some species from their cones.

Disturbance has positive and negative effects

Extensive stand mortality sometimes results from large insect outbreaks and diseases, releasing nutrients from affected trees and reducing competition among surviving and newly establishing trees. This in turn enhances forest renewal and succession. However, exotic or non-native insects and diseases introduced through global trade can have negative rather than positive impacts, since Canada's native forests may not be adapted to them.

While natural disturbances are essential to forest health and renewal, they can have a negative impact on the people, communities and businesses that reside in or rely on forests. Fire poses threats to human safety, property and infrastructure, but natural disturbances can also temporarily reduce the supply of timber, with socio-economic impacts on communities and citizens.

Disturbances affect the carbon cycle

Since forests absorb carbon as they grow and release it when they die and decay or when they burn in forest fires, they play an important role in the carbon cycle. The impacts of natural disturbances, especially fire, are among the many complex factors that determine whether forests absorb or release more carbon each year.

Source: National Forestry Database. See *Sources and information* for more detail and additional sources.

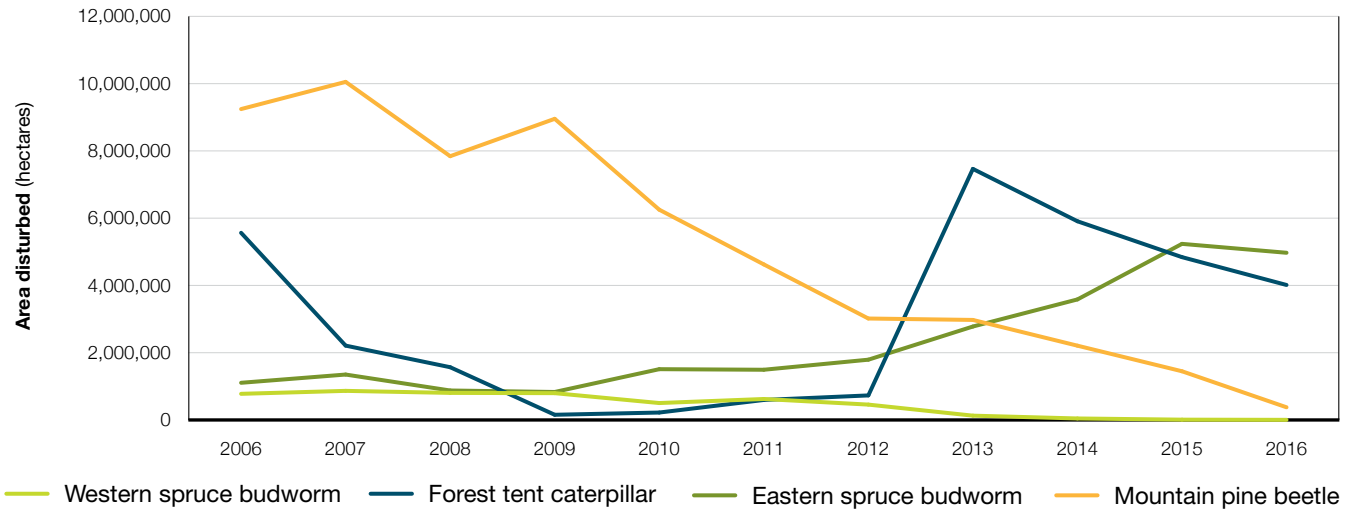
Indicator: Forest insects

In 2016, 15.5 million hectares (ha) of forest were affected by insects in Canada.

- This represents a 1.5% decrease in area affected over the previous year.
- Growth of the spruce budworm outbreak in Quebec has slowed.
- Nationally, the area affected by forest tent caterpillar has decreased, but the area affected annually in Ontario increased from only 28,000 ha in 2012 to 1.1 million ha in 2016.
- The area affected by mountain pine beetle continues to decline.
- The outbreak of western spruce budworm in British Columbia's Douglas-fir forests has now ended.

- Insects are one of the most important disturbance agents in Canada's forests.
- Outbreaks of some key species like spruce budworm and forest tent caterpillar are cyclical.
- Bark beetles tend to erupt under a particular set of forest and climatic conditions.

Forest area containing defoliated trees for four insects in Canada, 2006–2016



Why is this indicator important?

- Insect outbreaks are second only to wildfires in the impact they have on Canada's forests.
- Monitoring multiple species is important because they often have synergistic and interrelated effects. Some species defoliate and weaken the trees, while others tend to attack and kill previously weakened trees.
- Because insect growth rates are directly tied to environmental temperatures, insects are sensitive indicators of climate change at both local and continental scales.

What is the outlook?

- The slowing of the spruce budworm outbreak in Quebec is a positive development, but the outbreak may still spread into Atlantic Canada's large areas of susceptible spruce-fir forest.
- Mountain pine beetle continues to spread in Alberta, and its eastward movement into Saskatchewan and beyond remains a concern.
- The outlook for the current spruce beetle outbreak in British Columbia remains highly uncertain. It will likely depend on cumulative drought stress in susceptible spruce forests.

Source: BC Ministry of Forests, Lands and Natural Resource Operations; National Forestry Database. See *Sources and information* for more detail.

Indicator: Forest diseases

Tree diseases can reduce growth, decrease stand productivity and wood quality, and cause tree death. In a commercial context, this is detrimental; however, in a non-commercial setting, disease can lead to increased biodiversity and nutrient cycling.

- The environment plays an important role in the disease process, mediating interactions between the host tree and pathogens.
- Native forest pathogens, such as the root disease agent *Armillaria ostoyae*, can be widespread and have serious impacts, ranging from volume loss to death.
- Historically, exotic introduced pathogens have had significant impacts on native trees. For example:
  - White pine blister rust, caused by *Cronartium ribicola*, has caused significant losses of five-needle pines.
  - Annosus root rot, caused by *Heterobasidion irregulare*, has the potential to have huge impact on red pine plantations.
  - Dutch elm disease, caused by *Ophiostoma novo-ulmi*, has caused significant losses to urban elms in many cities.

- Tree disease occurs as a result of prolonged interaction between a tree and a stress factor that affects normal functioning.
- Stress factors are often biological and include pathogens, which are primarily fungi. Pathogens can infect the roots, stems or leaves of trees.
- Trees can also be injured by environmental stress, such as drought, which can affect growth and, when prolonged, cause death.

Why is this indicator important?

- Forest diseases can cause significant loss of volume over an extended period of time and these losses may not be immediately obvious if infections are not lethal.
- If a host becomes stressed by changes in environmental conditions (e.g., drought), pathogens can have greater impacts, resulting in greater losses to disease.
- Forest diseases can be difficult to manage economically at the landscape level.

Golden-yellow fruiting bodies of Armillaria *spp., the causal agents of Armillaria root rot, at the base of an infected birch tree.*

What is the outlook?

- Drought has affected aspen and spruce productivity in the Prairie provinces in the recent past, and the changing climate may lead to more severe impacts, in turn reducing the area of these species.
- The oak wilt pathogen, *Bretziella fagacearum* (previously *Ceratocystis fagacearum*), has not been reported in Canada, but it is widespread in the United States and has recently been observed near Detroit, close to the Canadian border. The Canadian Food Inspection Agency regulates the importation of oak material.
- Annosus root rot is increasing in eastern Canada and if untreated it may soon affect every red pine plantation, resulting in losses of high-value trees.
- Forest disease is a natural ecosystem process and disease impacts will continue.

Source: Bérubé, J.A., Dubé, J., et al. 2017; Canadian Food Inspection Agency; Cheng, L., Huang, J.G., et al. 2017. See *Sources and information* for more detail and additional sources.

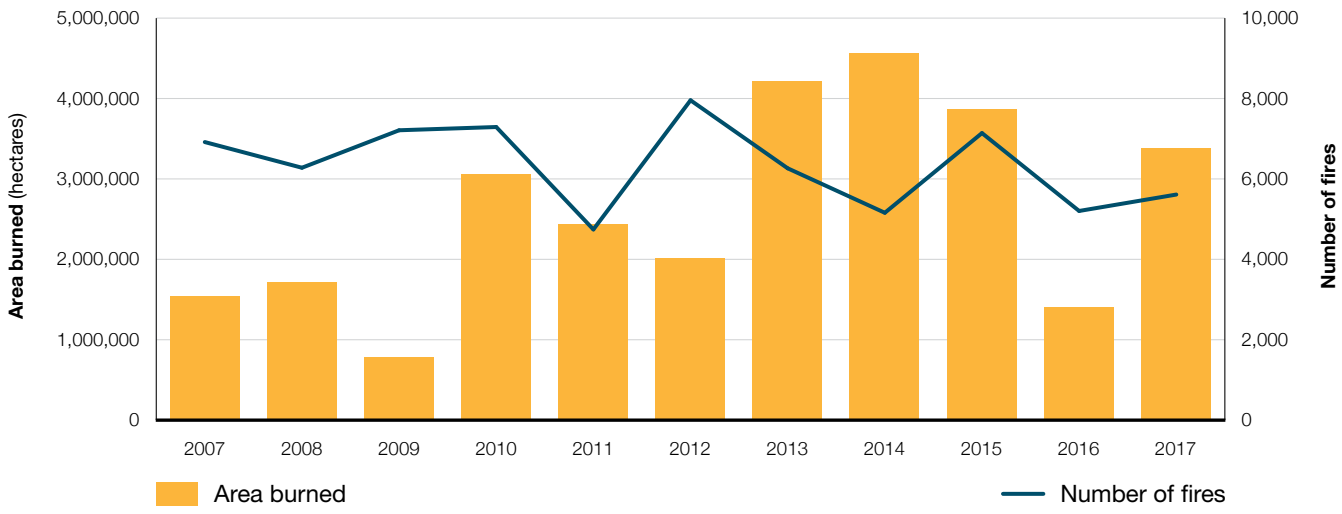
Indicator: Forest fires

In 2017, Canada experienced 5,611 forest fires, with approximately 3.4 million hectares (ha) burned, well above the average annual area burned.

- The 2017 fire season was the third in a row with above-average impacts on affected communities, including large numbers of evacuations, high property damage, poor air quality and costly fire-suppression efforts.
- British Columbia had one of the worst fire years on record, with over 1.2 million ha burned and over $500 million in fire suppression costs.
- In British Columbia, 65,000 people were evacuated from their homes because of fires. Significant fire-related evacuations also occurred in Alberta, Saskatchewan and Manitoba.

The top priority of all fire management agencies is protection of human life, and evacuations are a key part of that protection. People are evacuated not only to avoid fatalities, but also to avoid the adverse health effects of smoke inhalation. During large fire events, such as those in 2015, 2016 and 2017, the federal government provides support to provincial and territorial fire authorities on request. This includes fire intelligence from Natural Resources Canada as well as other support from multiple federal departments and agencies and groups such as the Red Cross.

Forest area burned and number of forest fires in Canada, 2007–2017



Why is this indicator important?

- Forest fires are a natural part of the forest ecosystem and are important in many parts of Canada for maintaining the health and diversity of the forest. However, they may also result in costly economic and environmental losses and public health and safety concerns, directly threatening communities and infrastructure, or reducing visibility and air quality through smoke.
- The increased frequency and severity of fires affects the cost of fire management and results in greater impacts on people and communities, such as evacuations and losses of homes and businesses.
- Information on trends in the fire situation across the country helps researchers assess both the health of Canada's forests and the effects of climate change.

What is the outlook?

- When and where significant fire activity occurs varies greatly from year to year, but fire trend analysis indicates that fire seasons are starting earlier and lasting longer.
- The frequency and severity of forest fires in Canada is predicted to increase as climate change brings about warmer temperatures and less rainfall.

Source: National Forestry Database; Natural Resources Canada–Canadian Forest Service. See *Sources and information* for more detail and additional sources.

Indicator: Carbon emissions and removals

In 2016, total net emissions of carbon dioxide equivalent (CO_2e) from Canada's managed forests (forest lands managed for timber production) were about 78 million tonnes (Mt), meaning that they were a net source of emissions.

Total net emissions are calculated by adding emissions/removals caused by human activities in Canada's managed forests to emissions/removals caused by large-scale natural disturbances in Canada's managed forests.

Human activities in Canada's managed forests accounted for removals of about 20 Mt CO_2e in 2016, while large-scale natural disturbances accounted for emissions of about 98 Mt CO_2e, resulting in net emissions of 78 Mt CO_2e (these figures include carbon monoxide emissions, which are reported in a separate category in the *National Inventory Report*; see section 6.9.4 of Canada's 2018 *National Inventory Report 1990–2016*).

- Forest lands managed for timber production, and the wood products harvested from these lands, continue to be an ongoing sink of carbon (20 Mt CO_2e in 2016) (a "carbon sink" removes carbon dioxide from the atmosphere).
- The area burned in managed forests in 2016 was 0.77 million hectares (ha), about half of the area burned in 2015. This decrease resulted in lower emissions than in 2015, mainly because of the smaller total area burned.
- The impacts of the mountain pine beetle in British Columbia continued to decline, and insect damage in Canadian forests in 2016 was relatively minor, although spruce budworm impacts in eastern Canada are reflected in the current emissions estimates.

Canada's *2018 National Inventory Report 1990–2016* (from which these results are derived) has implemented a new approach for estimating and reporting on emissions and removals resulting from human activities in managed forests. Please see the textbox titled *A new approach to reporting* for more information about these changes.

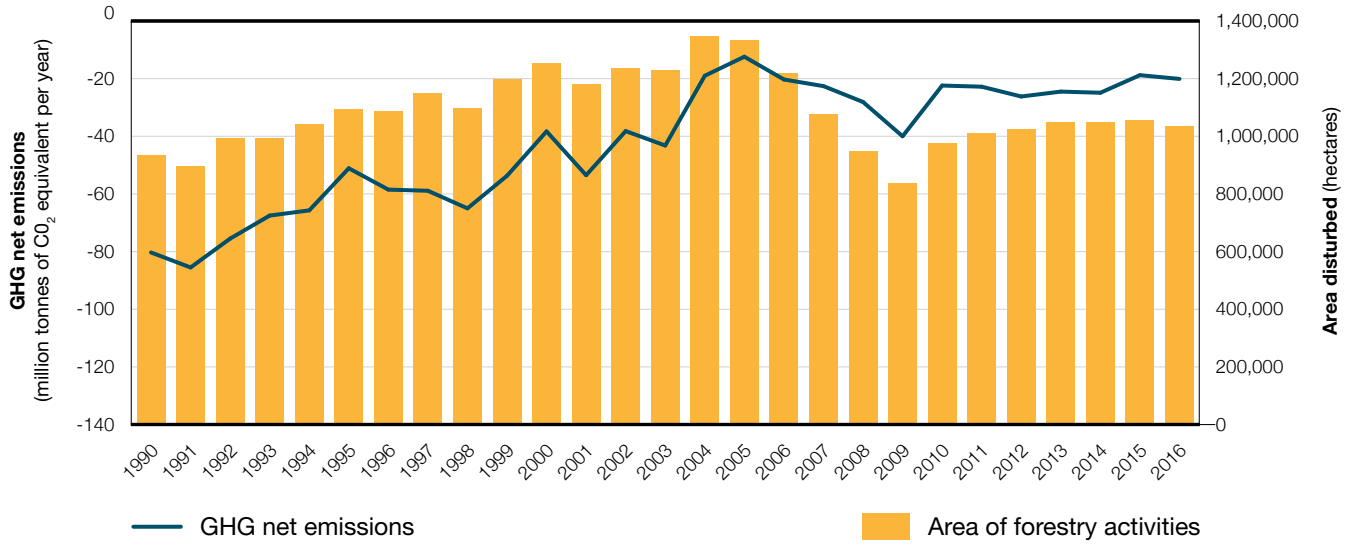
Under the United Nations Framework Convention on Climate Change (UNFCCC), Canada must report annually on greenhouse gas emissions from the managed forest.

The "managed forest" is made up of all forests under direct human influence. It's a subset of Canada's total forest area and includes forests managed for harvesting, forests subject to fire or insect management, and protected forests, like those found in national and provincial parks.

The managed forest area in Canada is about 226 million hectares, or 65% of Canada's total forest area. All other forests in Canada are considered "unmanaged."

The data in this indicator is consistent with UNFCCC reporting. More information about definitions and methods can be found in Canada's *2018 National Inventory Report 1990–2016*.

Net carbon emissions in Canada's managed forest: Areas subject to human activities, 1990–2016

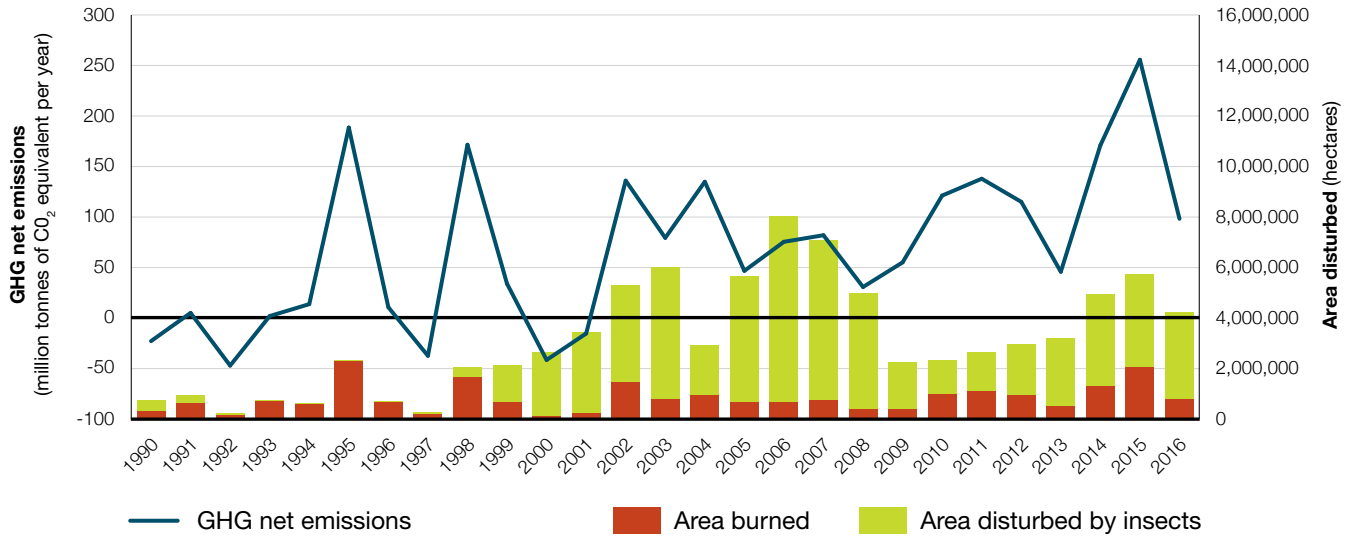


In Canada's managed forests, forest management activities, such as harvesting, slash pile burning and regeneration, as well as the use and disposal of harvested wood products, were a net sink of about 20 Mt CO_2e in 2016.

Why is this indicator important?

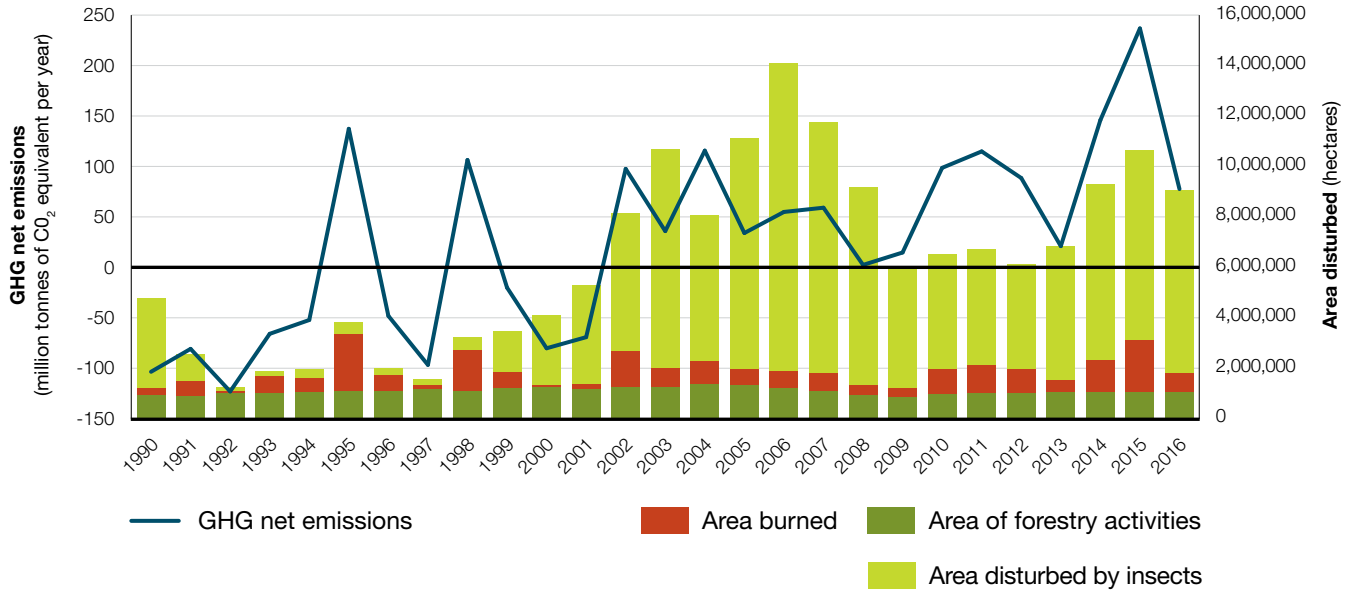
- Changes in forest management and the use of harvested wood products can help mitigate the impacts of climate change.
- Natural disturbances, mostly outside the control of humans, significantly affect the ability of Canada's managed forest to consistently absorb more CO_2 than it emits.
- Carbon as carbon dioxide (CO_2) in the atmosphere is an important contributor to global warming.
- Canada's forest sector contributes to both emissions and removals of CO_2 from the atmosphere; however, in 2016, Canada's managed forests were a net source of CO_2.

Net carbon emissions in Canada's managed forest: Areas subject to natural disturbances, 1990–2016



Natural disturbances in Canada's managed forests resulted in emissions of about 98 Mt CO_2e in 2016. Forest GHG emissions were much lower than in 2015, in large part because of the smaller area burned than in 2015 and the continued decline of the mountain pine beetle outbreak in British Columbia, although spruce budworm is beginning to have an impact in eastern Canada.

Net carbon emissions in Canada's managed forest: All areas, 1990–2016



The total net emissions and removals from Canada's managed forests, taking into account both human activities and natural disturbances, were about 78 Mt CO_2e (–20 + 98 = 78) in 2016. This includes emissions from wood harvested in Canada and used in Canada and abroad.

What is the outlook?

- The impacts of climate change on Canada's future forest GHG balance are difficult to predict. Regionally, impacts can be both positive (enhanced forest growth and therefore greater carbon sinks) and negative (higher mortality, more forest fires, more insect outbreaks). Given the larger-than-usual extent of area burned in 2017, especially in British Columbia, we expect emissions of GHGs to be similar to those reported in 2015.
- Increased use of long-lived wood products to store carbon in the built environment and use of wood products instead of emissions-intensive building materials provide opportunities for climate change mitigation.

A new approach to reporting

Canada's *National Forest Carbon Monitoring, Accounting and Reporting System* provides annual estimates of the greenhouse gas balance for Canada's managed forests. These estimates of emissions and removals are reported annually in Canada's *National Inventory Report* to the United Nations Framework Convention on Climate Change.

In previous years, estimates of carbon emissions and removals from Canada's managed forests displayed large year-over-year variability because natural disturbances, especially forest fires, masked the subtler impacts of human forest management activities. The Intergovernmental Panel on Climate Change (IPCC) recognized this challenge for countries like Canada, which are interested in better understanding emissions due to human activities but where these impacts are difficult to see when combined with natural disturbances. Therefore, the IPCC recommended that countries develop new approaches to separate emissions and removals caused by human activities (anthropogenic partition) from emissions and removals caused by natural disturbances (natural partition).

This separation of human-caused emissions and removals from natural disturbance-caused emissions and removals makes it possible to detect trends in emissions attributable to forest management. This enhances Canada's ability to monitor and report on the consequences of climate change mitigation efforts by the forest sector. Details of the new approach, which has been in use since 2017, including definitions and methods, are provided in sections A3.5.2.3 Part 2 of Canada's 2018 *National Inventory Report 1990–2016*.

Source: Environment and Climate Change Canada. See *Sources and information* for more detail.

How do forests benefit Canadians?

Forests provide a wide range of economic, social and environmental benefits for both individual Canadians and the communities in which they live.

Forests provide economic opportunities

The forest industry provides economic benefits through jobs and income. These benefits are especially important in rural and Indigenous communities.

Timber is not the only forest product that provides economic benefits for Canadians. Non-timber forest products, including forest-based foods such as maple syrup, blueberries, mushrooms and game meat, contribute significantly to the economies of many rural communities.

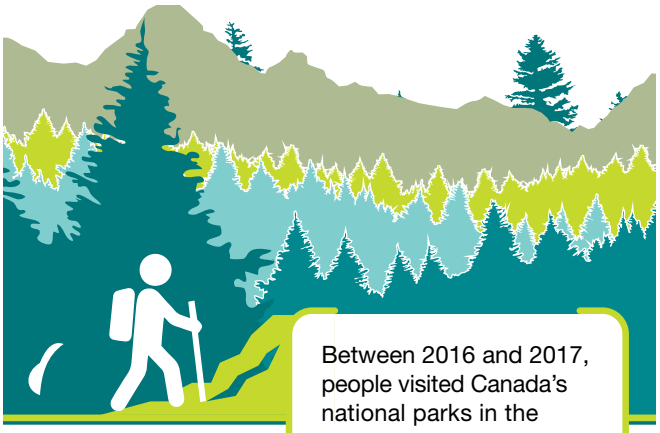
In 2017, the forest industry accounted for 209,940 direct jobs – including foresters, scientists, engineers, computer technologists, technicians and skilled tradespeople – and an estimated 107,380 indirect jobs in related industries. These jobs help ensure the economic sustainability of rural communities, and the benefits trickle down through entire local economies.

In 2016, approximately
3.9 MILLION PEOPLE LIVED IN CANADA'S BOREAL FOREST REGION.

Social and cultural benefits of forests are important to Canadians

Eleven million Canadians live in or adjacent to forested land.

The social and cultural benefits of forests are harder to quantify than the economic ones, but for both rural and urban Canadians they offer many opportunities, such as ecotourism and recreation. Forests are also of great cultural, aesthetic and spiritual importance to many people across the country, especially Indigenous peoples.



Between 2016 and 2017, people visited Canada's national parks in the boreal forest region approximately
9 MILLION TIMES.

Forests provide ecosystem services and other environmental benefits

Forests benefit Canadians environmentally through the range of essential ecosystem services that they provide. For example, forests preserve soils, cycle nutrients and support biodiversity. Trees and other forest plants filter pollutants from air and water, acting as natural cleansers. Trees in cities and other urban areas help improve air and water quality and reduce surface and air temperatures.

By absorbing and storing carbon, forests also play a key role in the carbon cycle – the constant movement of carbon from the land and water to the atmosphere and living organisms – and in maintaining the global carbon balance. In addition, they help moderate climate change by absorbing carbon emitted by human activities like burning fossil fuels.

Growing evidence demonstrates the benefit of forests for mental health and well-being

In addition to the benefits outlined above, healthy urban forests generate direct and indirect benefits for health and social wellness. A growing body of socio-economic and clinical studies indicates that access to trees in urban areas can increase the longevity of seniors, improve health outcomes for children and youth, lower levels of stress and increase workplace satisfaction.

Source: Natural Resources Canada–Canadian Forest Service; Statistics Canada. See *Sources and information* for more detail and additional sources.

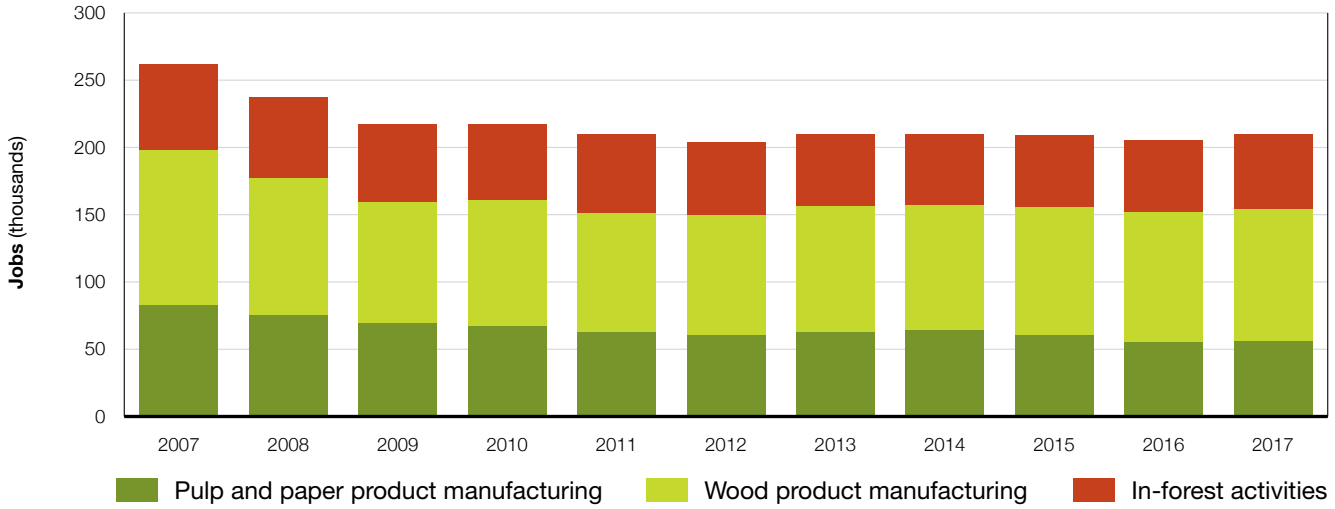
Indicator: Employment

Employment in the forest industry has been largely stable over the past nine years. Between 2016 and 2017, overall forest sector employment grew slightly by 1.9%.

- Some increase in in-forest employment (+3.5%) may be attributed to increased fire-related activities in 2017.
- Employment in wood product manufacturing has been growing steadily since 2010 and grew again in 2017 (+1.4%).
- Employment in the pulp and paper sector has been more variable. After three years of decreases, employment in the pulp and paper sector increased slightly in 2017 (+1.8%) thanks to growth in converted paper product manufacturing (e.g., paper bags) offsetting losses in paper manufacturing.

The total number of jobs should always be considered alongside wages and other indicators. With advances in technology, fewer workers are required to produce the same level of output, but those jobs tend to be higher skilled and higher paid (see the sustainability indicator *Average earnings*).

Forest industry direct employment, 2007–2017



Why is this indicator important?

- The Canadian forest industry is an important employer nationwide and contributes to the economic and social welfare of all Canadians.
- Forestry's contribution is particularly important in many rural and Indigenous communities, where forest-related work is often the main source of income.

What is the outlook?

- Pulp and paper sector employment outlooks vary by sub-sector; decline in paper demand is expected to continue leading to more job losses whereas demand for pulp and converted paper products is strong. Continuing job losses in newsprint could be accelerated by trade disputes with the United States.
- Strong demand for Canadian softwood lumber, especially from the growing US housing market, will ensure job growth in wood product manufacturing, but changes in fibre supply due to forest fires and pest management will challenge growth.
- In the short term, employment outlook will depend on the interplay of these dynamics. For example, job gains in solid wood product and converted paper manufacturing could offset losses in paper manufacturing, resulting in stable or slight growth in job numbers. In the long term, forest sector diversification (e.g., the bioeconomy) will provide new job opportunities in Canada's forest sector.

Source: Statistics Canada. See *Sources and information* for more detail.

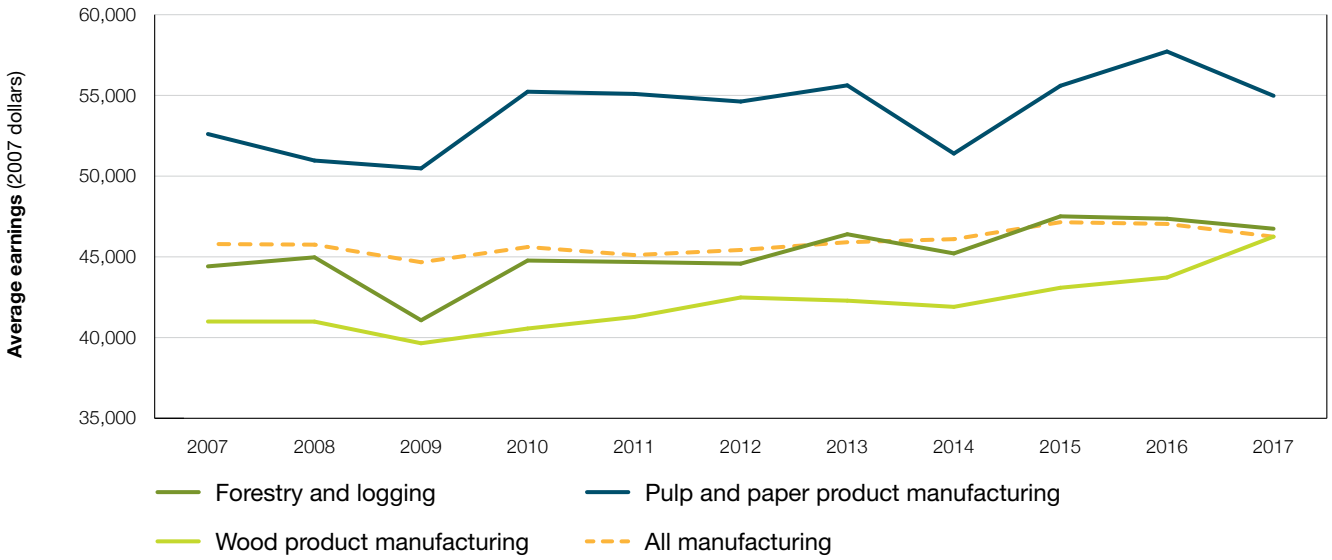
Indicator: Average earnings

In 2017, average earnings in the forest industry decreased slightly from 2016 levels.

- Despite the slight decrease in 2017 (–0.6%), forest industry earnings remain 4.9% higher than they were five years ago.
- While average earnings in wood product manufacturing increased 5.8% in 2017 over 2016 levels, forestry and logging earnings and pulp and paper manufacturing earnings decreased by 1.3% and 4.8%, respectively, likely because of reduced activity in these segments.
- Overall, the forest industry continues to outcompete average earnings for all manufacturing, which declined 1.7% between 2016 and 2017.

Average earnings refers to the average net annual income per person directly employed in the forest industry, not including overtime pay.

Average earnings in the forest industry compared with all manufacturing sectors, 2007–2017



Why is this indicator important?

- Trends in forest industry average earnings indicate the importance of the industry to the economy and to the social well-being of Canadians, especially when compared with average earnings in other industries.
- Real wage growth (meaning wage growth that isn't the result of inflation) shows the change in actual purchasing power of forest industry employees.

What is the outlook?

- Average earnings in pulp and paper manufacturing experienced growth between 2014 and 2016 but could now be negatively affected by adverse market conditions and trade disputes.
- Average earnings in the forestry and logging sub-sector and the wood product manufacturing sub-sector should continue to be stable or increase over the next few years.
- Earnings in the forest industry could be increased by filling the demand for highly skilled workers and by creating new highly skilled and highly paid positions in the bioeconomy.

Source: Statistics Canada. See *Sources and information* for more detail.

Indicator: Communities

Canadian forests provide innumerable economic, recreational, cultural and environmental benefits for all Canadians, in both rural and urban settings.

- About 31% or 11 million Canadians live in or adjacent to forested areas.
- The forest sector is a major source of income in 105 census subdivisions in Canada.
- About 9,700 Indigenous people were employed in the forest sector in 2017 according to the Statistics Canada Labour Force Survey.

Forest proximity, forest sector income and forest sector Indigenous employment across Canada are just some of the indicators that together portray how forests influence the lives and communities of Canadians.

Two horses canter past a pile of logs in the Larose Forest, just east of Ottawa, Ontario. Logging roads and paths in the Larose Forest are converted to recreational trails for ten different user groups, including horseback riders, snowmobilers, mountain bikers, and mushers.

Indigenous employment in Canada's forest sector: Results from the 2016 Census

- Canada's Census Program provides a statistical portrait of the country every five years. According to the 2016 Census, the forest sector employed 11,565 Indigenous people, accounting for 6.2% of all forest sector employment.
- Census data also showed that Indigenous employment in the forest sector is concentrated in in-forest activities and wood product manufacturing.
- Note that the sampling methodologies of the Labour Force Survey and Census differ and therefore produce different results, with the Census being more comprehensive.

Why is this indicator important?

- In communities with a large proportion of workers and revenue linked to the forest sector, social and economic well-being are highly dependent on the economic strength of the sector.
- Residents of forested areas benefit from a range of environmental services (clean air and water, erosion protection, wildlife habitat) and from opportunities for outdoor recreation. These benefits enhance human health by improving physical, mental and spiritual well-being and reducing stress.

What is the outlook?

- Indigenous participation in Canada's forest industry is expected to increase. Several Indigenous-led projects were announced in 2017 and new Government of Canada programs, such as Clean Energy for Rural and Remote Communities, present additional opportunities for Indigenous participation in the natural resources sector, including forestry.
- The forest sector will continue to contribute to livelihoods and well-being for both rural and urban Canadians. Sector recovery and diversification will provide more economic development opportunities for rural Canadians, and forest-based climate actions are expected to play an important role in Canada's transition to a low-carbon economy.

Source: Natural Resources Canada–Canadian Forest Service; Statistics Canada. See *Sources and information* for more detail.

How does the forest industry contribute to Canada's economy?

The forest industry is one of Canada's most important manufacturing sectors.

The forest industry:

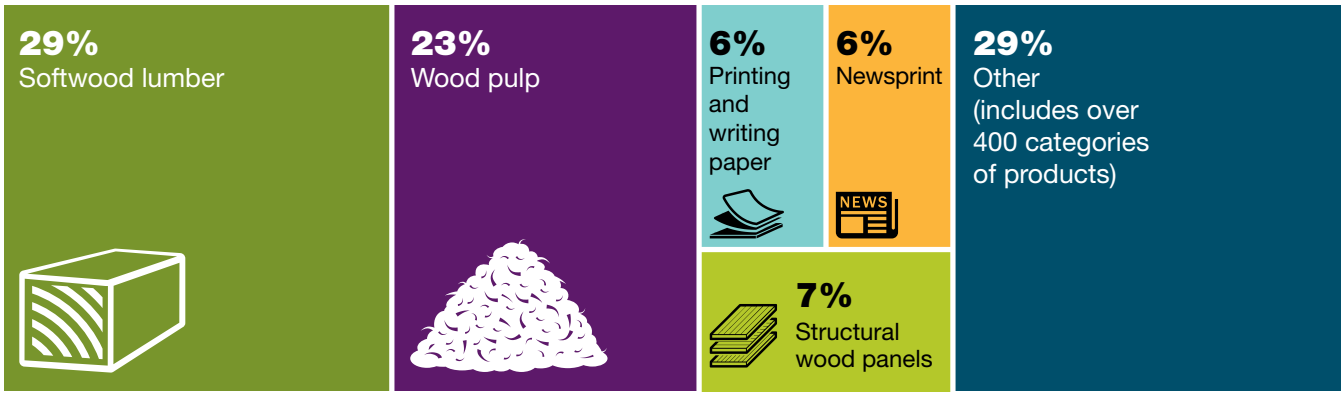
- employed about 209,940 people across the country (2017), including an estimated 11,565 Indigenous employees (2016)
- accounted for about 7.2% of Canada's total exports in 2017
- generated more than $1.4 billion in revenue for provincial and territorial governments in 2016
- contributed roughly $24.6 billion to Canada's economy in 2017

The forest industry represents a smaller percentage of Canada's economy than other resource sectors, but it creates more jobs and contributes more to the balance of trade for every dollar of value added than do other major resource sectors.

More than lumber and pulp and paper

The heart of the Canadian forest sector is traditional forest products, including lumber, other solid wood products, pulp and paper and activities such as forest management and logging. However, with Canada's commitment to clean technology and the transition to a low-carbon economy, non-traditional forest products, such as advanced bioproducts, are growing in importance.

EXPORTS OF CANADIAN FOREST PRODUCTS (2017)



An economic engine from coast to coast

Forest operations take place in all regions of Canada except the Far North. Of the total forest industry jobs in Canada:

- 52% are in Ontario and Quebec
- 39% are in Western Canada and the Prairies (with the vast majority in British Columbia)
- 9% are in Atlantic Canada

The Canadian forest industry is a major employer nationwide, but its economic contributions are particularly important in many rural and Indigenous communities, where forest-related work is often the main source of income. In these communities, forestry jobs are crucial to ensuring economic sustainability.

Increased export markets

Globalization is increasing trade possibilities beyond Canadian producers' traditional markets. The US market has long been the main importer of Canadian forest products; however, the impact of the US housing crash and global financial crisis that began in 2008 spurred Canadian producers to expand to other markets. Exports to Asian markets, mainly China, have risen sharply over the past decade and helped increase the robustness of this trade-dependent sector.

Source: National Forestry Database; Statistics Canada. See *Sources and information* for more detail.

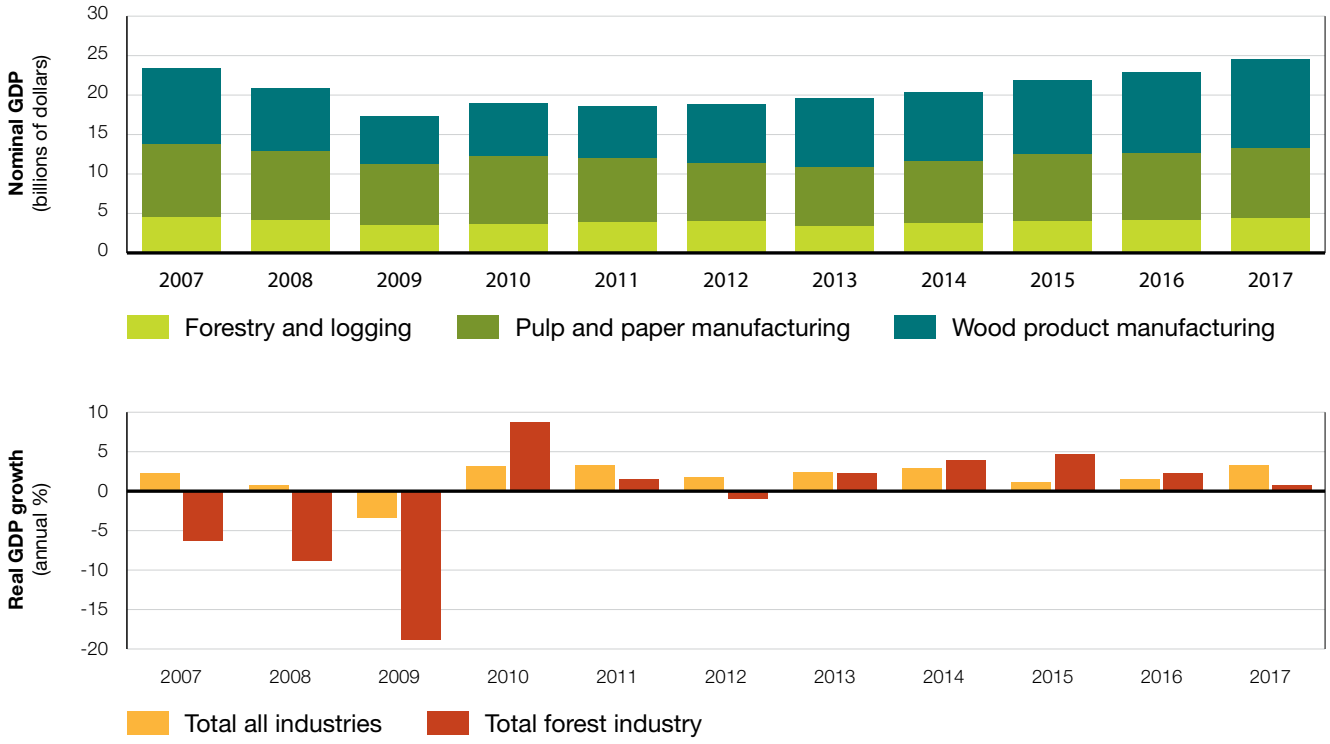
Indicator: Gross domestic product

The forest industry contributed $24.6 billion (1.6%) to Canada's nominal gross domestic product (GDP) in 2017.

- The forest industry GDP grew by 0.7% in real terms in 2017, underperforming the overall Canadian economy, which grew by 3.3%.
- Canada's wood product manufacturing and pulp and paper real GDP were positively driven by solid demand and strong prices, increasing by 2.2% and 1.5%, respectively. The contribution of forestry and logging to Canada's real GDP decreased 3.6% between 2016 and 2017, likely due to decreased in-forest activity following forest fires and pest infestations.

Gross domestic product (GDP) is the total value of all final goods and services produced annually in a country. It can be thought of as the size of a country's economy.

Canadian forest industry's GDP, 2007–2017



Why is this indicator important?

- Contribution to nominal GDP is one of the primary indicators used to compare the size and health of Canada's forest industry with the size and health of other economic sectors in a financial year.
- The change in real GDP shows the growth of the forest industry after inflation is factored out; therefore it shows real year-over-year growth. Real GDP allows analysts to gauge the trend of the Canadian forest industry's contribution to the economy.

What is the outlook?

- Strong demand for Canadian lumber and some pulp and paper products will contribute to forest industry GDP growth, but growth in 2018 is not expected to be as strong as in 2017.
- In the long term, forest industry GDP could be negatively affected by trade disputes (e.g., the newsprint trade dispute with the United States) and the impacts of fires and pests on fibre supply.

Source: Statistics Canada. See *Sources and information* for more detail.

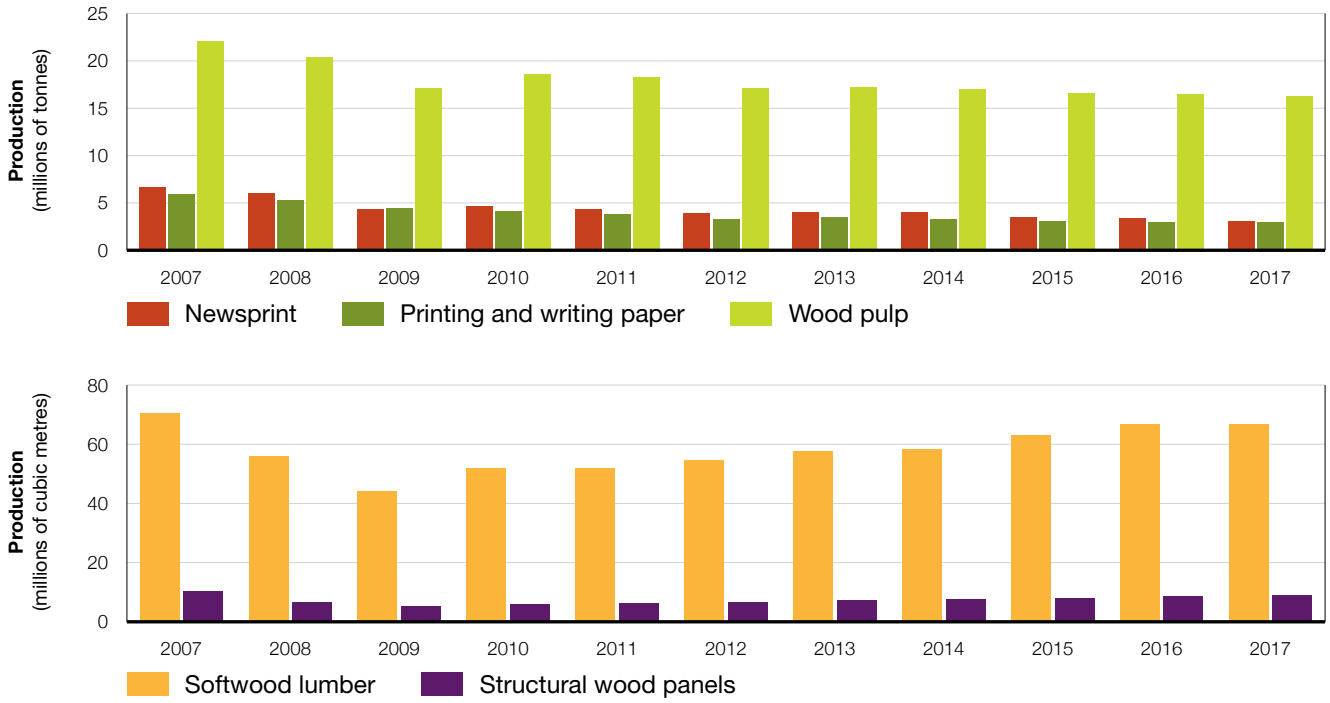
Indicator: Production

Between 2016 and 2017, production of most forest products decreased slightly. However, there was no change in the volume of softwood lumber produced, and production of structural panels increased by 1.4%.

- Production of softwood lumber was unchanged in 2017 from 2016. While demand was very strong for solid wood products, disruptions resulting from forest fires in Western Canada limited production increases.
- The declining demand for printing and writing paper, including newsprint, means that mill closures take place periodically. Globally, there were significant closures of printing and writing paper mills in 2016 and 2017, helping to maintain production in Canada relatively unchanged. However, newsprint did not benefit from such mitigating circumstances, and production declined 8.6% from 2016 levels, following mill closures and conversions.
- Despite production decreases in many forest products, Canada's exports fared well in 2017. For more information, see the sustainability indicator *Exports*.

Canada is the world's largest producer of newsprint, the largest producer of northern bleached softwood kraft pulp and the second-largest producer of softwood lumber.

Production of Canadian forest products, 2007–2017



Why is this indicator important?

- Canada is one of the top manufacturers of forest products in the world.
- Production is one of the first indicators to be influenced by economic and market challenges.

What is the outlook?

- Production declines in certain segments of the pulp and paper industry (e.g., newsprint and printing and writing paper) will continue and could be accelerated by trade disputes. Production of wood pulp should remain stable or increase in response to global demand.
- Demand for Canadian softwood lumber and structural panels will grow in 2018 as a result of the growing US housing market, but production could be limited by a shortage in fibre supply (e.g., due to pest infestations and forest fires in Western Canada).

Source: APA – The Engineered Wood Association; Pulp and Paper Products Council; Statistics Canada. See *Sources and information* for more detail.

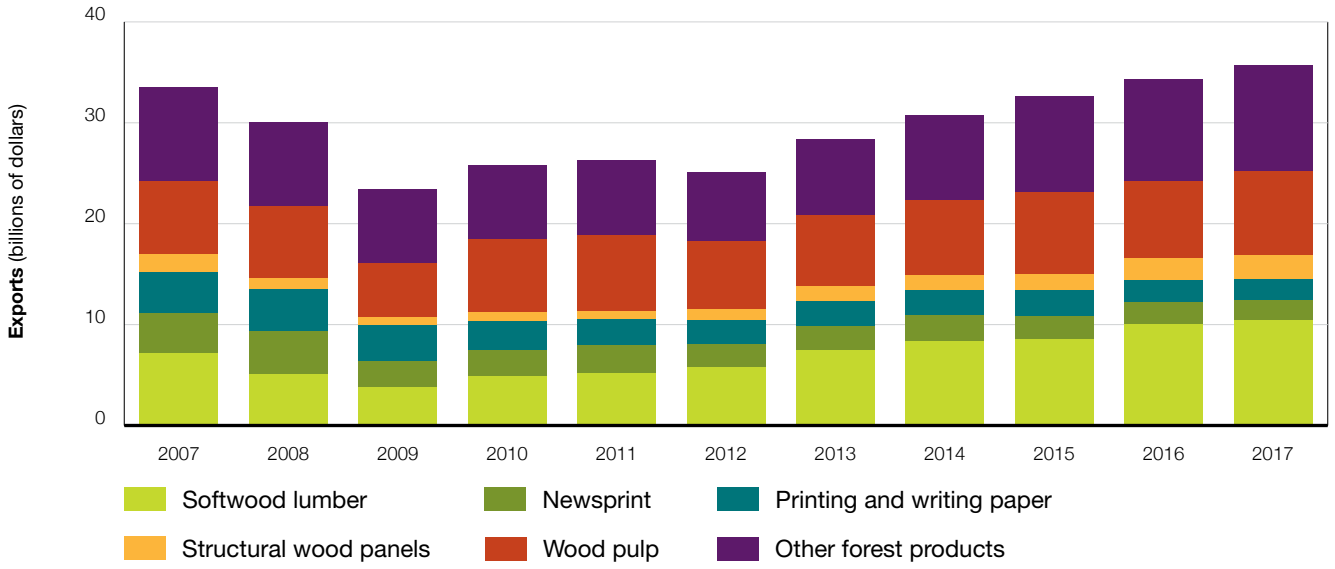
Indicator: Exports

In 2017 Canada's forest product exports were valued at $35.7 billion, a 3.8% increase from 2016.

- Export value increased across all products except printing and writing paper and newsprint, which decreased by 8.2% and 10.1%, respectively, as a result of demand and production reductions.
- Structural panels and wood pulp saw the largest increases in export value, up 13.1% and 8.6%, respectively. Both products benefited from strong demand and rising prices.
- Between 2012 and 2017, the export value of Canada's wood products increased by 42.2%.
- 2017 was a challenging year for many Canadian exporters, with several ongoing forest product trade disputes involving key trading partners such as the United States and China. Nevertheless, strong US housing demand coupled with high lumber prices helped Canada's forest industry post its strongest financial performance in the last decade. For more information, see the sustainability indicator *Financial performance*.

By value, Canada is the fourth-largest forest product exporter in the world, behind the United States, China and Germany, and the leading exporter of softwood lumber and newsprint.

Exports of Canadian forest products, 2007–2017



Why is this indicator important?

- As one of the world's largest forest products exporters, Canada is a key supplier to nations around the globe.
- Canada has an abundant and renewable supply of wood that is sustainably managed. By exporting forest products, the Canadian forest industry meets the needs of consumers around the world while making a substantial contribution to Canada's economy and balance of trade.

What is the outlook?

- The export value of Canada's forest products, especially softwood lumber and wood pulp, should increase as demand from our main markets (i.e., China and the United States) remains strong.
- Export values for certain pulp and paper products, namely newsprint and printing and writing paper, will continue to decline as more paper products are replaced by digital media.

Source: Statistics Canada. See *Sources and information* for more detail.

How is the forest industry changing?

Shifts in global demand for traditional forest products and growing demand for non-traditional products are changing Canada's forest industry.

As more consumers turn to digital media in place of print media, the market for newsprint and printing and writing paper continues to shrink. Trade disputes in recent years also point to the vulnerability of a trade-exposed, commodity-focused sector.

At the same time, the development of innovative new products and new applications for existing products is helping the forest sector adjust to changes in market needs, improve financial performance and demonstrate its commitment to environmental performance.

Demand for Canadian wood products for infrastructure projects is growing. Recent advances in engineered wood products and building systems, as well as changes to Canadian building codes, are resulting in the construction of taller, more sustainable and more energy efficient buildings made of wood. Since 2009, more than 500 mid-rise buildings across Canada were built using wood as the primary construction material.

Wood-fibre residues and byproducts of forest product manufacturing can be used to make bioproducts, including biochemicals, biomaterials and bioenergy.

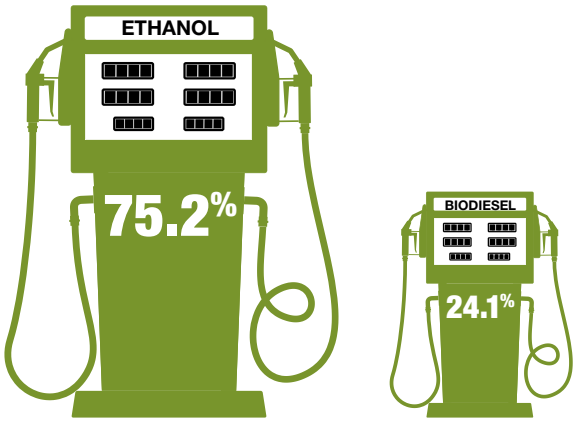
Bioproducts are a fast-growing category of forest products. For example, biochemicals are being used to make a wide range of products, including biodegradable plastics, industrial chemicals, personal care products and pharmaceuticals.

New markets and new challenges are transforming forest industry structure

With increased global integration through trade and multinational firms, many Canadian forest industry firms have acquired assets in the United States. Since 2010, Canada's three largest pulp and paper companies made six acquisitions, with three of these investments in the United States. British Columbia's three largest forest companies now own 45 softwood mills in the United States, and there are further investment plans for new sawmill developments. The structure of the forest sector has shifted from Canadian companies in North American markets to North American companies in global markets.

REVENUES FROM CANADIAN BIOPRODUCTS PRODUCED FROM FOREST AND AGRICULTURAL SOURCES TOTALLED $4.3 BILLION IN 2015

Almost two-thirds of these sales were from biofuels, of which:



New technologies are improving environmental performance

Investment in new technologies is also bringing change to forest industry operations. The use of bioenergy is reducing carbon emissions and fossil fuel use. For example, by generating bioenergy from waste products and increasing energy efficiency, Canada's forest industry cut its total energy use by 31% and reduced its greenhouse gas emissions by 49% between 2005 and 2015. Research on expanding pulp mills into biorefineries, where residues from the pulp-making process can be used to make new bioproducts, is underway.

Source: Natural Resources Canada; Statistics Canada. See *Sources and information* for more detail.

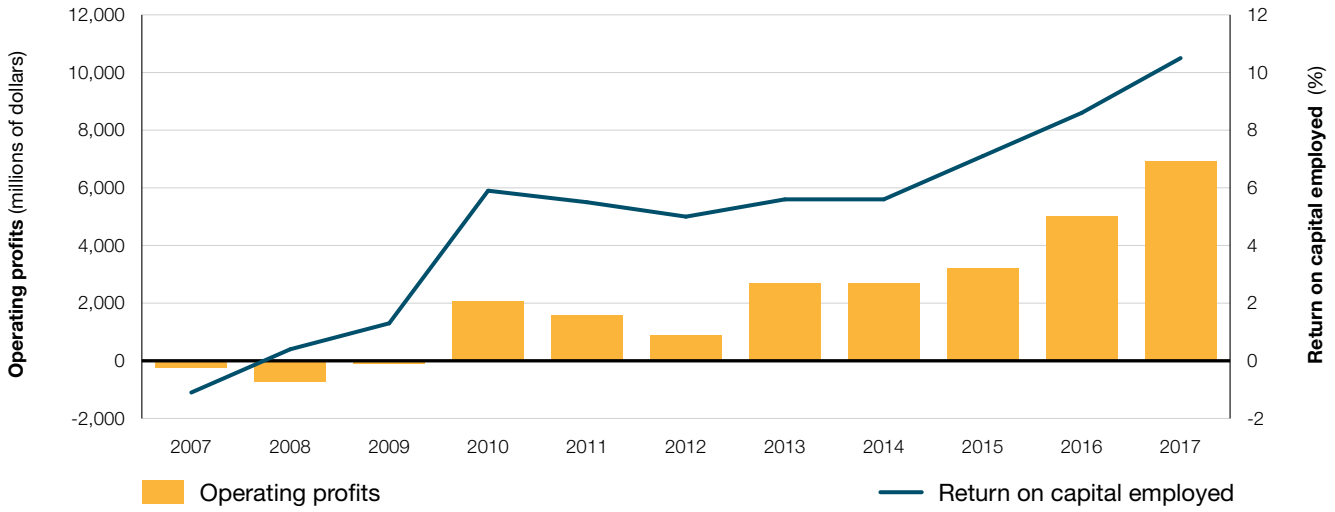
Indicator: Financial performance

The forest industry's financial performance improved in 2017 and marked five consecutive years of growth both in operating profits and in return on capital employed.

- Operating profits rose by 37.3% over 2016 levels.
- Return on capital employed increased to 10.5% in 2017, up from 8.6% in 2016.
- The forest industry's financial performance benefited from improving commodity prices and strong demand for Canada's key forest products.

Both operating profits and the return on capital employed indicate the economic competitiveness of the forest industry. "Operating profit" measures the difference between operating revenues and operating expenses. "Return on capital employed" measures the efficiency of capital use in the industry.

Financial performance by Canada's forest industry, 2007–2017



Why is this indicator important?

- Strong financial performance is essential for the continued economic competitiveness of Canada's forest industry.
- Both operating profits and return on capital employed help show whether Canada's forest industry can attract investment and continue to generate economic activity.

What is the outlook?

- The Canadian dollar is expected to remain weak against the US dollar, which is favourable for the Canadian forest industry.
- The forest industry will face several challenges in 2018, such as a shortage in fibre supply (most notably due to fire and pests), declining demand for some paper products and trade disputes, which could have a negative impact on the industry's financial performance.
- Capital investments and acquisitions by Canadian publicly traded forest industry firms and an improving US housing market could counteract these challenges and instead bolster financial performance in 2018.

Source: Statistics Canada. See *Sources and information* for more detail.

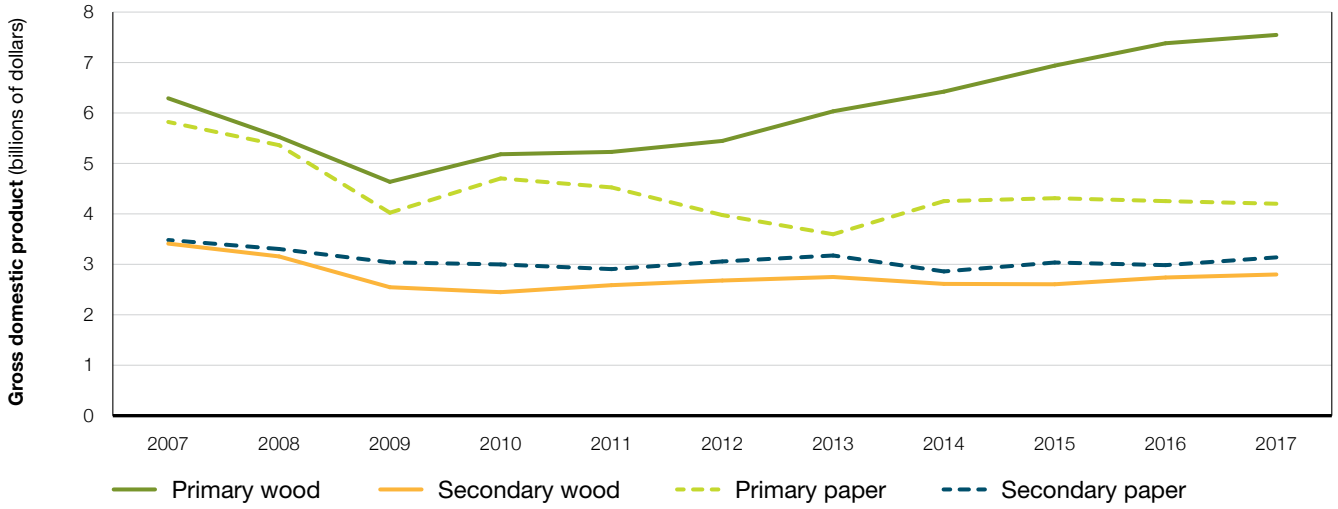
Indicator: Secondary manufacturing

In 2017, the secondary wood and paper product industries in Canada generated over $5.9 billion in real gross domestic product (GDP). This represents a 3.6% increase from 2016 but is still 14% less than 2007.

- Secondary wood manufacturing increased by 2% in 2017 from 2016, while secondary paper manufacturing fell by 5%.
- Secondary manufacturing accounted for 34% of the total contribution of forest product manufacturing to GDP in 2017, down slightly from 2016.

Lumber and paper are used in secondary wood and paper product manufacturing to make intermediate and final products, such as doors and envelopes.

Gross domestic product from primary and secondary wood and paper product industries, 2007–2017



Why is this indicator important?

- Secondary manufacturing of forest products generates additional employment and revenue, which in turn increase the forest industry's overall contribution to the Canadian economy.
- Largely focused on domestic markets that tend to be more stable than the primary products geared to international demand, secondary manufacturing helps balance changes in world markets.

What is the outlook?

- Demand is expected to be stable for secondary paper products, given the steady growth of the North American economy.
- Demand is expected to grow for secondary wood products as the US housing market continues to expand.
- This favourable demand outlook for both segments is tempered by the increase in competition from low-cost international producers, possible cooling in the domestic housing market and the threat of tariff restrictions.

Source: Industry Canada; Statistics Canada. See *Sources and information* for more detail.

Indicator: Forest industry carbon emissions

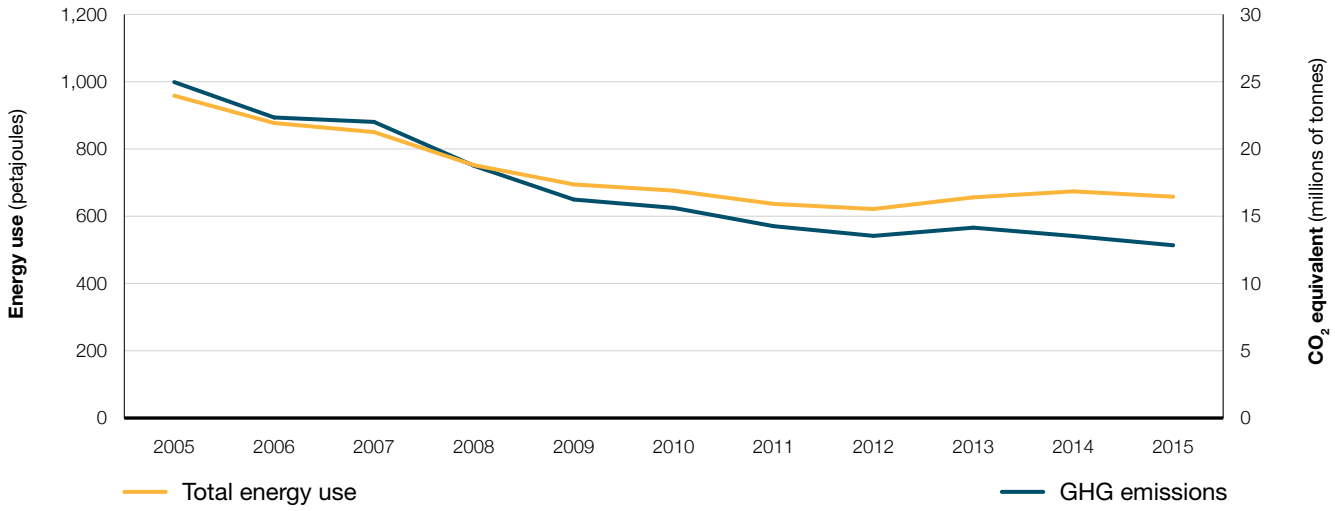
Total greenhouse gas emissions (GHGs, expressed as carbon dioxide equivalents, or CO_2e) from fossil fuel use in the Canadian forest industry have steadily decreased over the last 10 years, while energy use has remained relatively flat in recent years.

- The forest industry's ability to generate its own electricity, largely from bioenergy, has reduced its reliance on fossil fuels.
- Bioenergy continues to increase its share of the energy mix, accounting for 57% of forest industry energy use in 2015, up from 49% in 2000 and 43% in 1990.
- Between 2005 and 2015, the forest industry reduced energy use by 31% and total GHG emissions (direct emissions plus indirect emissions from purchased electricity) by 49%.

Canada measures its national emission levels annually for all sectors and assesses its emissions against targets for greenhouse gas (GHG) reductions.

The forest industry has achieved both reductions in energy use through greater efficiencies and reductions in GHG emissions by changing the fuel mix. Decreased production and the decline of the pulp and paper industry have also contributed to the trend.

Fossil fuel greenhouse gas (GHG) emissions and total energy use in Canada's forest industry, 2005–2015



Why is this indicator important?

- Scientists agree that there is a strong link between climate change and activities that burn fossil fuels and emit carbon dioxide, methane, nitrous oxide and other GHGs.
- By monitoring the forest industry's GHG emissions, we can assess the improvement of its emissions record over time.

What is the outlook?

- Technologies that reduce energy use and GHG emissions provide significant environmental benefits and reduce energy costs for manufacturers. Investments in these technologies are expected to continue and accelerate as Canada fully implements carbon pricing and a Clean Fuel Standard.
- Since overall reductions in GHG emissions will likely be tempered by increases in economic activity, GHG emissions and total energy use will likely continue to decline but at a slower rate.

Source: Environment and Climate Change Canada; Natural Resources Canada; Statistics Canada. See *Sources and information* for more detail.

Statistical profiles

Canada

Population (January 2018): 36,963,854
Arboreal emblem: Maple

Forest inventory

Forest area by classification (hectares)	
Forest land	347,069,000
Other wooded land	40,865,660
Other land with tree cover	8,498,940
Forest area change (hectares, 2016)	
Afforestation	Not available
Deforestation (total; by sectors below)	37,000
Agriculture	12,300
Forestry	1,400
Mining, oil and gas	12,300
Built-up	6,600
Hydroelectric	4,500
Forest type (forest land only)	
Coniferous	67.8%
Mixedwood	15.8%
Broadleaf	10.5%
Temporarily non-treed	5.9%
Forest ownership	
Provincial	76.6%
Territorial	12.9%
Private	6.2%
Aboriginal	2.0%
Federal	1.6%
Municipal	0.3%
Other	0.4%
Growing stock (million cubic metres)	
Total volume	47,320

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	15,489,117
Fire (2017)	
Area burned (hectares)	3,371,833
Number of fires	5,611

Forest management

Harvesting (2016)	
Area harvested (hectares)	766,659
Volume harvested (cubic metres)	156,743,605
Regeneration (hectares, 2016)	
Area planted	410,221
Area seeded	15,790
Third-party certification (hectares, 2017)	
Area certified	169,865,528
Protected forest (IUCN categories)	
I a Strict nature reserve	0.1%
I b Wilderness area	1.9%
II Ecosystem conservation and protection	4.2%
III Conservation of natural features	0.5%
IV Conservation through active management	0.2%
V Landscape conservation and recreation	0.02%

Greenhouse gas inventory

For forest lands affected by land-use change (2016)	
Removals from the atmosphere due to afforestation (CO_2e/yr, megatonnes)	-0.4
Total emissions due to deforestation (CO_2e/yr, megatonnes)	9.7
For managed forests (2016)	
Area of managed forests (hectares)	226,000,000
Total net emissions or removals to the atmosphere, all causes (CO_2e/yr, megatonnes)	77.6
Net emissions or removals due to natural disturbances (CO_2e/yr, megatonnes)	97.7
Net emissions or removals due to human forest management activities and from harvested wood products (CO_2e/yr, megatonnes)	-20.1
Transfers from the managed forest sector to the forest products sector due to harvesting (CO_2e/yr, megatonnes)	-164.3

Domestic economic impact

Canadian housing starts (2017)	219,763
Contribution to nominal GDP (current dollars, 2017)	
Forestry and logging industry	4,315,000,000
Pulp and paper product manufacturing industry	8,900,000,000
Wood product manufacturing industry	11,395,000,000
Total contribution to nominal GDP	24,610,000,000
Contribution to real GDP (constant 2007 dollars, 2017)	
Forestry and logging industry	4,437,000,000
Pulp and paper product manufacturing industry	7,225,000,000
Wood product manufacturing industry	10,113,000,000
Total contribution to real GDP	21,775,000,000
Revenue from goods manufactured (dollars, 2016)	
Logging industry	9,825,700,000
Pulp and paper product manufacturing industry	25,473,502,000
Wood product manufacturing industry	29,934,873,000
Total revenue from goods manufactured	65,234,075,000

Forest industry employment

Employment (number, 2017)	
Survey of Employment, Payrolls and Hours	186,838
Canadian System of National Accounts	209,940
Natural Resources Satellite Account	232,549
Direct and indirect employment	317,320
Wages and salaries (dollars, 2016)	
Logging industry	1,605,658,000
Pulp and paper manufacturing industry	3,374,508,000
Wood product manufacturing industry	4,945,748,000
Total wages and salaries	9,925,914,000

Trade

Balance of trade (total exports, dollars, 2017)	24,242,012,823
Value of exports (dollars, 2017)	
Primary wood products	1,442,093,949
Pulp and paper products	17,499,724,460
Wood-fabricated materials	16,729,745,639
Total value of exports	35,671,564,048
Value of imports (dollars, 2017)	
Primary wood products	495,467,186
Pulp and paper products	7,544,454,379
Wood-fabricated materials	3,389,629,660
Total value of imports	11,429,551,225

Domestic production and investment

Production (2017)	
Hardwood lumber (cubic metres)	1,336,500
Softwood lumber (cubic metres)	66,860,400
Newsprint (tonnes)	3,054,000
Printing and writing paper (tonnes)	2,975,000
Wood pulp (tonnes)	16,302,000
Structural panels (plywood and oriented strandboard, cubic metres)	8,855,194
Capital expenditures (dollars, 2017)	
Forestry and logging industry	458,600,000
Pulp and paper product manufacturing industry	917,500,000
Wood product manufacturing industry	862,500,000
Total capital expenditures	2,238,600,000
Repair expenditures (dollars, 2016)	
Forestry and logging industry	428,400,000
Pulp and paper product manufacturing industry	1,204,900,000
Wood product manufacturing industry	1,100,900,000
Total repair expenditures	2,734,200,000

Domestic consumption

Consumption (2017)	
Hardwood lumber (cubic metres)	1,422,275
Softwood lumber (cubic metres)	24,746,563
Newsprint (tonnes)	235,101
Printing and writing paper (tonnes)	1,342,309
Wood pulp (tonnes)	7,082,324
Structural panels (plywood and oriented strandboard, cubic metres)	4,273,348

See the *Sources and information* section for background information and sources for the statistics presented in these tables.

British Columbia

Population (January 2018): 4,849,442
Arboreal emblem: Western redcedar

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	5,471,065
Fire (2017)	
Area burned (hectares)	1,215,851
Number of fires	1,352

Forest management

Harvesting (2016)	
Area harvested (hectares)	183,788
Volume harvested (cubic metres)	66,379,661
Regeneration (hectares, 2016)	
Area planted	177,573
Area seeded	3,279
Third-party certification (hectares, 2017)	
Area certified	50,473,380

Domestic economic impact

Housing starts (2017)	43,664
Revenue from goods manufactured (dollars, 2016)	
Logging industry	4,791,364,000
Pulp and paper product manufacturing industry	4,469,262,000
Wood product manufacturing industry	10,541,875,000
Total revenue from goods manufactured	19,802,501,000

Forest industry employment

Employment (number, 2017)	
Canadian System of National Accounts	57,210
Survey of Employment, Payrolls and Hours	52,435
Natural Resources Satellite Account	Not available
Wages and salaries (dollars, 2016)	
Logging industry	736,427,000
Pulp and paper product manufacturing industry	599,436,000
Wood product manufacturing industry	1,553,837,000
Total wages and salaries	2,889,700,000

Trade

Balance of trade (total exports, dollars, 2017)	12,147,055,910
Value of domestic exports (dollars, 2017)	
Primary wood products	1,209,487,896
Pulp and paper products	4,424,162,305
Wood-fabricated materials	8,361,820,958
Total value of domestic exports	13,995,471,159
Value of imports (dollars, 2017)	
Primary wood products	71,347,760
Pulp and paper products	842,179,535
Wood-fabricated materials	934,887,954
Total value of imports	1,848,415,249

Alberta

Population (January 2018): 4,318,772
Arboreal emblem: Lodgepole pine

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	993,908
Fire (2017)	
Area burned (hectares)	49,119
Number of fires	1,217

Forest management

Harvesting (2016)	
Area harvested (hectares)	91,875
Volume harvested (cubic metres)	25,525,462
Regeneration (hectares, 2016)	
Area planted	64,759
Area seeded	1,066
Third-party certification (hectares, 2017)	
Area certified	23,060,640

Domestic economic impact

Housing starts (2017)	29,457
Revenue from goods manufactured (dollars, 2016)	
Logging industry	920,081,000
Pulp and paper product manufacturing industry	1,636,050,000
Wood product manufacturing industry	3,648,623,000
Total revenue from goods manufactured	6,204,754,000

Forest industry employment

Employment (number, 2017)	
Canadian System of National Accounts	16,095
Survey of Employment, Payrolls and Hours	15,020
Natural Resources Satellite Account	Not available
Wages and salaries (dollars, 2016)	
Logging industry	201,945,000
Pulp and paper product manufacturing industry	190,265,000
Wood product manufacturing industry	643,811,000
Total wages and salaries	1,036,021,000

Trade

Balance of trade (total exports, dollars, 2017)	3,127,237,100
Value of domestic exports (dollars, 2017)	
Primary wood products	19,988,685
Pulp and paper products	1,771,325,737
Wood-fabricated materials	1,674,456,622
Total value of domestic exports	3,465,771,044
Value of imports (dollars, 2017)	
Primary wood products	3,587,944
Pulp and paper products	185,944,361
Wood-fabricated materials	149,001,639
Total value of imports	338,533,944

Saskatchewan

Population (January 2018): 1,169,752
Arboreal emblem: White birch

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	567,727
Fire (2017)	
Area burned (hectares)	399,563
Number of fires	353

Forest management

Harvesting (2016)	
Area harvested (hectares)	21,872
Volume harvested (cubic metres)	3,919,485
Regeneration (hectares, 2016)	
Area planted	5,545
Area seeded	Not available
Third-party certification (hectares, 2017)	
Area certified	5,292,756

Domestic economic impact

Housing starts (2017)	4,904
Revenue from goods manufactured (dollars, 2016)	
Logging industry	130,467,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	571,181,000
Total revenue from goods manufactured	Not available

Forest industry employment

Employment (number, 2017)	
Canadian System of National Accounts	3,385
Survey of Employment, Payrolls and Hours	Not available
Natural Resources Satellite Account	Not available
Wages and salaries (dollars, 2016)	
Logging industry	22,007,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	103,942,000
Total wages and salaries	Not available

Trade

Balance of trade (total exports, dollars, 2017)	545,382,348
Value of domestic exports (dollars, 2017)	
Primary wood products	2,202,875
Pulp and paper products	285,010,730
Wood-fabricated materials	331,647,381
Total value of domestic exports	618,860,986
Value of imports (dollars, 2017)	
Primary wood products	4,083,387
Pulp and paper products	32,842,549
Wood-fabricated materials	36,552,702
Total value of imports	73,478,638

Manitoba

Population (January 2018): 1,346,993
Arboreal emblem: White spruce

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	1,639,571
Fire (2017)	
Area burned (hectares)	176,677
Number of fires	545

Forest management

Harvesting (2016)	
Area harvested (hectares)	7,644
Volume harvested (cubic metres)	1,070,198
Regeneration (hectares, 2016)	
Area planted	3,436
Area seeded	Not available
Third-party certification (hectares, 2017)	
Area certified	11,373,478

Domestic economic impact

Housing starts (2017)	7,501
Revenue from goods manufactured (dollars, 2016)	
Logging industry	41,555,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	499,454,000
Total revenue from goods manufactured	Not available

Forest industry employment

Employment (number, 2017)	
Canadian System of National Accounts	4,235
Survey of Employment, Payrolls and Hours	3,124
Natural Resources Satellite Account	Not available
Wages and salaries (dollars, 2016)	
Logging industry	10,060,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	118,536,000
Total wages and salaries	Not available

Trade

Balance of trade (total exports, dollars, 2017)	-79,105,031
Value of domestic exports (dollars, 2017)	
Primary wood products	1,240,047
Pulp and paper products	247,461,417
Wood-fabricated materials	228,072,050
Total value of domestic exports	476,773,514
Value of imports (dollars, 2017)	
Primary wood products	5,550,510
Pulp and paper products	366,003,735
Wood-fabricated materials	184,324,300
Total value of imports	555,878,545

Ontario

Population (January 2018): 14,318,750
Arboreal emblem: Eastern white pine

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	1,319,653
Fire (2017)	
Area burned (hectares)	112,337
Number of fires	776

Forest management

Harvesting (2016)	
Area harvested (hectares)	131,688
Volume harvested (cubic metres)	15,123,867
Regeneration (hectares, 2016)	
Area planted	43,676
Area seeded	6,708
Third-party certification (hectares, 2017)	
Area certified	28,171,032

Domestic economic impact

Housing starts (2017)	79,123
Revenue from goods manufactured (dollars, 2016)	
Logging industry	1,068,380,000
Pulp and paper product manufacturing industry	7,518,731,000
Wood product manufacturing industry	4,612,031,000
Total revenue from goods manufactured	13,199,142,000

Forest industry employment

Employment (number, 2017)	
Canadian System of National Accounts	44,170
Survey of Employment, Payrolls and Hours	38,813
Natural Resources Satellite Account	Not available
Wages and salaries (dollars, 2016)	
Logging industry	181,424,000
Pulp and paper product manufacturing industry	1,133,277,000
Wood product manufacturing industry	913,741,000
Total wages and salaries	2,228,442,000

Trade

Balance of trade (total exports, dollars, 2017)	-1,409,388,886
Value of domestic exports (dollars, 2017)	
Primary wood products	47,585,105
Pulp and paper products	2,890,495,100
Wood-fabricated materials	1,818,553,817
Total value of domestic exports	4,756,634,022
Value of imports (dollars, 2017)	
Primary wood products	61,108,724
Pulp and paper products	4,631,798,117
Wood-fabricated materials	1,473,116,067
Total value of imports	6,166,022,908

Quebec

Population (January 2018): 8,439,925
Arboreal emblem: Yellow birch

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	4,733,185
Fire (2017)	
Area burned (hectares)	38,392
Number of fires	319

Forest management

Harvesting (2016)	
Area harvested (hectares)	202,130
Volume harvested (cubic metres)	30,026,645
Regeneration (hectares, 2016)	
Area planted	88,538
Area seeded	Not available
Third-party certification (hectares, 2017)	
Area certified	44,557,321

Domestic economic impact

Housing starts (2017)	46,495
Revenue from goods manufactured (dollars, 2016)	
Logging industry	2,009,286,000
Pulp and paper product manufacturing industry	8,506,915,000
Wood product manufacturing industry	8,209,273,000
Total revenue from goods manufactured	18,725,474,000

Forest industry employment

Employment (number, 2017)	
Canadian System of National Accounts	65,515
Survey of Employment, Payrolls and Hours	58,995
Natural Resources Satellite Account	Not available
Wages and salaries (dollars, 2016)	
Logging industry	291,990,000
Pulp and paper product manufacturing industry	1,008,595,000
Wood product manufacturing industry	1,293,750,000
Total wages and salaries	2,594,335,000

Trade

Balance of trade (total exports, dollars, 2017)	7,632,038,996
Value of domestic exports (dollars, 2017)	
Primary wood products	98,194,616
Pulp and paper products	6,175,706,664
Wood-fabricated materials	3,486,820,397
Total value of domestic exports	9,760,721,677
Value of imports (dollars, 2017)	
Primary wood products	287,219,157
Pulp and paper products	1,305,804,974
Wood-fabricated materials	535,658,550
Total value of imports	2,128,682,681

New Brunswick

Population (January 2018): 760,744
Arboreal emblem: Balsam fir

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	No significant defoliation
Fire (2017)	
Area burned (hectares)	568
Number of fires	245

Forest management

Harvesting (2016)	
Area harvested (hectares)	81,439
Volume harvested (cubic metres)	9,341,187
Regeneration (hectares, 2016)	
Area planted	17,625
Area seeded	Not available
Third-party certification (hectares, 2017)	
Area certified	4,208,422

Domestic economic impact

Housing starts (2017)	2,324
Revenue from goods manufactured (dollars, 2016)	
Logging industry	674,057,000
Pulp and paper product manufacturing industry	1,834,218,000
Wood product manufacturing industry	1,303,512,000
Total revenue from goods manufactured	3,811,787,000

Forest industry employment

Employment (number, 2017)	
Canadian System of National Accounts	12,820
Survey of Employment, Payrolls and Hours	9,963
Natural Resources Satellite Account	Not available
Wages and salaries (dollars, 2016)	
Logging industry	106,163,000
Pulp and paper product manufacturing industry	236,375,000
Wood product manufacturing industry	Not available
Total wages and salaries	Not available

Trade

Balance of trade (total exports, dollars, 2017)	1,559,779,028
Value of domestic exports (dollars, 2017)	
Primary wood products	41,138,508
Pulp and paper products	1,107,983,866
Wood-fabricated materials	675,686,386
Total value of domestic exports	1,824,808,760
Value of imports (dollars, 2017)	
Primary wood products	62,539,250
Pulp and paper products	153,480,855
Wood-fabricated materials	49,009,627
Total value of imports	265,029,732

Nova Scotia

Population (January 2018): 957,470
Arboreal emblem: Red spruce

Disturbance

Insects (hectares, 2017)	
Area defoliated by insects and containing beetle-killed trees	4,753
Fire (2017)	
Area burned (hectares)	730
Number of fires	175

Forest management

Harvesting (2016)	
Area harvested (hectares)	34,075
Volume harvested (cubic metres)	3,740,527
Regeneration (hectares, 2016)	
Area planted	5,024
Area seeded	Not available
Third-party certification (hectares, 2017)	
Area certified	1,310,665

Domestic economic impact

Housing starts (2017)	3,984
Revenue from goods manufactured (dollars, 2016)	
Logging industry	108,617,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	457,960,000
Total revenue from goods manufactured	Not available

Forest industry employment

Employment (number, 2017)	
Canadian System of National Accounts	4,435
Survey of Employment, Payrolls and Hours	2,863
Natural Resources Satellite Account	Not available
Wages and salaries (dollars, 2016)	
Logging industry	30,206,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	79,592,000
Total wages and salaries	Not available

Trade

Balance of trade (total exports, dollars, 2017)	566,557,051
Value of domestic exports (dollars, 2017)	
Primary wood products	22,244,780
Pulp and paper products	447,919,936
Wood-fabricated materials	145,609,572
Total value of domestic exports	615,774,288
Value of imports (dollars, 2017)	
Primary wood products	14,584
Pulp and paper products	22,280,084
Wood-fabricated materials	26,922,569
Total value of imports	49,217,237

Prince Edward Island

Population (January 2018): 152,768
Arboreal emblem: Red oak

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	27
Fire (2017)	
Area burned (hectares)	7
Number of fires	4

Forest management

Harvesting (2016)	
Area harvested (hectares)	2,918
Volume harvested (cubic metres)	340,600
Regeneration (hectares, 2016)	
Area planted	317
Area seeded	Not available
Third-party certification (hectares, 2017)	
Area certified	0

Domestic economic impact

Housing starts (2017)	911
Revenue from goods manufactured (dollars, 2016)	
Logging industry	11,669,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	Not available
Total revenue from goods manufactured	Not available

Forest industry employment

Employment (number, 2017)	
Canadian System of National Accounts	570
Survey of Employment, Payrolls and Hours	Not available
Natural Resources Satellite Account	Not available
Wages and salaries (dollars, 2016)	
Logging industry	1,894,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	Not available
Total wages and salaries	Not available

Trade

Balance of trade (total exports, dollars, 2017)	28,101,810
Value of domestic exports (dollars, 2017)	
Primary wood products	0
Pulp and paper products	27,637,326
Wood-fabricated materials	480,423
Total value of domestic exports	28,117,749
Value of imports (dollars, 2017)	
Primary wood products	0
Pulp and paper products	14,950
Wood-fabricated materials	989
Total value of imports	15,939

Newfoundland and Labrador

Population (January 2018): 527,613
Arboreal emblem: Black spruce

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	38,417
Fire (2017)	
Area burned (hectares)	700
Number of fires	80

Forest management

Harvesting (2016)	
Area harvested (hectares)	8,570
Volume harvested (cubic metres)	1,225,467
Regeneration (hectares, 2016)	
Area planted	3,721
Area seeded	4,737
Third-party certification (hectares, 2017)	
Area certified	1,417,834

Domestic economic impact

Housing starts (2017)	1,400
Revenue from goods manufactured (dollars, 2016)	
Logging industry	69,360,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	Not available
Total revenue from goods manufactured	Not available

Forest industry employment

Employment (number, 2017)	
Canadian System of National Accounts	1,200
Survey of Employment, Payrolls and Hours	Not available
Natural Resources Satellite Account	Not available
Wages and salaries (dollars, 2016)	
Logging industry	23,356,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	Not available
Total wages and salaries	Not available

Trade

Balance of trade (total exports, dollars, 2017)	124,027,154
Value of domestic exports (dollars, 2017)	
Primary wood products	11,437
Pulp and paper products	121,949,878
Wood-fabricated materials	6,323,007
Total value of domestic exports	128,284,322
Value of imports (dollars, 2017)	
Primary wood products	15,870
Pulp and paper products	4,090,318
Wood-fabricated materials	150,980
Total value of imports	4,257,168

Yukon

Population (January 2018): 38,825
Arboreal emblem: Subalpine fir

Disturbance

Insects (hectares, 2016)	
Area defoliated by insects and containing beetle-killed trees	200,943
Fire (2017)	
Area burned (hectares)	399,281
Number of fires	115

Forest management

Harvesting (2016)	
Area harvested (hectares)	270
Volume harvested (cubic metres)	17,900
Regeneration (hectares, 2016)	
Area planted	7
Area seeded	Not available
Third-party certification (hectares, 2017)	
Area certified	0

Trade

Balance of trade (total exports, dollars, 2017)	253,214
Value of domestic exports (dollars, 2017)	
Primary wood products	0
Pulp and paper products	0
Wood-fabricated materials	272,339
Total value of domestic exports	272,339
Value of imports (dollars, 2017)	
Primary wood products	0
Pulp and paper products	14,842
Wood-fabricated materials	4,283
Total value of imports	19,125

Northwest Territories

Population (January 2018): 44,597
Arboreal emblem: Tamarack

Disturbance

Insects (hectares, 2015)	
Area defoliated by insects and containing beetle-killed trees	519,868
Fire (2017)	
Area burned (hectares)	861,031
Number of fires	262

Forest management

Harvesting (2016)	
Area harvested (hectares)	390
Volume harvested (cubic metres)	32,606
Regeneration (hectares, 2016)	
Area planted	Not available
Area seeded	Not available
Third-party certification (hectares, 2016)	
Area certified	0

Trade

Balance of trade (total exports, dollars, 2017)	8,922
Value of domestic exports (dollars, 2017)	
Primary wood products	0
Pulp and paper products	8,922
Wood-fabricated materials	0
Total value of domestic exports	8,922
Value of imports (dollars, 2017)	
Primary wood products	0
Pulp and paper products	0
Wood-fabricated materials	0
Total value of imports	0

Nunavut

Population (January 2018): 38,203

Trade

Balance of trade (total exports, dollars, 2017)	65,207
Value of domestic exports (dollars, 2017)	
Primary wood products	0
Pulp and paper products	62,579
Wood-fabricated materials	2,687
Total value of domestic exports	65,266
Value of imports (dollars, 2017)	
Primary wood products	0
Pulp and paper products	59
Wood-fabricated materials	0
Total value of imports	59

Sources and information

The data in this report are derived from a number of sources, which are identified here by their relevant section. All data are subject to revision. Some numbers are rounded and therefore may not always exactly match the sum of their elements.

In most cases, the data represent the year before the reporting period. However, where they are gathered from several sources, it generally takes longer to compile and produce them. In these cases, the numbers reflect results from two or three years before the reporting period. As well, while most figures are calculated for the calendar year (January 1 to December 31), some are based on the federal government's fiscal year (April 1 to March 31).

All dollar figures, unless specified otherwise, are in Canadian dollars.

It may not be possible to compare directly the data from the report's various sections, as they come from several sources and those sources may compile their statistics differently from each other.

Dates on which data were accessed online are now included for sources including the Food and Agriculture Organization of the United Nations, the National Forest Inventory, the National Forestry Database, and Statistics Canada.

Cover

- Photo of seedlings at Natures Affinity Inc. from "The Forests of Canada" collection, Natural Resources Canada–Canadian Forest Service.
- Photo of wood pellets courtesy of Pacific BioEnergy Prince George LP.
- Photo of wood board production line courtesy of Tolko Industries.
- Photo of woman with microscope from "The Forests of Canada" collection, Natural Resources Canada–Canadian Forest Service.
- Photo of Indigenous basket-maker from "The Forests of Canada" collection, Natural Resources Canada–Canadian Forest Service.
- Photo of water bomber courtesy of Viking Air Limited.

Infographic: Canada's treed land

Beaudoin, A., Bernier, P.Y., et al. 2017. Species composition, forest properties and land cover types across Canada's forests at 250m resolution for 2001 and 2011. Natural Resources Canada–Canadian Forest Service, Laurentian Forestry Centre, Quebec, Canada. https://doi.org/10.23687/ec9e2659-1c29-4ddb-87a2-6aced147a990 (accessed February 19, 2018).

Infographic: Canada's forests by the numbers

Certification Canada. Canadian statistics. http://certificationcanada.org/en/statistics/canadian-statistics/ (accessed May 10, 2018).

- Natural Resources Canada–Canadian Forest Service's calculation for the area certified in Canada uses the 2017 Year-end Net Area Certified to SFM Standards (without double certifications) value.

Food and Agriculture Organization of the United Nations. 2012. *FRA 2015: Terms and definitions*. Forest Resources Assessment Working Paper 180. Rome, Italy. http://www.fao.org/docrep/017/ap862e/ap862e00.pdf

- "Forest" and other terms are defined in FRA 2015: *Terms and Definitions*.

Food and Agriculture Organization of the United Nations. 2014. *Global forest resources assessment 2015 – Country report: Canada*. Rome, Italy. http://www.fao.org/3/a-az181e.pdf

Food and Agriculture Organization of the United Nations. FAO soils portal – Biodiversity – Facts and figures. http://www.fao.org/soils-portal/soil-biodiversity/facts-and-figures/en/ (accessed April 16, 2018).

Mosquin, T., Whiting, P., et al. 1995. *Canada's biodiversity: The variety of life, its status, economic benefits, conservation costs and unmet needs*. Ottawa, ON: Canadian Centre for Biodiversity, Canadian Museum of Nature.

- The value for the proportion of Canadian species found in forest ecosystems includes all species groups (e.g., vertebrates, invertebrates, plants, fungi). Species are included if they spend at least part of their life cycle in forest ecosystems.

National Forest Inventory. Standard reports, Table 4.0, Area (1000 ha) of forest and non-forest land in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T4_FOR_AREA_en.html (accessed April 10, 2018).

- The base estimate of forest area for Canada comes from the National Forest Inventory (NFI) report at the source above.
- The estimate of current forest area (2015) was calculated by taking the NFI baseline estimate and adjusting it for known increases in forest area (afforestation) and known decreases in forest area (deforestation) that have occurred since the NFI baseline data were collected. These adjustments are described in Canada's country report to the Food and Agriculture Organization (FAO) of the United Nations for *Global Forest Resources Assessment 2015*.

National Forest Inventory. Standard reports, Table 12.0, Area of forest land by ownership in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T12_FOROWN_AREA_en.html (accessed November 1, 2017).

National Forestry Database. Forest fires. http://nfdp.ccfm.org/en/data/fires.php (accessed July 3, 2018).

National Forestry Database. Forest insects, Table 4.1 Area of moderate to severe defoliation (including beetle-killed trees) by insects. http://nfdp.ccfm.org/en/data/insects.php (accessed July 3, 2018).

National Forestry Database. Harvest, Table 5.2 Area harvested by jurisdiction, tenure, management and harvesting method. http://nfdp.ccfm.org/en/data/harvest.php (accessed July 3, 2018).

- Data include federal, provincial and private forest lands.

National Forestry Database. Regeneration, Table 6.2.1 Number of seedlings planted by jurisdiction, tenure and species group. http://nfdp.ccfm.org/en/data/regeneration.php (accessed July 3, 2018).

Statistics Canada. CANSIM tables 379-0031, 329-0077 and 329-0074. http://www5.statcan.gc.ca/cansim/a01?lang=eng (accessed April 11, 2018).

- Natural Resources Canada–Canadian Forest Service's calculations for 2017 nominal GDP are based on Statistics Canada's tables 379-0031, 329-0077 and 329-0074: GDP in 2007 constant prices, and estimated industry price deflators.
- GDP is a measure of the economic production that takes place within the geographical boundaries of Canada. Nominal GDP is measured in current dollars. Current dollars are used to describe the value of production in any given year.

Statistics Canada. CANSIM table 383-0031: Labour statistics consistent with the System of National Accounts (SNA), by province and territory, job category and North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3830031 (accessed May 23, 2018).

Statistics Canada. 2016 Census of Population (special extraction, April 20, 2018).

- Natural Resources Canada–Canadian Forest Service calculations are based on Statistics Canada, 2016 Census of Population.
- Employment data from Statistics Canada's 2016 Census of Population:
  - These values refer to the number of people "employed," not "in the labour force," which includes those "unemployed."
  - "Indigenous" refers to persons who are First Nations (North American Indian), Métis or Inuk (Inuit) and/or those who are Registered or Treaty Indians (that is, registered under the Indian Act of Canada), and/or those who have membership in a First Nation or Indian band.

Statistics Canada. Table 15.6 Land and freshwater area, by province and territory. https://www150.statcan.gc.ca/n1/pub/11-402-x/2012000/chap/geo/tbl/tbl06-eng.htm (accessed March 5, 2018).

United Nations Framework Convention on Climate Change. 2002. *Report on the conference of the parties on its seventh session, held at Marrakesh from 29 October to 10 November 2001; Addendum, Part Two: Action taken by the conference of the parties*, FCCC/ CP/2001/13/Add.1 (January 21, 2002). https://unfccc.int/resource/docs/cop7/13a01.pdf#page=54

- National deforestation estimates are calculated on a periodic basis using the method described in the *National Deforestation Monitoring System* description report. For more information, see:
  - **Dyk, A., Leckie, D., et al**. 2015. *Canada's National Deforestation Monitoring System: System description*. Victoria, BC: Natural Resources Canada–Canadian Forest Service, Pacific Forestry Centre. http://cfs.nrcan.gc.ca/publications?id=36042

Wells, J., Childs, D., et al. 2014. *Boreal birds need half: Maintaining North America's bird nursery and why it matters*. Seattle, WA: Boreal Songbird Initiative; Memphis, TN: Ducks Unlimited Inc.; Stonewall, MB: Ducks Unlimited Canada. http://www.borealbirds.org/sites/default/files/pubs/birdsneedhalf_0.pdf

Infographic: From planning to production: faces in the forestry supply chain

Photo credits:

- Photo of Michael Vela courtesy of the University of British Columbia.
- Photo of John Fleming courtesy of John Fleming.
- Photo of Wade Lariviere by Kelly Lehoux courtesy of NorSask Forest Products LP.
- Photo of Kathy Stull courtesy of JD Irving Pulp and Paper.
- Photo of Minh Tan Ton-That courtesy of the National Research Council Canada.

Splash page

- Photo of Indigenous carpenter from "The Forests of Canada" collection, Natural Resources Canada–Canadian Forest Service.
- Photograph from "The Forests of Canada" collection, Natural Resources Canada–Canadian Forest Services, 2018.
- Caribou eating by Madison Muskopf/Thinkstock by Getty Images

Article: Meet some of Canada's leaders in the forest bioeconomy

Carlson, R. *Nature Biotechnology 34*, 247-255 (2016).

Photo credits:

- Tall wood building construction photo courtesy of Stephane Groleau.
- Workers processing live edge slab photo courtesy of Canadian Salvaged Timber.
- False colour microbeads photo by T. Morse, courtesy of Anomera Inc.

Article: Successful Indigenous-industry partnerships in the forest sector: The People of the Seafoam

Province of British Columbia. *Forest Tenures*. https://www2.gov.bc.ca/gov/content/industry/forestry/forest-tenures (accessed February 23, 2018).

Photo credits:

- Photo of Mariyah Dunn-Jones stripping bark courtesy of Helen Jones.
- Culturally Modified Tree photo by Michael Charlie, courtesy of the Pacheedaht First Nation.
- Workers in a sawmill photo courtesy of the Pacheedaht First Nation.

Article: The forest as a classroom

Photo credits:

- Toddler walking outdoors at the warm spring day. Photo by SbytovaMN/Thinkstock by Getty Images.
- Group looking for Minibeasts At Activity Centre. Photo by omgimages/Thinkstock by Getty Images.
- Children Building Camp In Forest Together. Photo by omgimages/Thinkstock by Getty Images.

Article: Collaboration in the complex case of the woodland caribou

- Photo of caribou being fitted with tag and radio collar courtesy of Kevin Bollefer.

Sustainability indicators

How much forest does Canada have?

Food and Agriculture Organization of the United Nations. 2014. *Global forest resources assessment 2015 – Country report: Canada*. Rome, Italy. http://www.fao.org/3/a-az181e.pdf

Food and Agriculture Organization of the United Nations. 2015. *Global forest resources assessment 2015 – Forest Land Use Data Explorer*. http://www.fao.org/forest-resources-assessment/explore-data/en/ (accessed March 30, 2018).

National Forest Inventory. Standard reports, Table 4.0, Area (1000 ha) of forest and non-forest land in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T4_FOR_AREA_en.html (accessed April 10, 2018).

- The base estimate of forest area for Canada comes from the National Forest Inventory (NFI) report at the source above.
- The estimate of current forest area (2015) was calculated by taking the NFI baseline estimate and adjusting it for known increases in forest area (afforestation) and known decreases in forest area (deforestation) that have occurred since the NFI baseline data were collected. These adjustments are described in Canada's country report to the Food and Agriculture Organization (FAO) of the United Nations for *Global Forest Resources Assessment 2015*.
- The Food and Agriculture Organization of the United Nations definition of "temporarily unstocked" (referred to here as "temporarily non-treed") is provided in FRA 2015: Terms and Definitions, listed above.

National Forest Inventory. Standard reports, Table 4.2, Area (1000 ha) of forest and non-forest land by boreal zone in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/BOR3_T4_FOR_AREA_en.html (accessed April 10, 2018).

National Forest Inventory. Standard reports, Table 5.0, Area (1000 ha) of forest land by forest type and age class in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T5_FORAGE20_AREA_en.html (accessed April 20, 2018).

Indicator: Forest area

Food and Agriculture Organization of the United Nations. 2012. FRA 2015: *Terms and definitions*. Forest Resources Assessment Working Paper 180. Rome, Italy. http://www.fao.org/docrep/017/ap862e/ap862e00.pdf

Food and Agriculture Organization of the United Nations. 2014. *Global forest resources assessment 2015 – Country report: Canada*. Rome, Italy. http://www.fao.org/3/a-az181e.pdf

National Forest Inventory. Standard reports, Table 4.0, Area (1000 ha) of forest and non-forest land in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T4_FOR_AREA_en.html (accessed April 10, 2018).

- The base estimate of forest area for Canada comes from the National Forest Inventory (NFI) report at the source above.
- The estimate of current forest area (2015) was calculated by taking the NFI baseline estimate and adjusting it for known increases in forest area (afforestation) and known decreases in forest area (deforestation) that have occurred since the NFI baseline data were collected. These adjustments are described in Canada's country report to the Food and Agriculture Organization (FAO) of the United Nations for *Global Forest Resources Assessment 2015*.
- The Food and Agriculture Organization of the United Nations definitions of "forest" and other terms are provided in *FRA 2015: Terms and Definitions*.
- Additional information can be found at:
  - **Dyk, A., Leckie, D., et al.** 2015. *Canada's national deforestation monitoring system: System description*. Victoria, BC: Natural Resources Canada–Canadian Forest Service, Pacific Forestry Centre. http://cfs.nrcan.gc.ca/publications?id=36042
  - **Johnston, M., Campagna, M., et al.** 2009. *Vulnerability of Canada's tree species to climate change and management options for adaptation: An overview for policy makers and practitioners*. Ottawa, ON: Canadian Council of Forest Ministers. http://cfs.nrcan.gc.ca/publications?id=30276
  - **Natural Resources Canada–Canadian Forest Service.** Changing climate, changing forest zones. http://www.nrcan.gc.ca/forests/climate-change/impacts/13093
  - **Price, D.T., Alfaro, R.I., et al.** 2013. Anticipating the consequences of climate change for Canada's boreal forest ecosystems. *Environmental Reviews* 21, 322–365. http://cfs.nrcan.gc.ca/publications?id=35306

Statistics Canada. Table 15.6 Land and freshwater area, by province and territory. https://www150.statcan.gc.ca/n1/pub/11-402-x/2012000/chap/geo/tbl/tbl06-eng.htm (accessed March 5, 2018).

Indicator: Deforestation and afforestation

Dyk, A., Leckie, D., et al. 2015. *Canada's National Deforestation Monitoring System: System description*. Victoria, BC: Natural Resources Canada–Canadian Forest Service, Pacific Forestry Centre. http://cfs.nrcan.gc.ca/publications?id=36042

- National deforestation estimates are calculated on a periodic basis using the method described in the *National Deforestation Monitoring System* description report. Figure data provided by the National Deforestation Monitoring System, special tabulation, April 30, 2018.

Environment and Climate Change Canada. 2018. *National Inventory Report 1990–2016: Greenhouse gas sources and sinks in Canada*. https://unfccc.int/documents/65715 (accessed April 13, 2018).

- Environment and Climate Change Canada's *National Inventory Report 1990–2016: Greenhouse Gas Sources and Sinks in Canada* is based on data and analysis from Natural Resources Canada–Canadian Forest Service's National Forest Carbon Monitoring, Accounting and Reporting System.

United Nations Framework Convention on Climate Change. 2002. *Report on the conference of the parties on its seventh session, held at Marrakesh from 29 October to 10 November 2001; Addendum, Part Two: Action taken by the conference of the parties*, FCCC/ CP/2001/13/Add.1 (January 21, 2002). https://unfccc.int/resource/docs/cop7/13a01.pdf#page=54

- Natural Resources Canada–Canadian Forest Service's National Deforestation Monitoring System and Forest Carbon Monitoring, Accounting and Reporting System both define "forest" as all areas of 1 hectare or more having the potential to develop forest cover, with a minimum crown closure of 25% and a minimum tree height of 5 metres at maturity in situ. This definition harmonizes with the definitions found in the Marrakesh Accords of the United Nations Framework Convention on Climate Change, but is different from the Food and Agriculture Organization of the United Nations' definition used elsewhere in this report.

- Values have been updated with new mapping, affecting estimates from 2004 onward, and totals now include hydroelectric reservoirs.

- Deforestation by the forestry sector signifies the creation of new permanent forestry access roads.

- Deforestation by the hydroelectric sector includes new hydro lines and reservoir flooding.

- Deforestation by the built-up sector includes industrial, institutional or commercial developments as well as municipal urban development, recreation (ski hills and golf courses) and transportation.

- Deforestation by the mining, oil and gas sector includes mine development for minerals and peat as well as oil and gas developments.

Indicator: Wood volume

McKeever, D.B., and Howard, J.L. 2011. Solid wood timber products consumption in major end uses in the United States, 1950–2009: A technical document supporting the Forest Service 2010 RPA assessment. Madison, WI: US Department of Agriculture, Forest Service, Forest Products Laboratory. https://doi.org/10.2737/FPL-GTR-199.

- Natural Resources Canada–Canadian Forest Service's calculation for number of average single-family houses that can be built from Canada's wood volume is based on 2009 US housing statistics.

National Forest Inventory. Standard reports, Table 4.0, Area (1000 ha) of forest and non-forest land in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T4_FOR_AREA_en.html (accessed April 10, 2018).

National Forest Inventory. Standard reports, Table 15.1, Total tree volume (million m^3) on forest land by forest type, age class, and terrestrial ecozone in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/NFI3_T15_FORAGE20_VOL_en.html (accessed April 10, 2018).

- Natural Resources Canada–Canadian Forest Service's calculations for the volume of wood along Canada's west coast refer to the Pacific Maritime ecozone, with data from National Forest Inventory Tables 4.0 and 15.1.

- Additional information on outlook for wood volume is available at:

  - **Gauthier, S., Bernier, P., et al**. 2015. Boreal forest health and global change. *Science* 349, 819–822. http://cfs.nrcan.gc.ca/publications?id=36186

  - **Gauthier, S., Bernier, P.Y., et al**. 2015. Vulnerability of timber supply to projected changes in fire regime in Canada's managed forests. *Canadian Journal of Forest Research* 45, 1439–1447. http://cfs.nrcan.gc.ca/publications?id=36169

  - **Girardin, M.P., Bouriaud, O., et al**. 2016. No growth stimulation of Canada's boreal forest under half century of combined warming and CO_2 fertilization. *Proceedings of the National Academy of Science* 113, E8406–E8414.

- **Girardin, M.P., Hogg, E.H., et al**. 2016. Negative impacts of high temperatures on growth of black spruce forests intensify with the anticipated climate warming. *Global Change Biology* 22, 627–643. http://cfs.nrcan.gc.ca/publications?id=36216

- **Hember, R.A., Kurz, W.A., et al**. 2012. Accelerating regrowth of temperate-maritime forests due to environmental change. *Global Change Biology* 18, 2026–2040. http://cfs.nrcan.gc.ca/publications?id=33995

- On the wood volume graph, the category "Others" includes the data classifications "Unspecified conifers," "Unspecified hardwoods," "Other hardwoods" and "Unclassified"; "Cedar" represents the "Cedar & other conifers" data classification.

Is timber being harvested sustainably?

National Forest Inventory. Standard reports, Table 12.0, Area of forest land by ownership in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T12_FOROWN_AREA_en.html (accessed November 1, 2017).

National Forest Inventory. Standard reports, Table 16.0, Total tree volume (million m^3) by species group and age class in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T16_LSAGE20_VOL_en.html (accessed April 20, 2018).

National Forestry Database. Harvest, Table 5.1 Net merchantable volume of roundwood harvested by jurisdiction, tenure, category and species group. http://nfdp.ccfm.org/en/data/harvest.php (accessed July 3, 2018).

Indicator: Area harvested

National Forestry Database. Harvest, Table 5.2 Area harvested by jurisdiction, tenure, management and harvesting method. http://nfdp.ccfm.org/en/data/harvest.php (accessed July 3, 2018).

- Data include provincial Crown and private forest land subject to even-aged management (clearcutting), uneven-aged management (selection cutting), and commercial thinning harvest methods.

- Graph does not display federal lands because their small area cannot be represented at the given scale.

Indicator: Regeneration

National Forestry Database. Regeneration, Table 6.2 Area of direct seeding by jurisdiction, tenure and application method. http://nfdp.ccfm.org/en/data/regeneration.php (accessed July 3, 2018).

National Forestry Database. Regeneration, Table 6.2.1 Number of seedlings planted by jurisdiction, tenure and species group. http://nfdp.ccfm.org/en/data/regeneration.php (accessed July 3, 2018).

National Forestry Database. Regeneration, Table 6.2.2 Area planted by jurisdiction, tenure and species group. http://nfdp.ccfm.org/en/data/regeneration.php (accessed July 3, 2018).

- Data are for forests on provincial Crown lands across Canada.

- Federally and privately owned lands are excluded.

- Natural regeneration is often the most efficient approach for regenerating harvested areas when there is abundant existing understorey regeneration and a plentiful seed supply (e.g., lowland black spruce and tolerant hardwoods, respectively), or when tree species that can resprout from established root systems are present and desired (e.g., trembling aspen). The area of forest naturally regenerated is not reported by jurisdiction, so it is estimated as the difference between total area harvested and the area artificially regenerated.

- Artificial regeneration is suitable for sites where there is insufficient desired natural regeneration and where the objective is to achieve species composition targets required for sustainable forest management objectives.

Indicator: Volume harvested relative to sustainable wood supply

National Forestry Database. Wood supply, Table 2.1 Wood supply estimates by tenure and species group. http://nfdp.ccfm.org/en/data/woodsupply.php (accessed July 3, 2018).

- Wood supply includes allowable annual cuts for provincial Crown lands and potential harvests for federal and private lands.

National Forestry Database. Harvest, Table 5.1 Net merchantable volume of roundwood harvested by jurisdiction, tenure, category and species group. http://nfdp.ccfm.org/en/data/harvest.php (accessed July 3, 2018).

- Harvests include industrial roundwood only and exclude fuel wood and firewood.

- The discrepancy between the harvested volumes of "total industrial roundwood" and the sum of the "total industrial softwoods" and "total industrial hardwoods" is due to a very small amount of harvest categorised as "unspecified." Typically, this harvest occurs in mixedwood forests where neither softwood nor hardwood categories strictly apply, and it accounts for less than 1% of the harvested volume of total industrial roundwood. More information on these data can be found at the National Forestry Database.

How does disturbance shape Canada's forests?

Boulanger, Y., Gauthier, S., et al. 2014. A refinement of models projecting future Canadian fire regimes using homogeneous fire regime zones. *Canadian Journal of Forest Research* 44, 365–376. http://cfs.nrcan.gc.ca/publications?id=35420

Gauthier, S., Bernier, P., et al. 2014. Climate change vulnerability and adaptation in the managed Canadian boreal forest. *Environmental Reviews* 22, 256–285. http://cfs.nrcan.gc.ca/publications?id=35357

Gauthier, S., Bernier, P., et al. 2015. Boreal forest health and global change. *Science* 349, 819–822. http://cfs.nrcan.gc.ca/publications?id=36186

National Forestry Database. Forest fires. http://nfdp.ccfm.org/en/data/fires.php (accessed July 3, 2018).

- The National Forestry Database sources 2017 fire data from the Canadian Interagency Forest Fire Centre (CIFFC).

- The graphic shows the 2007–2017 fire data broken down by cause class. *The State of Canada's Forests: Annual Report 2018* does contain 2017 data, as published on the National Forestry Database website; however, these data are preliminary and the breakdown by cause class has not been finalized. As a result, note that the "Unknown" category for 2017 is overrepresented in the calculations. "Human (excluding industry)" includes "Miscellaneous known causes," "Recreation," "Residents," "Railways" and "Incendiary"; "Industry" includes "Forest industry" and "Other industry."

Nealis, V., and Cooke, B. 2014. *Risk assessment of the threat of mountain pine beetle to Canada's boreal and eastern pine forests*. Ottawa, ON: Canadian Council of Forest Ministers. http://cfs.nrcan.gc.ca/publications?id=35406

Sambaraju, K., DesRochers, P., et al. 2016. Forest ecosystem health and biotic disturbances: Perspectives on indicators and management approaches. In G. Larocque (ed.), *Ecological forest management handbook*, 459–515. Boca Raton, FL: CRC Press. https://cfs.nrcan.gc.ca/publications?id=36837

Indicator: Forest insects

BC Ministry of Forests, Lands and Natural Resource Operations. 2016. *2016 summary of forest health conditions in British Columbia*. https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/aerial-overview-survey-documents/aos_2016.pdf

National Forestry Database. Forest insects, Table 4.1 Area of moderate to severe defoliation (including beetle-killed trees) by insects. http://nfdp.ccfm.org/en/data/insects.php (accessed July 3, 2018).

- Forest area disturbed by defoliators includes only areas with tree mortality and moderate to severe defoliation. Defoliation does not always imply mortality. For example, stands with moderate defoliation often recover and may not lose much growth.

- Defoliation is mapped on an insect species basis, and a given area may be affected by more than one species at a time. This may result in double or triple counting in areas affected by more than one species, exaggerating the extent of the total area defoliated.

- Percent change value for the area impacted compared to the previous reported year (2015) uses data corrected after the publication of the 2017 report; the 2015 value for total area defoliated by insects was 15.7 million ha.

Indicator: Forest diseases

Bérubé, J.A., Dubé, J., et al. 2017. Incidence of Heterobasidion irregulare aerial basidiospores at different locations in southern Quebec. *Canadian Journal of Plant Pathology* 40, 34–38.

Canadian Food Inspection Agency. Ceratocystis fagacearum (oak wilt): Fact sheet. http://www.inspection.gc.ca/plants/plant-pests-invasive-species/diseases/oak-wilt/fact-sheet/eng/1325629194844/1325632464641

Cheng, L., Huang, J.G., et al. 2017. Drought causes reduced growth of trembling aspen in western Canada. *Global Change Biology* 23, 2887–2902.

Ennos, R.A. 2015. Resilience of forests to pathogens: An evolutionary ecology perspective. *Forestry* 88, 41–52.

Hogg, E.H., Michaelian, M., et al. 2017. Recent climatic drying leads to age-independent growth reductions of white spruce stands in western Canada. *Global Change Biology* 23, 5297–5308.

Price, D.T., Alfaro, R.I., et al. 2013. Anticipating the consequences of climate change for Canada's boreal forest ecosystems. *Environmental Reviews* 21, 322–365.

Ramsfield, T.D., Bentz, B.J., et al. 2016. Forest health in a changing world: Effects of globalization and climate change on forest insect and pathogen impacts. *Forestry* 89, 245–252.

Worrall, J.J., Rehfeldt, G.E., et al. 2013. Recent declines of Populus tremuloides in North America linked to climate. *Forest Ecology and Management* 299, 35–51.

Photo credit:

- Photo of Armaillaria root rot, Natural Resources Canada–Canadian Forest Service. https://tidcf.nrcan.gc.ca/en/diseases/factsheet/16.

Indicator: Forest fires

Alberta Emergency Management Agency. 2017. Alberta Emergency Alert – Critical alert – Wildfire. http://www.emergencyalert.alberta.ca/alerts/2017/09/4585.html (accessed May 28, 2018).

Canadian Broadcasting Corporation. 2017. Sask. community calls state of emergency, evacuations underway due to wildfire. http://www.cbc.ca/news/canada/saskatoon/pelican-narrows-smoke-evacuation-wildfire-1.4267021 (accessed May 28, 2018).

Manitoba Conservation and Water Stewardship. 2017. Fire update report. http://www.gov.mb.ca/conservation_fire/Fire-Update/2017/20170830fire1129am.html (accessed May 28, 2018).

National Forestry Database. Forest fires. http://nfdp.ccfm.org/en/data/fires.php (accessed July 3, 2018).

- The National Forestry Database sources 2017 fire data from the Canadian Interagency Forest Fire Centre (CIFFC).

Natural Resources Canada–Canadian Forest Service. Canadian Wildland Fire Information System – Monthly and seasonal forecasts. http://cwfis.cfs.nrcan.gc.ca/maps/forecasts (accessed April 18, 2018).

Wang, X., Parisien, M.-A., et al. 2017. Projected changes in daily fire spread across Canada over the next century. *Environmental Research Letters* 12(2). http://iopscience.iop.org/article/10.1088/1748-9326/aa5835/meta

Indicator: Carbon emissions and removals

Environment and Climate Change Canada. 2018. *National Inventory Report 1990–2016: Greenhouse gas sources and sinks in Canada*. https://unfccc.int/documents/65715 (accessed April 13, 2018).

- This indicator is estimated annually using Natural Resources Canada–Canadian Forest Service's National Forest Carbon Monitoring, Accounting and Reporting System. The system integrates information about forest inventories, forest growth, natural disturbances, forest management activities and land-use change to evaluate carbon stocks, stock changes and emissions of non-CO_2 greenhouse gases in Canada's managed forests. The system also estimates transfers to the forest product sector and the fate of harvested wood products manufactured from wood harvested in Canada since 1900, including carbon storage and emissions resulting from these products regardless of where in the world these emissions occur.

- "Managed land" includes all lands managed for production of wood fibre or wood-based bioenergy, for protection from natural disturbances, or for the conservation of ecological values. Within those managed lands, "forest" includes all areas of 1 hectare or more having the potential to develop forest cover, with a minimum crown closure of 25% and a minimum tree height of 5 metres at maturity in situ.

- Insect-affected areas in the second figure includes only those areas assigned to the natural partition where tree mortality due to insects exceeded 20% of biomass, while in the third figure all areas affected by insects are shown (anthropogenic and natural partitions).

- When stands are affected by stand-replacing wildfires, the emissions and subsequent removals during post-fire regrowth are reported in the category of "natural disturbances." When regrowing stands reach commercial maturity, the emissions and removals are reported in the "management activity" category. Stands affected by partial disturbances that cause more than 20% mortality are reported in the "natural disturbance" category until the biomass reaches pre-disturbance levels.

- Harvested wood product emissions are estimated using the "production approach" of the Intergovernmental Panel on Climate Change (IPCC) and include annual emissions from all wood harvested in Canada since 1900, regardless of its current location. Transfers of wood and paper products to landfills are assumed to instantly oxidize as CO_2.

- For forest lands affected by land-use change, the

deforestation and afforestation figures reflect annual rates. Figures for CO_2 equivalent (CO_2e) emissions and removals reflect the current year plus the emissions in the reporting year from lands that were converted from forest in the previous 20 years. Thus, the figures for CO_2e emissions include residual emissions from areas deforested over the past 20 years, and the figures for CO_2e removals in the reporting year include removals by all areas afforested over the past 20 years.

  - Emissions bear a positive sign. Removals bear a negative sign.

- Starting in 2015, international greenhouse gas (GHG) reporting guidelines changed with respect to harvested wood products. Accordingly, Canada reports the net GHG balance of forested ecosystems and the net GHG balance from harvested wood products. In previous years, all wood removed from the forest was assumed to instantly release all carbon to the atmosphere, despite the long-term storage of carbon in houses and other long-lived wood products. Reporting the fate of carbon in harvested wood products encourages both the sustainable management of forests and the management of harvested wood products aimed at extending carbon storage.

- Additional information can be found at:

  - **Kurz, W.A., Shaw, C.H., et al**. 2013. Carbon in Canada's boreal forest: A synthesis. *Environmental Reviews* 21, 260–292. http://cfs.nrcan.gc.ca/publications?id=35301

  - **Lemprière, T.C., Kurz, W.A., et al**. 2013. Canadian boreal forests and climate change mitigation. *Environmental Reviews* 21, 293–321. http://cfs.nrcan.gc.ca/publications?id=35627

  - **Metsaranta, J.M., Shaw, C.H., et al**. 2017. Uncertainty of inventory-based estimates of the carbon dynamics of Canada's managed forest (1990–2014). *Canadian Journal of Forest Research* 47, 1082–1094. http://cfs.nrcan.gc.ca/publications?id=38890

  - **Natural Resources Canada–Canadian Forest Service**. Carbon budget model. http://www.nrcan.gc.ca/forests/climate-change/carbon-accounting/13107 (accessed April 3, 2018).

  - **Natural Resources Canada–Canadian Forest Service**. Inventory and land-use change. https://www.nrcan.gc.ca/forests/climate-change/carbon-accounting/13111 (accessed May 3, 2017).

  - **Stinson, G., Kurz, W.A., et al**. 2011. An inventory-based analysis of Canada's managed forest carbon dynamics, 1990 to 2008. *Global Change Biology* 17, 2227–2244. http://cfs.nrcan.gc.ca/publications?id=32135

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Mosquin, T., Whiting, P., et al. 1995. *Canada's Biodiversity: The variety of life, its status, economic benefits, conservation costs and unmet needs*. Ottawa, ON: Canadian Centre for Biodiversity, Canadian Museum of Nature.

Natural Resources Canada–Canadian Forest Service calculations are based on 1) Statistics Canada, 2016 Census of Population, and 2) Natural Resources Canada, North American boreal zone map shapefiles (https://www.nrcan.gc.ca/forests/boreal/14252).

- "Adjacent" (in "Canadians who live in or adjacent to forested areas") is not defined by a specific distance from a forested area, but through analyses. Forested area data are laid over Statistics Canada dissemination areas (DAs); if any portion of a DA contains forested land, the entire population of that DA is considered to live in or adjacent to forests.

- Statistics Canada defines a dissemination area as a "small area composed of one or more neighbouring blocks, with a population of 400 to 700 persons." A DA is a "relatively stable geographic unit" and "the smallest standard geographic area for which all census data are disseminated." All of Canada is divided into dissemination areas. (http://www12.statcan.gc.ca/census-recensement/2011/ref/dict/geo021-eng.cfm).

- GIS-based analyses used the BOREAL and B_ALPINE layers.

Natural Resources Canada–Canadian Forest Service

calculations are based on 1) Parks Canada, *Parks Canada Attendance 2016-17* (https://www.pc.gc.ca/en/docs/pc/attend), and 2) Natural Resources Canada, *North American boreal zone map shapefiles* (https://www.nrcan.gc.ca/forests/boreal/14252).

- GIS-based analyses used the BOREAL and B_ALPINE layers.
- Parks Canada attendance data were not available for 5 out of the 20 of parks located within Canada's boreal region.

Park, B.J., Tsunetsugu, Y., et al. 2010. The physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest bathing): Evidence from field experiments in 24 forests across Japan. *Environmental Health and Preventive Medicine* 15, 18–26. https://www.ncbi.nlm.nih.gov/pubmed/19568835

Statistics Canada. CANSIM table 383-0031: Labour statistics consistent with the System of National Accounts (SNA), by province and territory, job category and North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3830031 (accessed May 23, 2018).

Takano, T., Nakamura, K., et al. 2002. Urban residential environments and senior citizens' longevity in megacity areas: The importance of walkable green spaces. *Epidemiology and Community Health* 56, 913–918. http://jech.bmj.com/content/56/12/913

Yamaguchi, M., Deguchi, M., et al. 2006. The effects of exercise in forest and urban environments on sympathetic nervous activity of normal young adults. *International Medical Research* 34, 152–159. https://www.researchgate.net/publication/7034388_The_Effects_of_Exercise_in_Forest_and_Urban_Environments_on_Sympathetic_Nervous_Activity_of_Normal_Young_Adults

Indicator: Employment

Statistics Canada. CANSIM table 383-0031: Labour statistics consistent with the System of National Accounts (SNA), by province and territory, job category and North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3830031 (accessed May 23, 2018).

- Data from Statistics Canada's new Natural Resources Satellite Account (NRSA) are a key source of information on the economic contribution of the forest sector in Canada and will be included in future releases of *The State of Canada's Forests*. The NRSA is the result of collaboration between NRCan and Statistics Canada and is able to capture additional economic activity in segments of the forest industry that have traditionally been difficult to measure, such as wood furniture manufacturing. According to data from the NRSA, the forest sector directly employed 232,549 people across the country in 2017.
- Statistics Canada released revised 2016 SNA employment data in 2017. In the 2017 State of Forests report, total forest sector employment was reported as 211,075. This number was revised to 205,660 by Statistics Canada.

Indicator: Average earnings

Statistics Canada. CANSIM table 281-0027: Survey of Employment, Payrolls and Hours (SEPH), average weekly earnings by type of employee overtime status and detailed North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=2810027 (accessed April 10, 2018).

Statistics Canada. CANSIM table 326-0020: Consumer Price Index. http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3260020 (accessed April 10, 2018).

- Additional information can be found at:
  - **Natural Resources Canada–Canadian Forest Service**. Industry – Overview. http://www.nrcan.gc.ca/forests/industry/13311
  - Data exclude overtime.
  - Previous issues of *The State of Canada's Forests* calculated real average earnings using GDP at market prices as the measure of inflation. This year, the Consumer Price Index (including volatile commodities) was used because it is a better indicator of the spending power of Canadians.

Indicator: Communities

Natural Resources Canada–Canadian Forest Service calculations are based on 1) Statistics Canada, 2016 Census of Population, and 2) Natural Resources Canada–Canadian Forest Service, North American boreal zone map shapefiles (https://www.nrcan.gc.ca/forests/boreal/14252).

- "Adjacent" (in "Canadians who live in or adjacent to forested areas") is not defined by a specific distance from a forested area, but through analyses. Forested area data are laid over Statistics Canada dissemination areas (DAs); if any portion of a DA contains forested land, the entire population of that DA is considered to live in or adjacent to forests.
  - Statistics Canada defines a dissemination area as a

"small area composed of one or more neighbouring blocks, with a population of 400 to 700 persons." A DA is a "relatively stable geographic unit" and "the smallest standard geographic area for which all census data are disseminated." All of Canada is divided into dissemination areas. (http://www12.statcan.gc.ca/census-recensement/2011/ref/dict/geo021-eng.cfm).

- GIS-based analyses used the BOREAL and B_ALPINE layers.

Statistics Canada. 2017 Labour Force Survey and 2016 Census of Population (special extractions, June 7, 2018 and April 20, 2018, respectively).

- Natural Resources Canada–Canadian Forest Service calculations for Indigenous employment are based on Statistics Canada, 2017 Labour Force Survey and 2016 Census of Population.

- Note that the Labour Force Survey is completed annually and that the Census of Population is completed every five years. As such, reported employment values may differ.

- A decline in this indicator may reflect either a decline in the fortunes of the forest sector (e.g., if a mill closes, the income from the forest sector goes down) or an increase in diversification of the economy overall (e.g., there may be no changes in forest sector income, but other sources of income increase). As a result, an increasing or a declining trend in the number of Census subdivisions having the forest sector as a major economic driver is hard to interpret in the absence of other information.

- A "forested area" is defined for this indicator as an area with over 60% tree cover.

- The forest sector communities indicator is based on Statistics Canada's Census subdivisions. A "subdivision" is "the general term for municipalities (as determined by provincial/territorial legislation) or areas treated as municipal equivalents for statistical purposes (e.g., Indian reserves, Indian settlements and unorganized territories)." Since there is no standardized definition of "community" across provinces and territories, using Census subdivisions allows for a consistent approach in reporting over time.

- Employment data from Statistics Canada's 2016 Census of Population: This value refers to the number of people "employed" and not "in the labour force," which includes those "unemployed." "Indigenous" refers to persons who are First Nations (North American Indian), Métis or Inuk (Inuit) and/or those who are Registered or Treaty Indians (that is, registered under the *Indian Act*), and/or those who have membership in a First Nation or Indian band.

- The forest sector is considered to be a major economic driver if it accounts directly for 20% or more of market income (i.e., total income excluding government transfers) in a census subdivision. This differs from the previous definition of "forest dependence," which was based on more than 50% of total income (including transfer income) being directly attributable to the forest sector.

Photo credit:

- Photo of two riders cantering through the Larose Forest by Madison Farrow-Beck.

How does the forest industry contribute to Canada's economy?

National Forestry Database. Revenues, Table 8.1 Statement of revenues from the sale of timber from provincial Crown land, by jurisdiction. http://nfdp.ccfm.org/en/data/revenues.php (accessed July 3, 2018).

Statistics Canada. CANSIM table 383-0031: Labour statistics consistent with the System of National Accounts (SNA), by province and territory, job category and North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3830031 (accessed May 23, 2018).

Statistics Canada. 2016 Census of Population (special extraction, April 20, 2018).

- Natural Resources Canada–Canadian Forest Service calculations are based on Statistics Canada, 2016 Census of Population.

- Indigenous employment data from Statistics Canada's 2016 Census of Population:

- These values refer to the number of people "employed," not "in the labour force," which includes those "unemployed."

- "Indigenous" refers to persons who are First Nations (North American Indian), Métis or Inuk (Inuit) and/or those who are Registered or Treaty Indians (that is, registered under the *Indian Act*), and/or those who have membership in a First Nation or Indian band.

Statistics Canada. Merchandise trade data, monthly data (special extraction, April 25, 2018).

- Natural Resources Canada–Canadian Forest Service's calculations for 2017 nominal GDP are based on Statistics Canada's tables 379-0031, 329-0077 and 329-0074: GDP in 2007 constant prices, and estimated industry price deflators.

- The classification of the exports of forest products is determined by the international Harmonized Sales codes. The further breakdown of these products is consistent with the nomenclature used in the Food and Agriculture Organization of the United Nations Joint Forest Sector Questionnaire.

- "Other" includes approximately 415 different product categories.

Indicator: Gross domestic product

Nominal GDP:

Statistics Canada. CANSIM table 379-0029: Gross domestic product (GDP) at basic prices by industry. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040101 (accessed April 11, 2018).

- For nominal GDP up to (and including) 2014.

Statistics Canada. CANSIM tables 379-0031, 329-0077 and 329-0074. http://www5.statcan.gc.ca/cansim/a01?lang=eng (accessed April 11, 2018).

- Natural Resources Canada–Canadian Forest Service's calculations for 2015–2017 nominal GDP are based on Statistics Canada's tables 379-0031, 329-0077 and 329-0074: GDP in 2007 constant prices, and estimated industry price deflators.

Real GDP:

Statistics Canada. CANSIM table 379-0031: Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3790031 (accessed April 11, 2018).

- Real GDP in 2007 constant prices.

- Data from Statistics Canada's new Natural Resources Satellite Account (NRSA) are a key source of information on the economic contribution of the forest sector in Canada and will be included in future releases of *The State of Canada's Forests*. The NRSA, the result of collaboration between Natural Resources Canada and Statistics Canada, is able to capture economic activity in forest industry segments that have traditionally been difficult to measure, such as wood furniture manufacturing. According to data from the NRSA, the forest sector directly accounted for $27.6 billion (or 1.4%) of Canada's nominal GDP in 2017.

- Nominal and real GPD vary in that real values are adjusted for inflation whereas nominal values are not. Therefore, real GDP is used to account for differences between time periods (e.g., comparing 2016 and 2017 GDP).

Indicator: Production

APA – The Engineered Wood Association. Quarterly production reports.

- The production and consumption data of structural panels (plywood and oriented strand board) are from APA – The Engineered Wood Association.

Pulp and Paper Products Council.

- Production and consumption figures for newsprint, printing and writing paper, and wood pulp are based on data of the Pulp and Paper Products Council.

Statistics Canada. CANSIM table 303-0064: Lumber production, shipments and stocks, by Canada and provinces. http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3030064 (accessed February 27, 2018).

- Data used for lumber production include total softwood production for Canada.

Indicator: Exports

Statistics Canada. Merchandise trade data (obtained via Global Trade Atlas) (special extraction, February 16, 2018).

- "Total all forest products" includes only HS Codes 44, 47 and 48.

How is the forest industry changing?

Natural Resources Canada. Comprehensive energy use database. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm (accessed March 6, 2018).

- Industrial Sector – Aggregated Industries:
  - Table 8: Pulp and Paper Secondary Energy Use and GHG Emissions
  - Table 15: Forestry Secondary Energy Use and GHG Emissions
- Industrial Sector – Disaggregated Industries:
  - Table 28: Wood Products Industries Secondary Energy Use and GHG Emissions
  - Table 34: Converted Paper Products Industry Secondary Energy Use and GHG Emissions

Statistics Canada. 2016. *Report on energy supply and demand in Canada* (2014 preliminary). http://www.statcan.gc.ca/pub/57-003-x/57-003-x2016002-eng.htm (accessed March 20, 2018).

- The methodology for estimating the amount of primary energy attributed to wood and spent pulping liquor in the pulp and paper manufacturing sub-sector was updated in 2015, causing changes in the data series between 1995 and 2002. In addition, from 1990 to 2010, wood waste and spent pulping liquor were incorrectly included in other fuels when estimating electricity generation in the Report on Energy Supply and Demand in Canada. This has now been corrected for the 2011, 2012 and 2013 data points, but will not be corrected for years prior to those. These changes have directly affected the estimates for industrial energy use and electricity generation, and indirectly affected the emissions estimates. The time series data for 2011–2013 may therefore not be completely consistent with data for earlier years.

- Additional information about the Natural Resources Canada–Canadian Forest Service's *Investments in Forest Industry Transformation Program* can be found at http://www.nrcan.gc.ca/forests/federal-programs/13139.

Statistics Canada. 2017. *Results from the 2015 bioproducts production and development survey*. http://www.statcan.gc.ca/pub/18-001-x/18-001-x2017001-eng.pdf

- The 2015 survey data were the most current at the time of publication.

- "Bioproducts" included biofuels, bioenergy, organic chemicals, materials and composites, intermediary biochemicals and biomaterials, and other bioproducts.

Indicator: Financial performance

Statistics Canada. Quarterly balance sheet and income statement, by North American Industry Classification System (NAICS) (special extraction).

Indicator: Secondary manufacturing

Industry Canada. Trade data online. https://www.ic.gc.ca/app/scr/tdst/tdo/crtr.html?productType=NAICS&lang=eng (accessed April 6, 2018).

Statistics Canada. CANSIM table 304-0014: Manufacturers' sales, inventories, orders and inventory to sales ratios, by North American Industry Classification System (NAICS), Canada. http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3040014 (accessed April 6, 2018).

Statistics Canada. CANSIM table 379-0031: Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3790031 (accessed April 11, 2018).

- Real GDP in 2007 constant prices.

- Industry Canada defines "value added" as a measure of net output, meaning gross output minus the purchased inputs that have been embodied in the value of the product.

- Domestic consumption is calculated as domestic sales minus exports plus imports.

Indicator: Forest industry carbon emissions

Environment and Climate Change Canada. 2018. *National Inventory Report 1990–2016: Greenhouse gas sources and sinks in Canada*. https://unfccc.int/documents/65715 (accessed April 13, 2018).

- **Environment and Climate Change Canada**'s *National Inventory Report 1990–2016: Greenhouse Gas Sources and Sinks in Canada* is based on data and analysis from Natural Resources Canada–Canadian Forest Service's National Forest Carbon Monitoring, Accounting and Reporting System.

Natural Resources Canada. Comprehensive energy use database. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm (accessed April 28, 2018).

- Residential End-Use Model, and Electricity Energy-Use Model

Statistics Canada. 2018. *Report on energy supply and demand in Canada* (2016 preliminary). http://www.statcan.gc.ca/pub/57-003-x/57-003-x2018002-eng.htm (accessed April 28, 2018).

Statistical profiles

Population

Statistics Canada. 2016 Census of Population (special extraction, April 20, 2018).

Forest inventory

Forest area by classification

Food and Agriculture Organization of the United Nations. 2014. *Global forest resources assessment 2015 – Country report: Canada*. Rome, Italy. http://www.fao.org/3/a-az181e.pdf

National Forest Inventory. Standard reports, Table 4.0, Area (1000 ha) of forest and non-forest land in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T4_FOR_AREA_en.html (accessed April 10, 2018).

- The base estimate of forest area for Canada comes from the National Forest Inventory (NFI) report at the source above.
- The estimate of current forest area (2015) was calculated by taking the NFI baseline estimate and adjusting it for known increases in forest area (afforestation) and known decreases in forest area (deforestation) that have occurred since the NFI baseline data were collected. These adjustments are described in Canada's country report to the Food and Agriculture Organization of the United Nations for *Global Forest Resources Assessment 2015*.
- The National Forest Inventory uses the following definitions from the Food and Agriculture Organization of the United Nations:
  - Forest – land spanning more than 0.5 hectares where the tree canopy covers more than 10% of the total land area and the trees can grow to a height of more than 5 metres. It does not include land that is predominantly urban or used for agricultural purposes.
  - Other land with tree cover – areas of land where tree canopies cover more than 10% of the total area and the trees, when mature, can grow to a height of at least 5 metres. Includes treed areas on farms, in parks and gardens, and around buildings. Also includes tree plantations established mainly for purposes other than wood production, such as fruit orchards.
  - Other wooded land – areas of land where: 1) tree canopies cover 5–10% of the total area and the trees, when mature, can grow to a height above 5 metres; or 2) shrubs, bushes and trees together cover more than 10% of the area. These areas include treed wetlands (swamps) and land with slow-growing and scattered trees. They do not include land that is predominantly agricultural or urban.
  - The base estimate of forest area for Canada comes from the National Forest Inventory (NFI) report at the source listed above.
- The estimate of current forest area was calculated by taking the National Forest Inventory baseline estimate at the source above (Table 4.0) and adjusting it for known increases in forest area (afforestation) and known decreases in forest area (deforestation) that have occurred since baseline data were collected. These adjustments are described in Canada's 2015 country report to the Food and Agriculture Organization of the United Nations (http://www.fao.org/3/a-az181e.pdf).

Forest area change

Environment and Climate Change Canada. 2018. *National inventory report 1990–2016: Greenhouse gas sources and sinks in Canada*. https://unfccc.int/documents/65715 (accessed April 13, 2018).

- Environment and Climate Change Canada's *National Inventory Report 1990–2016: Greenhouse Gas Sources and Sinks in Canada* is based on data and analysis from Natural Resources Canada–Canadian Forest Service's National Forest Carbon Monitoring, Accounting and Reporting System.

Forest type

National Forest Inventory. Standard reports, Table 5.0, Area (1000 ha) of forest land by forest type and age class in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T5_FORAGE20_AREA_en.html (accessed April 20, 2018).

Forest ownership

National Forest Inventory. Standard reports, Table 12.0, Area (1000 ha) of forest land by ownership in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T12_FOROWN_AREA_en.html (accessed November 1, 2017).

Growing stock

National Forest Inventory. Standard reports, Table 15.0, Total tree volume (million m^3) on forest land by forest type and age class in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T15_FORAGE20_VOL_en.html (accessed April 20, 2018).

National Forest Inventory. Standard reports, Table 16.0, Total tree volume (million m^3) by species group and age class in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T16_LSAGE20_VOL_en.html (accessed April 20, 2018).

Disturbance

Insects

National Forestry Database. Forest insects, Table 4.1 Area of moderate to severe defoliation (including beetle-killed trees) by insects. http://nfdp.ccfm.org/en/data/insects.php (accessed July 3, 2018).

- Forest area disturbed by defoliators includes only areas with tree mortality and moderate to severe defoliation. Defoliation does not always imply mortality. For example, stands with moderate defoliation often recover and may not lose much growth.
- Defoliation is mapped on an insect species basis, and a given area may be affected by more than one species at a time. This may result in double or triple counting in areas affected by more than one species, exaggerating the extent of the total area defoliated.

Fire

National Forestry Database. Forest fires. http://nfdp.ccfm.org/en/data/fires.php (accessed July 3, 2018).

- National data include all burned areas within Canada's forests. Provincial data do not include fires within national parks. In 2017, 84 fires burned 282,131 hectares in national parks across Canada. Some of these fires were controlled or prescribed burning for ecological restoration purposes.
- The National Forestry Database sources 2017 fire data from the Canadian Interagency Forest Fire Centre (CIFFC).

Forest management

Harvesting

National Forestry Database. Harvest. http://nfdp.ccfm.org/en/data/harvest.php (accessed July 3, 2018).

- The national and provincial/territorial profile figures for harvesting volumes include data for industrial roundwood, fuel wood and firewood from provincial and territorial Crown land and from private land.
- Area harvested data include federal, provincial and private forest lands.

Regeneration

National Forestry Database. Regeneration. http://nfdp.ccfm.org/en/data/regeneration.php (accessed July 3, 2018).

Third-party certification

Certification Canada. Canadian statistics. http://certificationcanada.org/en/statistics/canadian-statistics/ accessed March 6, 2018).

- If a forest area has been certified to more than one of the three sustainable forest management standards (Canadian Standards Association, Sustainable Forestry Initiative, and Forest Stewardship Council), the area is counted only once. Therefore, the total certification for sustainable forest management standards may be less than the sum of the individual totals for these standards. The independently certified forest area is calculated using forest management units, which include streams, lakes, rivers and roads.

Protected forest

National Forest Inventory. Standard reports, Table 9.0, Area (1000 ha) of forest land by IUCN category and age class in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T9_PSAGE20_AREA_en.html (accessed December 5, 2017).

Greenhouse gas inventory

Source

Environment and Climate Change Canada. 2018. *National Inventory Report 1990–2016: Greenhouse gas sources and sinks in Canada*. https://unfccc.int/documents/65715 (accessed April 13, 2018).

- Environment and Climate Change Canada's *National Inventory Report 1990–2016: Greenhouse Gas Sources and Sinks in Canada* is based on data and analysis from Natural Resources Canada–Canadian Forest Service's National Forest Carbon Monitoring, Accounting and Reporting System.

- For forest lands affected by land-use change, the deforestation and afforestation figures reflect annual rates. Figures for CO_2 equivalent (CO_2e) emissions and removals reflect the current year plus the emissions in the reporting year from lands that were converted from forest in the previous 20 years. Thus, the figures for CO_2e emissions include residual emissions from areas deforested over the past 20 years, and the figures for CO_2e removals in the reporting year include removals by all areas afforested over the past 20 years.

  – Emissions bear a positive sign. Removals bear a negative sign.

- See the sources and information for the sustainability indicator *Carbon emissions and removals* for more detail.

Domestic economic impact

Canadian housing starts

Statistics Canada. CANSIM table 027-0009: Canada Mortgage and Housing Corporation, housing starts, under construction and completions, all areas. http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=0270009 (accessed April 20, 2018).

- A rate adjustment is used for economic or business data to remove seasonal variations in the data. The time of year will affect most data. Adjusting for the seasonality in data enables more accurate month-to-month comparisons. The seasonally adjusted annual rate (SAAR) is calculated by dividing the unadjusted annual rate for the month by its seasonality factor and creating an adjusted annual rate for the month. These adjustments are most often used when economic data are released to the public.

Contribution to nominal GDP

Statistics Canada. CANSIM tables 379-0031, 329-0077 and 329-0074. http://www5.statcan.gc.ca/cansim/a01?lang=eng (accessed April 11, 2018).

- Natural Resources Canada–Canadian Forest Service's calculations for 2017 nominal GDP are based on Statistics Canada's tables 379-0031, 329-0077 and 329-0074: GDP in 2007 constant prices, and estimated industry price deflators.

- Gross domestic product (GDP) is a measure of the economic production that takes place within the geographical boundaries of Canada. Nominal GDP is measured in current dollars. Current dollars are used to describe the value of production in any given year.

- Data from Statistics Canada's new Natural Resources Satellite Account (NRSA) are a key source of information on the economic contribution of the forest sector in Canada and will be included in future releases of *The State of Canada's Forests*. The NRSA, the result of collaboration between Natural Resources Canada and Statistics Canada, is able to capture economic activity in forest industry segments that have traditionally been difficult to measure, such as wood furniture manufacturing. According to data from the NRSA, the forest sector directly accounted for $27.6 billion (or 1.4%) of Canada's nominal GDP in 2017.

Contribution to real GDP

Statistics Canada CANSIM table 379-0031: Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3790031 (accessed April 11, 2018).

- Gross domestic product (GDP) is a measure of the economic production that takes place within the geographical boundaries of Canada. Real GDP is measured in 2007 constant prices and corrects for inflation, enabling accurate comparisons between years.

Revenue from goods manufactured

Statistics Canada. CANSIM table 301-0008: Principal statistics for manufacturing industries, by North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3010008 (accessed April 22, 2018).

Statistics Canada. CANSIM table 301-0009: Logging industries, principal statistics by North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3010009 (accessed April 22, 2018).

- Revenue from goods manufactured includes revenue from the sale of goods manufactured using materials owned by the establishment, as well as from repair work, manufacturing service charges and work contracted to others.

Forest industry employment

Employment

Statistics Canada. CANSIM table 281-0024: Survey of Employment, Payrolls and Hours (SEPH), employment by type of employee and detailed North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=2810024 (accessed April 20, 2018).

Statistics Canada. CANSIM table 383-0031: Labour statistics consistent with the System of National Accounts (SNA), by province and territory, job category and North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3830031 (accessed May 23, 2018).

Statistics Canada. Table: 38-10-0285-01 (formerly CANSIM 388-0010). Natural resources satellite account, indicators. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3810028501 (accessed June 18, 2018).

- Natural Resources Canada calculations based on Statistics Canada's CANSIM table 388-0010.

- Employment includes jobs held by people employed directly in the following industries: forestry and logging, support activities for forestry, pulp and paper product manufacturing, and wood product manufacturing. Natural Resources Canada prefers to use employment data from Statistics Canada's System of National Accounts (SNA) because these data are linked to the underlying framework used to compile the Canadian System of National Economic Accounts (e.g., GDP, national wealth). Employment data can also be sourced from Statistics Canada's Labour Force Survey (LFS) and the Survey of Employment, Payrolls and Hours (SEPH). The strength of LFS data is their demographic information, and they can be used to capture the level of self-employment in the forest sector. The SEPH data focus on industry and can be used for comparing direct company employment in forestry with that in other sectors.

- Indirect employment is calculated by Natural Resources Canada using Statistics Canada's National Symmetric Input-Output Tables (15-207-XCB) and Statistics Canada's National Multipliers (15F0046XDB).

Wages and salaries

Statistics Canada. CANSIM table 301-0008: Principal statistics for manufacturing industries, by North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3010008 (accessed April 22, 2018).

Statistics Canada. CANSIM table 301-0009: Logging industries, principal statistics by North American Industry Classification System (NAICS). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3010009 (accessed April 22, 2018).

- Wages and salaries are the earnings, in cash or in kind, of Canadian residents for work performed before deduction of income taxes and contributions to pension funds, employment insurance and other social insurance schemes.

Trade

Statistics Canada. Merchandise trade data (special extraction), monthly data.

- Balance of trade is the difference between the value of the goods and services that a country exports domestically and the value of the goods and services that it imports. If a country's exports exceed its imports, it has a trade surplus. If its imports exceed exports, the country has a trade deficit.

Domestic production and investment

Production

APA – The Engineered Wood Association. Quarterly production reports.

- The production and consumption data of structural panels (plywood and oriented strand board) are from APA – The Engineered Wood Association.

Pulp and Paper Products Council.

- Production and consumption figures for newsprint, printing and writing paper, and wood pulp are based on data of the Pulp and Paper Products Council.

Statistics Canada. CANSIM table 303-0064: Lumber production, shipments and stocks, by Canada and provinces. http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3030064 (accessed February 27, 2018).

- Data used for lumber production include total softwood production for Canada.

Capital expenditures and repair expenditures

Statistics Canada. CANSIM table 029-0045: Capital and repair expenditures, by North American Industry Classification System (NAICS), Canada, provinces and territories. http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=0290045 (accessed April 20, 2018).

- Capital expenditures include the costs of procuring, constructing and installing or leasing new durable plants, machinery and equipment, whether for the replacement of or addition to existing assets. Also included are all capitalized costs, such as costs for feasibility studies and architectural, legal, installation and engineering fees; the value of capital assets put in place by firms, either by contract or with the firm's own labour force; and capitalized interest charges on loans for capital projects.

- Repair expenditures include costs to repair and maintain structures, machinery and equipment.

Domestic consumption

Natural Resources Canada calculations of consumption figures for a range of products.

- This information is available only at the national level.

- Domestic consumption of wood pulp (tonnes) contains Natural Resources Canada–Canadian Forest Service estimates of import volumes that may be subject to revision.

Notes

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