The State of Canada's Forests

ANNUAL REPORT 2019

Canada

Natural Resources Canada

Ressources naturelles Canada

The State of Canada's Forests

ANNUAL REPORT 2019

Canada

Table of Contents

Minister's Message

Canada's forests are one of the great legacies of our land. For generations, they have been the backbone of our economy. Today, they remain a dynamic economic engine, contributing almost $28 billion to our GDP and providing jobs for more than 210,000 Canadians. In fact, the forest sector is a major contributor of jobs and income in about 300 communities.

When most Canadians think of forest products, they probably envision traditional products, such as lumber for building a deck, mulch for their garden or paper cups for their coffee.

But that's only part of the story.

Today's forest industry has transformed itself, entering areas you might not expect. For example, lignin, a component of wood fibre, is being used to create densified wood that is as strong as steel.

Lignin can also create transparent wood that is stronger and more insulating than glass. It can even make carbon foam, capable of absorbing sound and radiation in everything from aircraft to ships, walls to stealth technologies.

Forests are also central to meeting Canada's climate change goals. Since 2006, the forest industry has reduced its total greenhouse emissions by 38 percent — a remarkable achievement. And we will continue to use nature-based solutions to fight climate change, including through our commitment to plant two billion trees to clean our air and water and make our communities greener.

In addition, our forests provide much of the feedstock for the emerging bioeconomy, which uses sustainably sourced biomass to create products such as bioplastics, biochemicals and biofuels. These biofuels are being used to generate heat and power, including in remote communities, thereby displacing higher-emitting fuels such as diesel.

Wood is also part of innovative new materials that are making Canada a leader in tall wood construction. This contributes to a low-carbon future by reducing the use of non-renewable materials.

Canada's sustainably managed forests have been a major part of our history. As this report makes clear, they are also crucial to our future.

The Honourable Seamus O'Regan
Minister of Natural Resources

Canada's forests: Managing for the future

Forests in Canada are managed for a variety of economic, ecological, and social benefits for both current and future generations.

Treaty/settlement lands are owned and managed by a First Nation, Métis, or Inuit authority. In addition to their rights on these lands, these authorities generally also have specified non-exclusive rights in a broader area defined in the treaty, settlement, or final agreement.

Indian reserves are Crown lands that have been "set apart by Her Majesty for the use and benefit of a band" under the *Indian Act*.

Federal reserves include military bases and training areas and other lands owned by the federal government. Forestry is rarely the primary management objective on these lands.

Private forests range from small family-owned woodlots to large woodlands owned and managed by forest companies. These forests are managed for various purposes, including commercial timber supply.

Other forest lands are areas that do not fit into any of the other categories. Fire suppression often occurs in these forests and there may be local use of forest resources.

Restricted areas are managed for a wide variety of special purposes, ranging from wildlife values in some, to mining in others.

Protected areas sustain natural and cultural heritage and conserve biodiversity. Forest management activities, such as prescribed burning, may occur.

Non-forested land
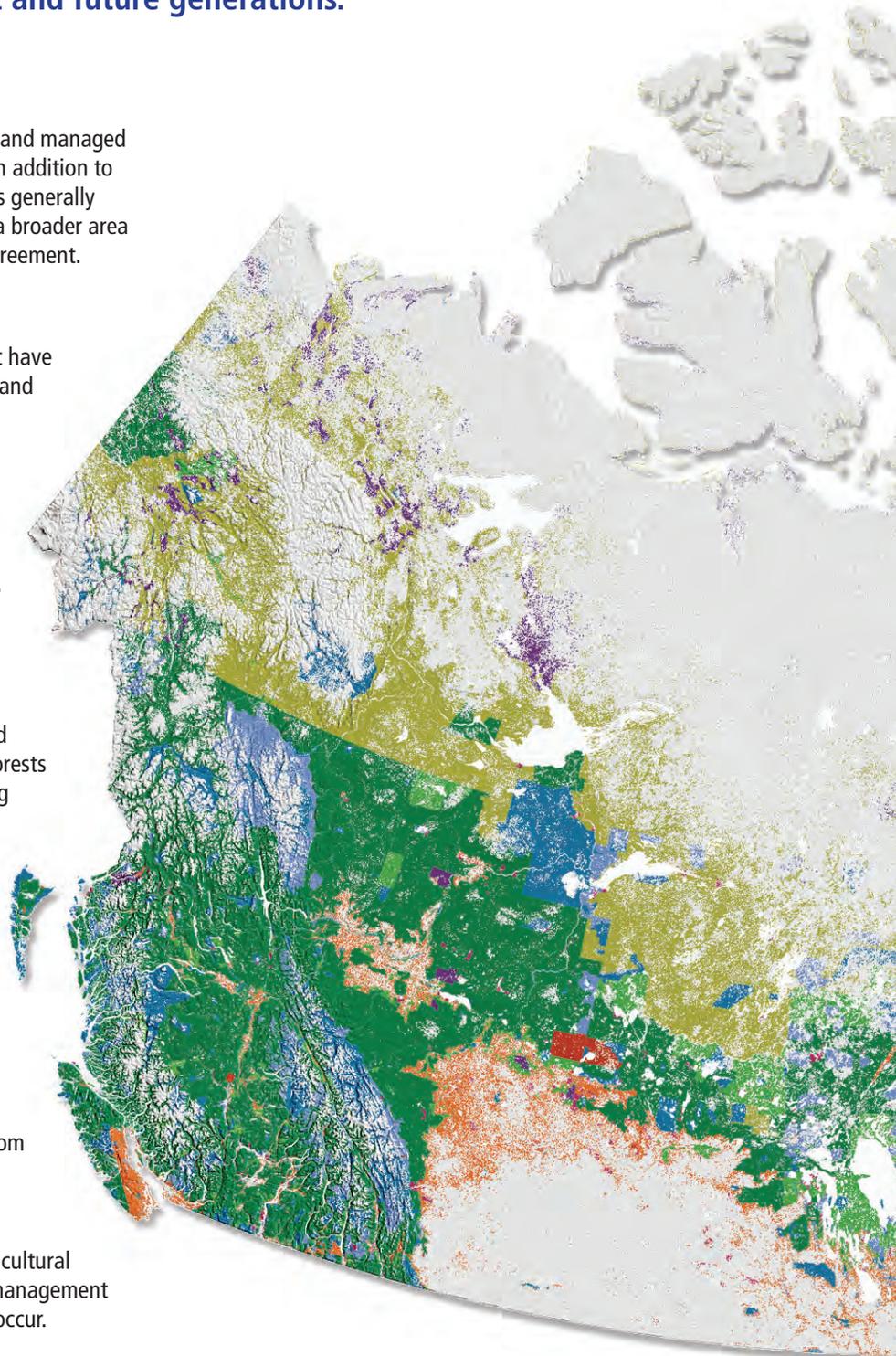
The map data and metadata can be found online at https://open.canada.ca/data/en/dataset/ d8fa9a38-c4df-442a-8319-9bbcbdc29060. A description of the mapping methodology is published in The Forestry Chronicle, and can be fount at https://doi.org/10.5558/tfc2019-017.

Short-term tenure areas are the areas where volume- or area-based tenure arrangements of less than five years, or cutting permits, are granted. These areas are primarily managed for commercial timber harvesting.

Long-term tenure areas are the areas where volume- or area-based tenure arrangements of more than five years are in place. These areas are primarily managed for commercial timber harvesting.

What are tenure areas?

Tenure is how governments allocate harvest rights and management responsibilities for timber on Crown land. Ninety percent of forests in Canada are on provincial or territorial Crown land, and these contribute 84% of Canada's commercial timber supply. Some tenure arrangements grant access to a specified volume of timber, while others grant access to timber resources in a specified area; therefore, tenures may overlap or only apply to certain types of timber within a designated area.

Note: This map does not indicate the managed forest for the purposes of reporting on greenhouse gas emissions to the United Nations Framework Convention on Climate Change. For more information, see the sustainability indicator **Carbon emissions and removals**.

Canada is a leader in sustainable forest management

Canada's forests are vast and well-managed

Canada is the third most forested country in the world, with

347 million ha

of forest land (2017).

Canada has

164 million ha

(47%) of forests certified to third-party standards of sustainable forest management – more than any other country (2018).

Nearly

30 million ha

(or about 9%) of Canada's forests are in legally established protected areas (2016).

Forest area and area certified for the five most forested countries

Country	Total forest area	Area certified
Russia	815	57
Brazil	494	8
Canada	347	164
United States	310	39
China	208	7

Millions of hectares

■ TOTAL FOREST AREA ■ AREA CERTIFIED
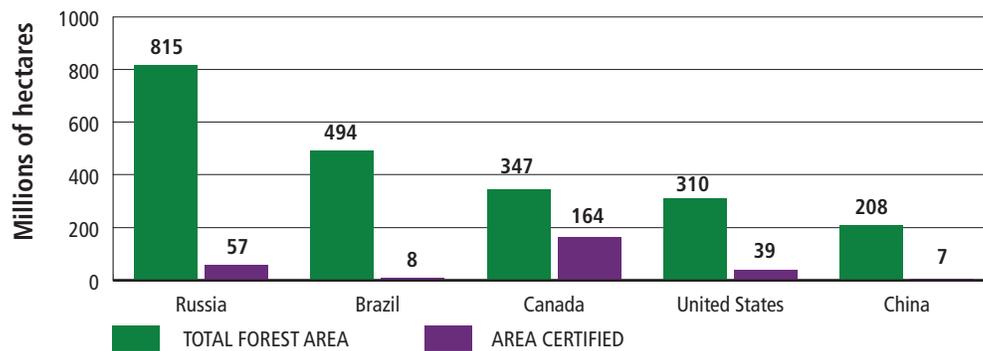
Canada's forests provide many non-timber benefits

Canada produces nearly

71%

of the world's maple syrup (2017).

Over

90%

of Canada's forests are publicly owned.

Over

300

bird species can be found in Canada's boreal forest.

Canada's forests are shaped by dynamic processes

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

Disturbance	Area (ha)	Percent of forest area (%)
Area impacted by insects (2017)	15,628,659	4.5%
Area burned (2018)	2,272,274	0.7%
Area harvested (2017)	755,884	0.2%
Area deforested (2017)	35,385	0.01%

Canada's forest land (2017)
347,039,050 ha
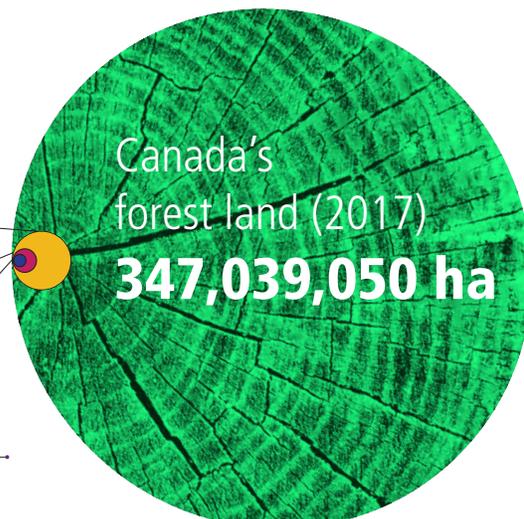
Canada's forests are important to the economy

The forest industry directly employed

210,615
people (2018).

11,565
Indigenous people (2016).

23,315
immigrants (2016).

The forest industry contributed
$25.8 billion
(1.2%) to Canada's gross domestic product (2018).

The forest sector is a major contributor of jobs and income in about
300 communities (2016).

Women in forestry

Graduation from agriculture, natural resources and conservation programs

Percentage (y-axis: 0, 20, 40, 60, 80, 100)
Years (x-axis: 2000, 2005, 2010, 2015)

Forest industry employment

Percentage (y-axis: 0, 20, 40, 60, 80, 100)
Years (x-axis: 2000, 2005, 2010, 2015)
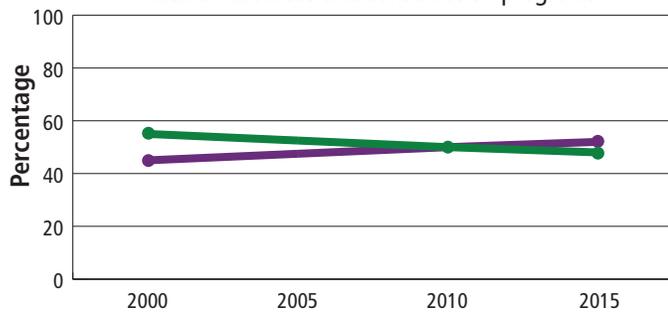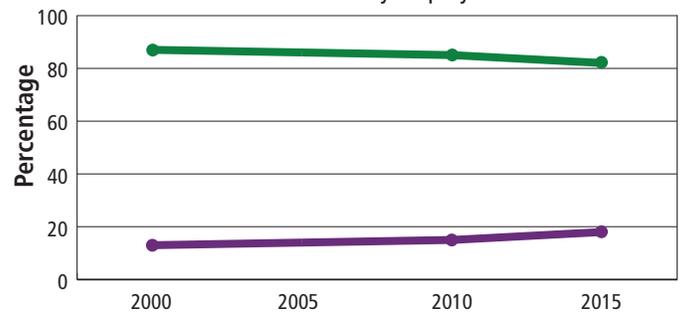
— Men   — Women

Canada's forests contribute to a low-carbon economy

Biomass
is the second-largest source of renewable electricity after hydro (2016).

85% of Canada's
bioenergy
comes from forest biomass (2016).
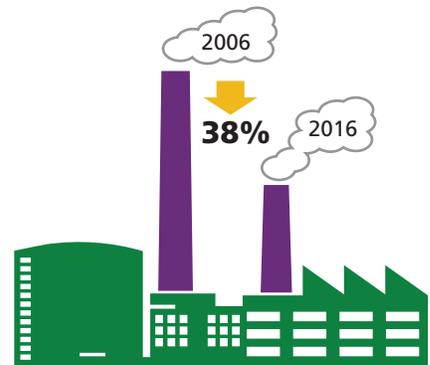
2006
38% 2016

Between 2006 and 2016, the forest industry reduced total
fossil GHG emissions by 38%.

The "second life" of trees support a low carbon future

Whether as a standing spruce tree or a vaulted ceiling, Canada's forest resources play an important role in the management of carbon emissions and removals.

When thinking about Canada's forests, most people think of endless vistas of conifers and stands of fiery maples absorbing carbon dioxide from the air and storing it in the tree's wood. But the truth is, carbon storage does not only occur in growing trees. Once a tree is harvested, its second life as a forest-based product begins. Because products manufactured from forest biomass continue to store carbon, both the living trees *and* the forest products we create from them have the opportunity to contribute to a low-carbon future in Canada.

> **Carbon storage occurs when carbon dioxide is "captured" from the air and stored within something, such as the wood of a tree. This wood then becomes a "carbon sink."**

Storing carbon in long-lived forest products

Strategic use of forest resources means that carbon can be stored in forest products for decades. For example, 2x4 dimensional lumber beams are used in 90% of new single-family houses in North America. As well, cross laminated timber – consisting of three to seven layers of lumber glued together to create structural panels with exceptional strength and stability – are essential for tall wood building construction. These forest products store carbon for the duration of their lives, so a combination of sustainable forest management and strategic use of forest products means that carbon is stored for as long as possible.
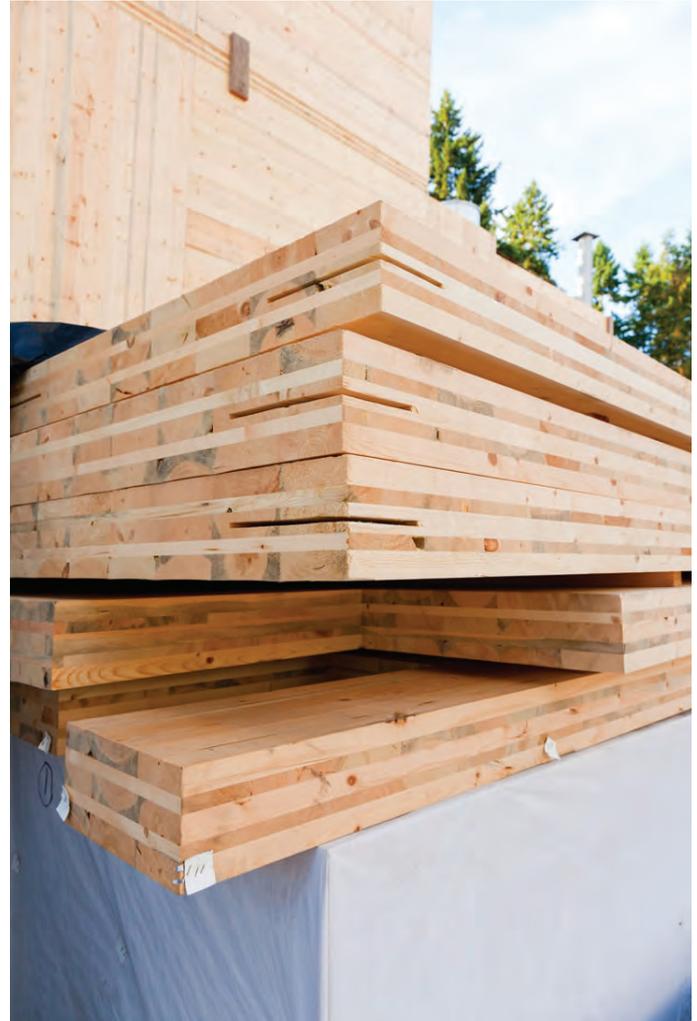
Cross-laminated timber panels.

What is the bioeconomy?

In the bioeconomy, renewable and sustainably sourced biomass resources are used to provide a greater range of consumer and industrial products to society. The biomass comes from trees, agricultural crops and organic residuals from harvesting and timber processing. Potential products range from food additives and textiles to construction materials, auto parts, bioplastics, biochemicals, and fuel for vehicles and planes.
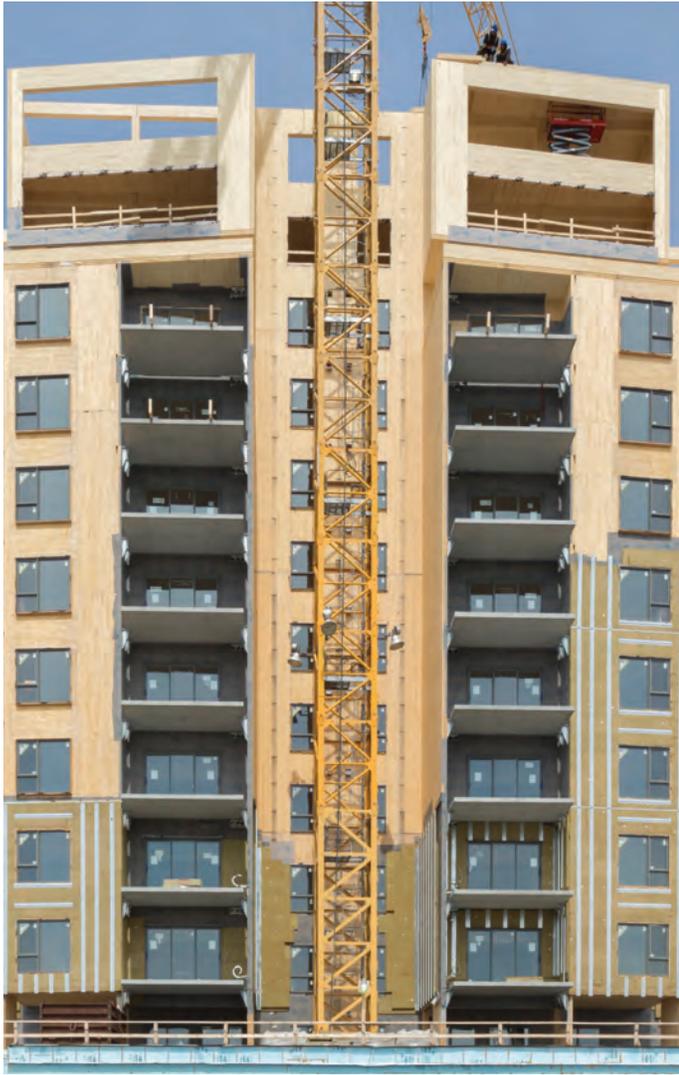
A 13-storey residential tall wood building in Quebec City's Pointe-aux-Lièvres eco-district.

Replacing non-renewable resources

Products from sustainably managed forests also contribute to a low-carbon future by replacing carbon-intensive, non-renewable construction materials. For example, glued laminated timber (glulam) is a structural engineered wood product that can reduce the need for traditional construction materials such as steel and concrete. Remote communities can use local forest biomass from nearby harvest areas or from forest thinning activities undertaken to reduce forest fire risks to produce heat and electricity and offset the amount of fossil fuel historically brought into the community.

Finding a use for every part of the tree

Canadian forest sector companies strive to find a use for every part of the tree and in doing so help to grow Canada's bioeconomy. For example, sawmills generate residues in the form of wood chips or sawdust. These residues are valuable and can be processed into panels, paper products, or wood pellets, for both domestic use and international export. In fact, the forest industry is a leader in finding new ways to use forest biomass to offset greenhouse gases (GHGs) and add value to the Canadian economy. These efforts have contributed to a 38% reduction in total fossil GHG emissions from the forest industry between 2006 and 2016.

With the combination of long-lived and innovative wood products and forest management activities, Canada's forest sector has the potential to reduce CO_2 emissions by 50 million tonnes annually by 2050. That is how Canada's trees contribute to a green future, both inside and outside the forest.

Waste sawdust and wood chips from sawmills can be used to create panels, paper, or wood pellets.

Transparent wood, 3D printing, and stealth technology

Canadians live surrounded by traditional forest products, whether it is construction lumber, mulch in the garden or paper coffee cups. However, Canadians might be surprised to learn that scientists and entrepreneurs are increasingly using forest biomass in items such as cellphone screens, concrete blocks, and batteries. These non-traditional uses are growing and strengthening Canada's bioeconomy.

Transforming waste into high-value materials

Innovative forest-based materials, created by using cutting-edge science and creative thinking, are increasingly available commercially as alternatives to traditional, non-renewable materials. Looking for ways to grow the added value of their supply chain, the pulp and paper industry is keenly interested in the conversion of their waste products into specialty products.

For example, lignin is a component of wood fibre that is separated out during the pulping process. It can be used to create densified wood that is as strong as steel or transparent wood that is stronger and more insulating than glass. Of significant note, lignin, after cellulose, is the most abundant renewable carbon source on Earth. Lignin can also be used to make new products such as carbon foam – a strong, lightweight material capable of absorbing sound and radiation, which can be used for aircraft and ship insulation, wall panels and stealth technology.

3D printing with wood

The opportunities for innovation are not only at the end of the supply chain. One company in British Columbia, Advanced BioCarbon 3D (ABC3D), is increasing the utilization of biomass from harvested sites. ABC3D uses biomass that is not considered traditionally to be of commercial value and is usually left in the forest (e.g. branches and small hardwood trees). ABC3D processes the biomass into wood chips, then extracts resin from the wood. The biomass remaining after the resin extraction is processed into a bioplastic polymer. The resin and polymer are then recombined using proprietary technology to create a strong, lightweight bioplastic that can then be used in 3D printers. In a 3D printer, the bioplastic is heated and extruded through a nozzle, depositing layer after layer of bioplastic until it forms a complete three-dimensional object.
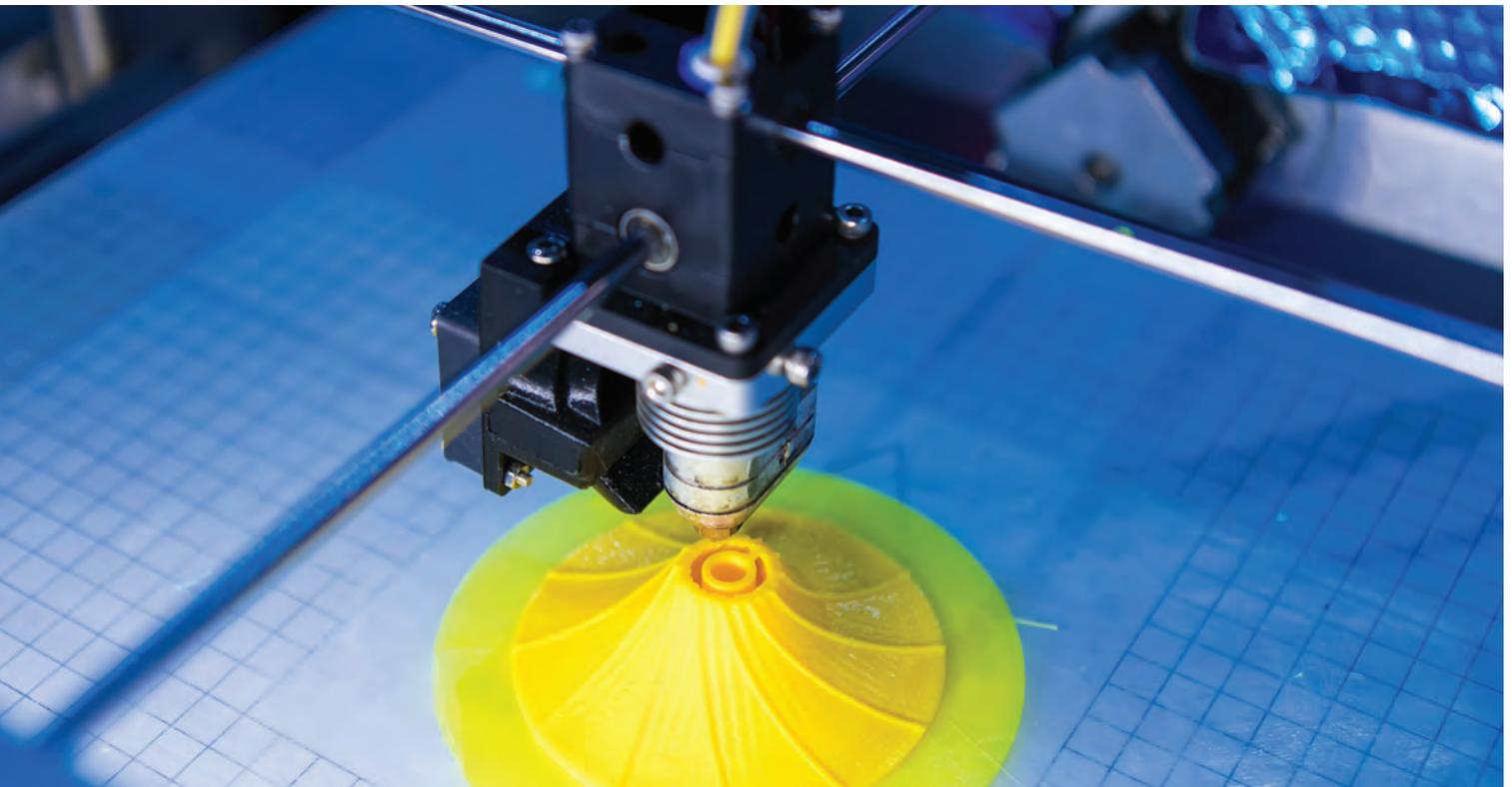
In a 3D printer, a strand of filament (yellow) is heated and extruded through a nozzle to create three-dimensional objects. Filament can be made from wood-based bioplastic.

An engineered wood fibre mat could replace fibreglass components in cars.

CEO Darrel Fry envisions a future where his company can create several types of filaments with different properties, such as carbon fibre-reinforced filament or conductive filament. "Our company is proving that from wood we can make sustainable, economical, high performance plastics," says Fry. "There's such high heat resistance and it's also very strong."

Continuing innovation

Many exciting new forest-based products are in the development and testing phases, ready to scale up and enter the market. TTS of Edmonton, Alberta, has produced the world's first engineered wood fibre mat to replace fibreglass components in cars. Origin Materials has repurposed a rubber plant in Sarnia, Ontario, to produce one component of traditional plastic soda bottles from biomaterials such as cardboard and sawdust. And in Port Cartier, Quebec, Bioenergy AE Côte-Nord Canada is building the world's first commercial facility to convert sawmill residue into 40 million litres of renewably sourced heating oil per year.

The forest sector is evolving, providing new ways for forests to benefit all Canadians. Increasing innovation in the sector is producing new renewable and sustainable bioproducts, such as carbon foam, bioplastics and biocrude, which are all part of diversifying the forest sector and expanding the bioeconomy.

Biomaterials such as cardboard and sawdust can be used to create bio-polyethylene terephthalate (bio-PET), a component in traditional plastic soda bottles.

Urban forests: a connection through time

Urban forests increase our quality of life by promoting mental well-being and encouraging physical activity. They reduce air pollution, cool temperatures in the summer and protect biodiversity. Urban property values increase with more trees, and neighbourhoods benefit from increased shade and beauty.

Venerable trees provide a tangible connection through generations.

But urban forests also serve Canadians as a connection through time – linking our past with our future.

Legacies of bygone eras

Forests Ontario's mission is "to be the voice of Ontario's forests." They launched the Heritage Trees program in 2009 in partnership with the Ontario Urban Forest Council. Through the program, Forests Ontario collects and tells the stories of unique trees in Ontario, highlighting their social, cultural, historical and ecological value to Canadians. For a tree to qualify as a Heritage Tree, it must be associated with a historic person or event or be growing on historically significant land. One such tree is a 225-year-old sycamore *(Platanus occidentalis)* in Windsor, Ontario, dating from before the War of 1812. According to Forests Ontario, the tree "is older than the city [of Windsor] itself, making it a symbol of health and prosperity for the region."

These venerable Heritage Trees across Ontario serve as visual and emotional anchors to our historical roots. Andrea Bake is a Program Standards and Development Officer for the City of Toronto. Bake says she feels most connected with her ancestors when she can visit something that was around while they were – something they may have touched, seen or visited. In a southern Ontario context, she says, "these are the ancient trees that have stood guard through the passing of time."

Weathering the storms – together

Trees represent a shared cultural history – and also strengthen a community's identity. John Simmons is a retired urban forester who worked for the Halifax Regional Municipality in Nova Scotia for 34 years. He recalls that in 2003, Hurricane Juan ripped through the city with wind speeds of 160 kilometres an hour. Afterwards, 70% of trees in Halifax's renowned 75 hectare Point Pleasant Park were gone. "People were emotional," says Simmons. "They were teary-eyed as they came in." The park was initially closed for safety reasons, but because the community was so devastated, Simmons and his team opened a path at the bottom of the park and let residents in to see for themselves the damage Juan had done. The municipality wanted citizens to be included and to understand why restoring the urban forest would take time. The team then dedicated themselves to restoring – and improving – Point Pleasant Park. Now, planting of strategically placed evergreen conifers and leafy deciduous trees has made the park more resilient in the face of extreme weather events. And Halifax residents can continue enjoy the beauty of this historic park, as they have for over 150 years.

Urban forest in Montréal, Quebec.

Shaping the urban landscape

Across Canada, community residents are working together to create future urban legacies. One inspiring example of leadership and collaboration in urban forestry can be found in Montréal, Quebec. In 2012, the municipality set a goal to increase its urban tree canopy from 20% to 25% by 2025. To help achieve this goal, 40 local and national corporations and community partners banded together to create the Alliance forêt urbaine, which has set its own target of planting 50,000 new trees and plants by 2022. The Alliance forêt urbaine organizes various initiatives around Montréal, tailored to local environments, which encourage and engage residents to participate in re-shaping their neighbourhoods. One such initiative offered urban-friendly trees at a discounted rate to encourage Montréal residents to increase the tree cover on their own properties. Through that campaign alone, more than 9,000 trees have already been planted and are now contributing to a greener future.

Inspiring the next generation of urban forest stewards

Several initiatives across Canada are designed to provide younger generations with the knowledge and passion to promote and protect their urban forests for the future. Dr. Stephen Sheppard works at the University of British Columbia (UBC) – the first university in Canada to offer an undergraduate degree in Urban Forestry. To teach Canadian youth about the importance of a green urban environment, Sheppard designed a video game called Future Delta 2.0. The video game is set in the real-life town of Delta, British Columbia, in 2100. Players must navigate a dystopian Delta ravaged with potential effects of climate change. "Hotspots" (localized heat islands) exist in areas without

a healthy tree canopy, where drought and fire are real risks. Free to download, Delta 2.0 proved to be so popular that a second game, Our Future Community, is also being developed in collaboration with local high school teachers. Sheppard's team hopes that the Future Delta 2.0 game will "motivate interest, learning, behaviour change and civic engagement" – much like the Citizen's Coolkit on Climate Change & Urban Forestry. Also developed by UBC, the Coolkit helps local residents better understand the values of green spaces in the city (such as parks, streets and backyards). The guide also provides "a new way of reading and understanding landscape" in order to translate individual ideas into neighbourhood-wide actions.

Trees in our urban forests are the unbroken link between our past and our future. By preserving, protecting and promoting urban forestry, Canadian urban landscapes will continue to flourish and provide Canadians with benefits for generations to come.
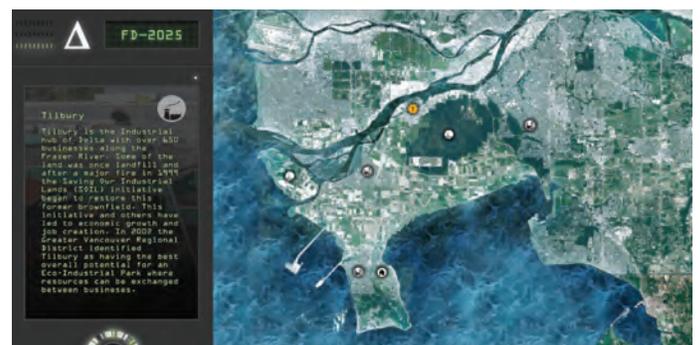
Screenshot of the Future Delta 2.0 video game developed by a team at the University of British Columbia.

Women championing women in forestry

Women are still under-represented in forestry – but here are six women working to change that.

Katrina Van Osch-Saxon:
Increasing enrollment in forestry programs

Professor Katrina Van Osch-Saxon started teaching at Fleming College's School of Environmental and Natural Resource Sciences (located on Frost Campus in Kawartha Lakes, Ontario) in 2012 – and immediately noticed that women were greatly under-represented in the programs. Van Osch-Saxon thought that a root cause may be a lack of awareness about the diversity and breadth of opportunities in forestry-related industries. Even growing up working in arboriculture with her father, Van Osch-Saxon didn't really realize the potential career opportunities for herself. So, in 2016 she spearheaded the "Women In Trees" event at Fleming College's Frost Campus. There representatives from urban forestry, forestry, and arboriculture industries spoke to female students – as well as the general public – about opportunities available to them in tree-related careers.

Van Osch-Saxon started Women In Trees as a one-time initiative, but the event was so successful and received so enthusiastically that she hosted it again in 2017 and 2019. Van Osch-Saxon has had students tell her that it was the Women In Trees event that led them to enroll in one of the forestry programs at Fleming. In fact, her colleague Joanna Hodge, a professor in the School of Environmental and Natural Resource Sciences at Fleming College, was also inspired by Van Osch-Saxon's success. Hodge organized her own inaugural "Women In Rocks" event, designed to highlight the opportunities for women in earth sciences. Keeping in the spirit of "women helping women," Van Osch-Saxon and Hodge plan to continue to build on their respective successes by amalgamating their areas of passion under the umbrella "Women in Natural Resources" (WINRS). WINRS will take place in the spring of 2020 at Frost Campus, where several programs have planned activities to showcase potential career opportunities for women in natural resources.

Cindy Shaw and Dr. Nicole Heshka:
Mentoring the next generation of role models through truth and reconciliation

The SINEWS bursary program got its name from its mandate: Sistering Indigenous and Western Science. Inspired by women mentors throughout their own careers, Natural Resources Canada researchers Cindy Shaw and Dr. Nicole Heshka created the one-year pilot bursary program by combining two of their passions: increasing opportunities for women and improving Indigenous relations.

Applicant teams consist of two women – one Indigenous and one non-Indigenous – competing for a $12,000 bursary. Applicants must demonstrate that their scientific project is consistent with public Indigenous interests and is in an area relevant to forestry and other areas of Natural Resources Canada's research mandate. Shaw and Heshka believe that by integrating different experiences and perspectives "women can play a significant role in truth and reconciliation between Canada's Indigenous and non-Indigenous communities." They also believe the integration can create more opportunities and support for women in science. The researchers were shocked at the large response: 74 applications for the bursary from across Canada. The SINEWS team ultimately awarded the bursary to 16 students (i.e. 8 pairs).

The concept of increasing mentorship opportunities for women in natural resources is close to both Shaw's and Heshka's hearts. "Ultimately, we want these students to go back to their communities and be role models, mentors, and/or inspirations to other women in the community," says Shaw. Adds Heshka, "I was lucky to have incredible mentors and role models throughout my studies and professional career, which gave me the strength to stand up for myself and succeed. We want to continue building that mentorship capacity in the younger generation of women."

Tanya Wick:
Re-imagining the forest industry

Tanya Wick is Tolko Industries Ltd.'s first female vice-president, and she says she did it by being unabashedly confident. For Wick, career success is "not about using your masculine traits to become 'one of the guys;' it's about incorporating women's ideas and ways of thinking into the business. I encourage women not to be afraid of doing things your own way – believe in yourself and get your ideas out there."

Wick has become an outspoken champion for diversity and inclusion in the forest industry. She has focused on changing the mindset that it is not a place for women while also advocating for greater career development opportunities for women. Wick believes that women shouldn't be promoted simply because they are women, but because the industry wants to attract and retain the best and brightest. To do that, Wick believes, the industry should strive to ensure that women who have great skills and ability are promoted and seen as role models for the industry. Wick puts her money where her mouth is. To date, she has helped launch Tolko's Women in the Workforce Strategy, joined the National Steering Committee for Gender Equity in Canada's Forest Sector, and was awarded the Forest Products Association of Canada (FPAC) Women in Forestry Award of Excellence in 2018.

Lacey Rose and Jess Kaknevicius:
Forging connections and enhancing support

After repeatedly finding themselves in the minority at forestry events, Lacey Rose and Jess Kaknevicius joked about starting an official "club" for women in forestry. A few years later, Rose and Kaknevicius launched Women In Wood (WIW). WIW was started in 2015 as a networking group for women "who work in, with and for the woods." Since then, the Facebook group has grown to almost 1,000 women across Canada, the United States and beyond, and WIW has organized and attended numerous forestry networking events.

Rose and Kaknevicius say that the phenomenal success of this group is due to the passion and rapport within the community of women who have come together to offer support, share stories, mentor each other, and ask questions. Both staunch advocates of increasing the number of women in forestry, Rose and Kaknevicius say that they are personally uplifted by the connections. Rose recalls one memorable discussion about working alone in bear country, when an outpouring of advice and support from other women in WIW alleviated a new forester's anxiety. "How many women before her have called it quits because they did not have anyone to discuss with?" wonders Rose.

In 2016, women represented **17%** of people employed in the forest industry, a **1.5% increase** since 2001.

Sustainability indicators

Canada's rich forest ecosystems are renewable resources that contribute to the quality of life of all Canadians. They offer significant environmental, social and cultural benefits, as well as opportunities for sustainable economic development.

Forests are an essential part of the solution to many global challenges. The ability of forests to mitigate the effects of climate change, provide renewable products and energy, support high-paying jobs, and contribute to a greener economy has received increasing attention. At the same time, climate change and extreme weather events affect Canada's forests and those communities that depend on forests.

Careful monitoring demonstrates sustainability

Because of their importance, Canada's forests need to be carefully monitored to ensure that any challenges to their health are addressed. Canada recognizes the need to balance in a holistic way the demands placed on its forests, so that current and future generations of Canadians can fully benefit.

Sustainability indicators are helpful tools to assess our forests and the benefits they provide. When measured over time, they:

- 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

Using internationally agreed-upon indicators helps contribute to global forest reporting

Canada is a member of the Montréal Process, an international working group of 12 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, together with information in the Statistical profiles section, reveal the state of and trends in Canada's forests and forest practices over time. These indicators are comparable to sustainability indicators published by other countries participating in the Montréal Process. Canada also uses some of these indicators to report on the United Nations Sustainable Development Goals.

Demonstrating a flow of benefits in a changing environment

These indicators 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 climate change and other emerging issues.

Canada has many years of experience with sustainable forest management. Even as economic, environmental and social circumstances change, Canada will continue to manage forests to provide a broad range of benefits. Similarly, Canada's trading partners can feel confident that the Canadian forest products come from sustainably managed sources with strong environmental performance.

Two new sustainability indicators

This year, two new indicators have been included in this report: Forest area within protected areas (page 23) and Forest area with long-term management plans (page 28). These indicators help to better demonstrate Canada's progress toward sustainable forest management. Collaborative data collection initiatives between the federal, provincial and territorial governments, such as the National Forestry Database, help ensure consistent national data are available to support reporting on these and other indicators in this report. This, in turn, helps support science-based decision making, research and program delivery.

Source: 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 forests cover 347 million hectares (ha) of land and make up nearly 9% of the world's total forest area. Canada is the third-most forested country in the world by area. With nearly 10 ha/person, Canadians enjoy more forest area per person than most other countries in the world, over 17 times the world average.

How much of Canada is forest?

■	Freshwater area	**8.9%**
■	Forest area	**34.8%**
■	Non-forest land	**56.3%**

What is the composition of Canada's forests?

■	Coniferous	**67.8%**	■	Mixedwood	**15.8%**
■	Broadleaf	**10.5%**	■	Temporarily non-treed	**5.8%**
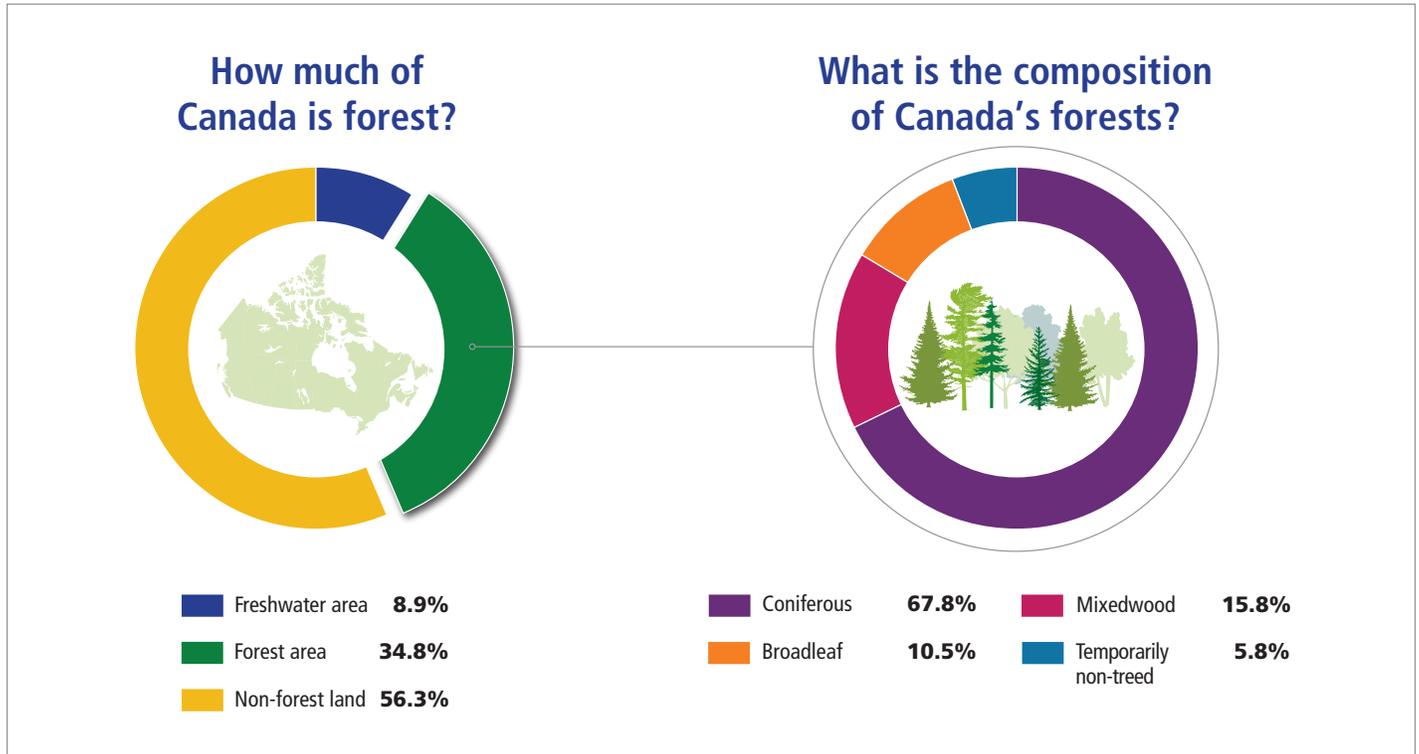
What is a forest?

Canada uses the Food and Agriculture Organization of the United Nations' definition of forest for the purposes of national forest inventory reporting:

- 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 at maturity

Land that is predominantly urban or used for agricultural purposes is not counted as forest.

A forest that has been harvested is still a forest

Forest land that temporarily has no trees is still considered to be forest when the disturbance's impact is known to be temporary, and trees are expected to grow back. This situation occurs, for example, after a natural disturbance such as fire or after harvesting. Changes in forest area result from:

- **afforestation** – the deliberate establishment of forests on lands previously not forested
- **deforestation** – the permanent clearing of forests to make way for new, non-forest land uses

Of the 0.01% of Canada's forest lost to deforestation each year, the causes are (2017):

Mining, oil and gas
37%

Agriculture
35%

Built-up
18%

Hydroelectric
6%

Forestry
4%

Indicator: Forest area

Canada has 347 million hectares (ha) of forest area (2017). From 1990 to 2017, Canada's total forest area decreased by less than half of 1%.

- Between 1990 and 2017, the area of forest in Canada's northernmost ecozones remained almost unchanged (0.0 to 0.1% loss of forest area over a 27-year period). In these ecozones, forests are remote and sparsely populated.

- The highest deforestation rates over the past 27 years have been in the Prairies (6.5% forest area loss since 1990), Mixedwood Plains (2.0%) and Boreal Plains (1.5%). In these three ecozones, the leading cause of forest area loss has been the conversion of forest to agricultural land.

- As shown in the figure below, in most ecozones there has been virtually no detectible deforestation over the past 27 years.

Canada's forest area, by ecozone

The following ecozones do not appear on the graph:

| | 1990 | | 2017 | | Arctic cordillera | | Northern Arctic | | Southern Arctic |
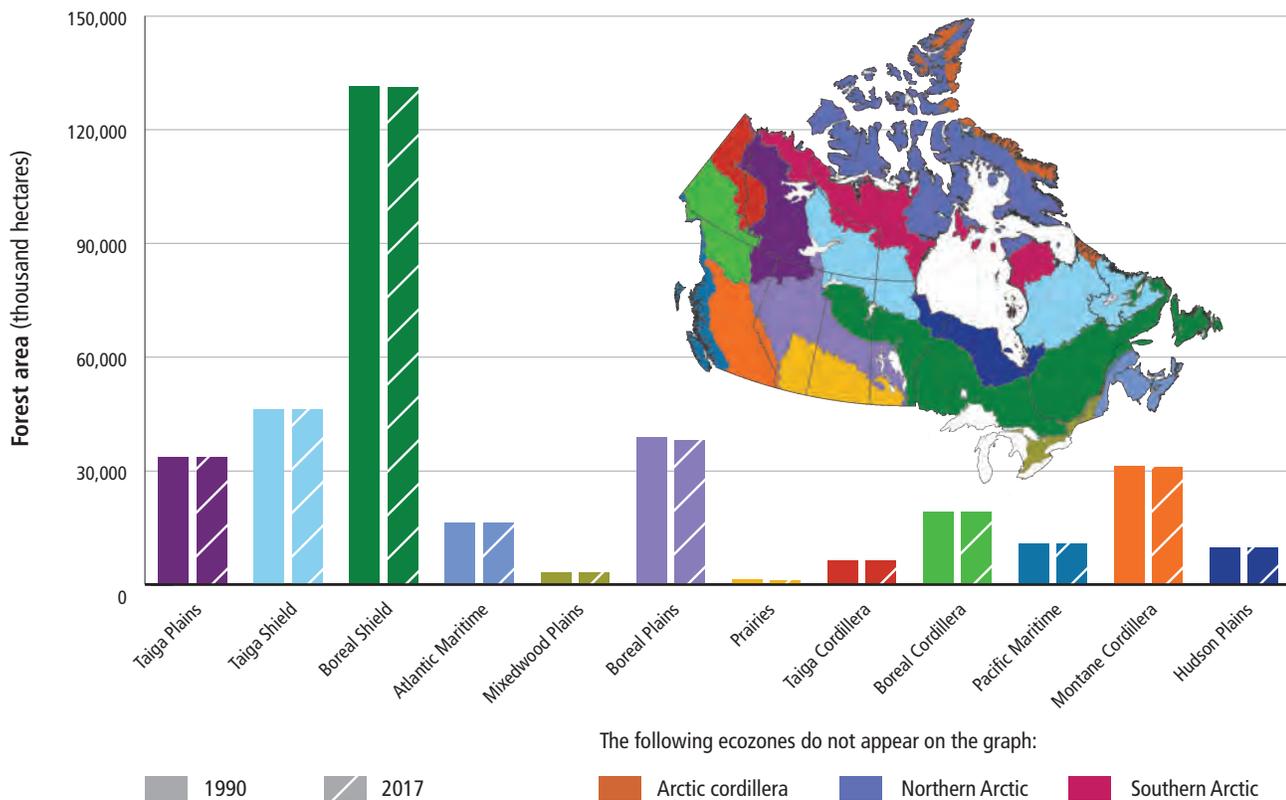
Why is this indicator important?

- Knowing where and why permanent losses and gains in forest area occur is important for managing forests sustainably.
- Permanent changes in forest area affect forest resources and can influence wildlife, biodiversity and ecosystem services, which include air and water purification and carbon sequestration.

What is the outlook?

- With a low rate of deforestation and a strong commitment to sustainable forest management practices, Canada's forest area is expected to remain stable over the near-term.
- Climate change could affect the extent of Canada's forest area over the longer term.

Indicator: Deforestation and afforestation

Canada's low annual deforestation rate has declined even further over the last 27 years, dropping from 64,000 hectares per year (ha/yr) in 1990 to about 35,000 ha/yr in 2017.

- Between 1990 and 2017, 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.
- Spikes in deforestation occur when large forest areas are flooded during hydroelectric reservoir development, as seen in 1993 and 2006 (see the following figure).

- Although urban and rural tree 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.

> The National Deforestation Monitoring System (NDMS) tracks changes from forest land to other land uses across Canada. Deforestation does not include forest harvesting activities where the forest will be regrown.

Estimated area (hectares) of annual deforestation in Canada, by industrial sector, 1990–2017
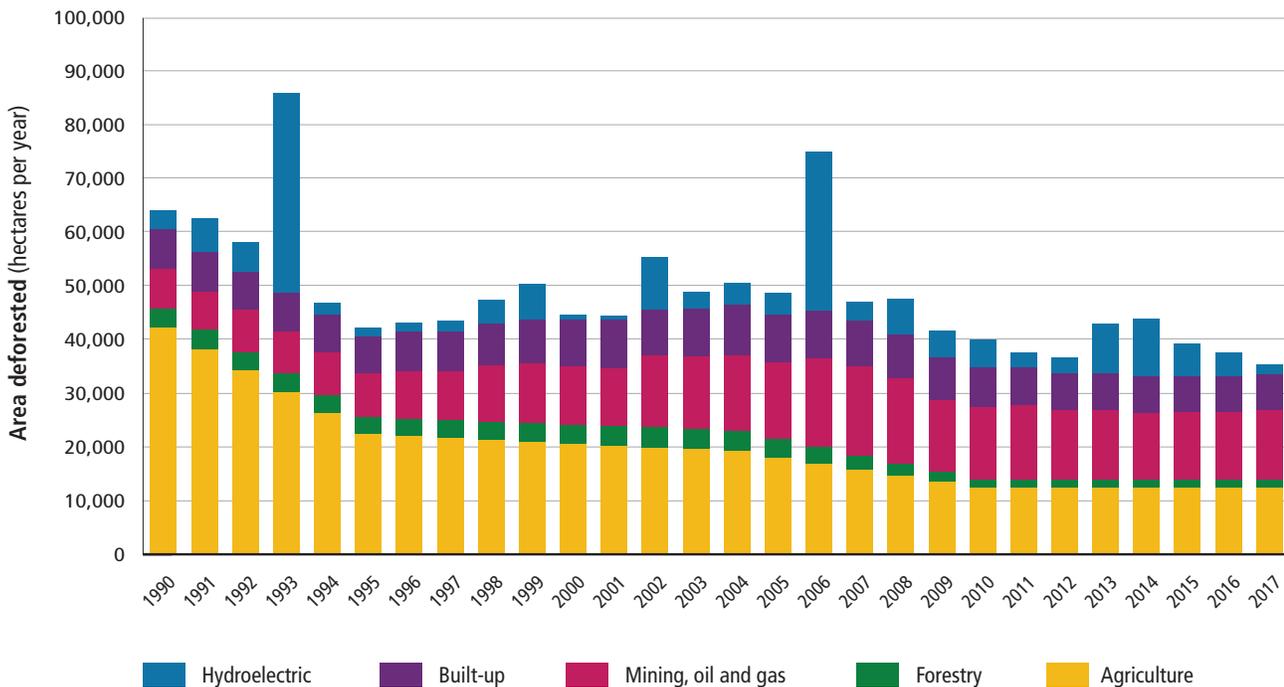
Why is this indicator important?

- Forest loss affects biodiversity, soil, air and water quality, and wildlife habitat.
- Forests store more carbon than many other ecosystems and can be managed to help mitigate climate change.

What is the outlook?

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

Indicator: Wood volume

Canada's forests contain an estimated 45 billion cubic metres of wood.

- To remain stable, wood volume gains from forest growth and regeneration must offset losses from human-caused disturbances (such as harvesting or deforestation) and natural disturbances (such as forest fires, windstorms, diseases and insect infestations).
- Volume decline between 1990 and 2016 is primarily due to natural disturbances.
- From 1990 to 2016, the area of forest affected by fire and insects was 20 times greater than the area affected by harvesting and deforestation.

> Wood volume includes the volume of all forest stands regardless of ownership, age class, protection status and whether or not the stand is managed for timber.
>
> Volume estimates are based on the main tree stem, excluding bark but including the stump and the top as well as defective and decayed wood.

Estimated wood volume (million cubic meters) in Canada

Year	1990	1995	2000	2005	2010	2015	2016
Wood volume	47,625.38	47,608.26	47,320.47	45,996.79	45,509.42	45,143.84	45,107.59

Why is this indicator important?

- Trends in wood volume provide an indication of overall forest health and productivity.
- Along with other information, wood volume is used to calculate forest biomass and carbon stocks.
- Wood volume production rates are one of the inputs used to determine sustainable harvest levels on land managed for timber production.

What is the outlook?

- Wood volume may take years or decades to recover in regions affected by especially large or severe disturbances, depending on the extent of mortality caused by the disturbances and on the rate of forest recovery.
- Climate change is affecting forest disturbance patterns and tree growth rates. Future trends in the change of wood volume will depend on how forests adapt to climate change and on how management practices are adapted.

Source: Kurz, W.A., Dymond, C.C., et al. 2009; National Forest Inventory; National Forestry Database. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

# Indicator: Forest area within protected areas

The forest area within protected areas has increased over the past two decades with the establishment of new parks and protected areas.

- Forest area within protected areas has more than doubled from 13.5 million hectares (ha) in 1990 to 29.5 million ha in 2016 through the creation of new protected areas.
- Forests within protected areas are dynamic, living ecosystems that are made up of young to old growth stands. Forest structure and species composition go through natural changes, such as those that occur following natural disturbances such as fire.
- Of Canada's forest area, 8.5% occurs within protected areas.
- This is a new indicator for *The State of Canada's Forests Annual Report*.

- **Protected areas play a critical role in Canada's efforts to conserve nature.**
- **Tracking the forest area within protected areas provides an indication of long-term planning to conserve these important ecosystems.**
- **The establishment of protected areas goes hand in hand with sustainable forest management in the surrounding landscape.**

Forest area within protected areas (thousands of hectares) in Canada

Year	1990	2000	2010	2015	2016
Forest area	13,546	18,174	28,206	29,507	29,507

Why is this indicator important?

- Forests provide habitat for the majority of Canada's terrestrial plant and animal species. Many forest species do well in a landscape where sustainable timber harvesting occurs while others require habitat that has not been affected by human activities (e.g. timber harvesting, road building). The establishment of protected areas and connectivity between them is therefore an essential part of land management planning.
- Canada committed to conserve 17% of its terrestrial areas and inland water by 2020 – and forest areas within protected areas make up a part of this conservation landscape. As we achieve this goal, it is important to track which terrestrial ecosystems are being protected to ensure all ecosystems are adequately represented.

What is the outlook?

- The forest area within protected areas will increase as new protected areas are established. In 2018, the government of Canada announced $1.3-billion to establish and enhance protected areas in Canada. Many of these new protected areas will occur in Canada's forests. As part of this effort, the registry of protected areas will be enhanced to recognize all areas with conservation measures that maintain native plants and animals. Forest inventory data will be used to characterize the forests in the new protected and conserved areas that are established.

Is timber being harvested sustainably?

Forests all over the country are harvested sustainably. Across Canada, all forests harvested on public lands must be regenerated – it's the law. This ensures that our forests remain healthy and that the forest industry can continue providing Canadians with benefits.

This law is the reason that a disproportionally high percentage of the world's certified sustainably managed forests are in Canada. Indeed, although Canada is home to 9% of the world's forest, it is also home to 36% of the world's certified sustainably managed forests.

Ensuring sustainability over the long term

Provincial and territorial governments are responsible for forest management because the vast majority (about 90%) of Canada's forests are located on provincial and territorial Crown lands. The individual government determines the annual level of harvest allowed on a particular area of Crown land, called allowable annual cut (AAC).

Because Crown lands harvested for commercial timber must be regenerated, either naturally or by planting and/or seeding, each province and territory has implemented regeneration standards and regulations. The standards address various aspects, including species composition, density and stocking levels.

> Only a very small portion of Canada's forest is harvested each year. Of Canada's 45 billion cubic metres (m³) of standing wood volume, about 0.3% (155.2 million m³) was harvested in 2017.
>
> In 2017, British Columbia accounted for nearly half (41.5%) of Canada's industrial roundwood harvest, followed by Quebec and Alberta.

599 million seedlings were planted on 410,000 ha of Crown and private forest lands (2017).
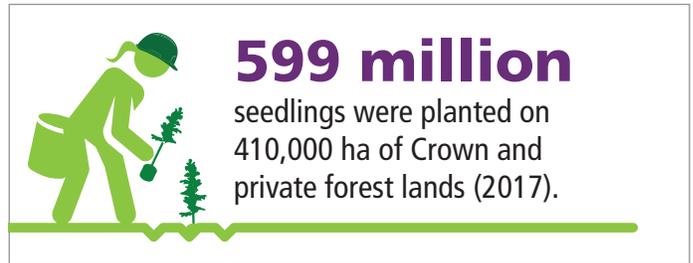
Science to support forests during climate change

With climate change-related disturbances occurring at a faster pace than before, Canada's forests could be significantly altered. For instance, increased occurrence of pest infestations and wildfires are damaging large quantities of trees. To ensure long-term sustainability for our forests, scientists across the country are working together to understand the impacts of climate change to continue to support healthy and resilient forests. Scientists are developing new tools to detect pests and diseases, as well as new forest management methods.

Ensuring benefits for all Canadians

Sustainable forests benefit all Canadians – from dependable livelihoods to clean air and water. These are the reasons that all orders of governments in Canada recognize the importance of keeping forests healthy and that everything is in place to make sure that harvested forests grow back, whether through natural or artificial regeneration. The regeneration guaranties that Canada's forests continue to produce wood fibre for commercial use, offer recreational opportunities, and provide ecosystem services, such as storing carbon, regulating water quality and quantity, and creating wildlife habitat.

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 2017, an estimated 756,000 hectares (ha) of forest were harvested.

- This is a 1.9% decrease from 2016 levels, when 770,000 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 due largely to a decrease in the area of public forest land harvested, primarily in British Columbia because harvesting was reduced on areas affected by the mountain pine beetle and forest fires.

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

Forest area harvested on private and Crown lands in Canada, 2007–2017

Area harvested (hectares)

Legend: Provincial and territorial Crown land — Private land
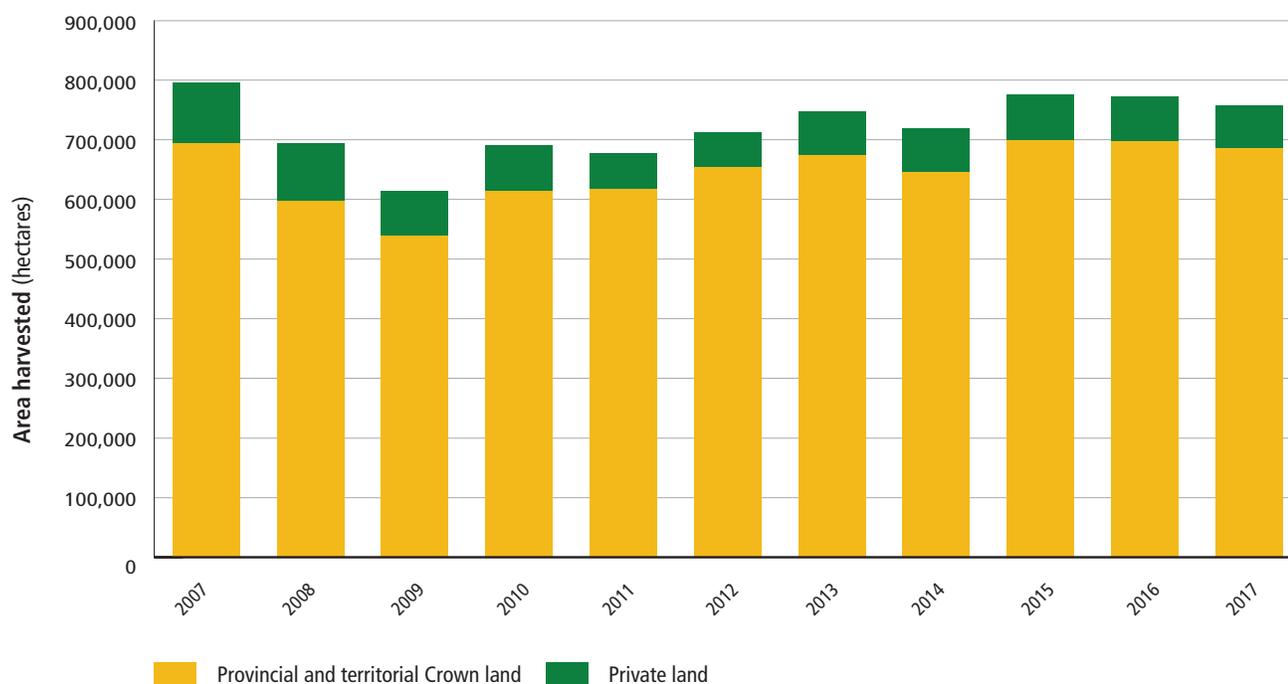
Why is this indicator important?

- 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 forest managers adjust their management objectives in response to natural disturbances such as pests and forest fires and to the variation in the demand for Canadian forest products.
- The demand for Canadian wood products is expected to remain strong for the foreseeable future, as residential construction in the U.S. slowly improves and expenditures on home repairs and remodeling grow.
- However, the area of forest harvested is not expected to exceed 2007 levels, just prior to the global economic recession.

Source: National Forestry Database. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Indicator: Regeneration

In 2017, 572 million seedlings were planted on 396,000 hectares (ha) of provincial and territorial Crown forest lands in Canada. Seeding was used to re-establish forests on an additional 18,000 ha.

- The number of seedlings planted declined 3% from 2016 but was still 7% higher than the 10-year average.
- The area planted increased 3% from 2016 and was 6% higher than the 10-year average.
- The total area artificially regenerated increased 2% in 2017 and was 6% above the 10-year average.

- Successful regeneration is required following forest harvesting on Crown forest lands.
- Forest type, harvesting method and desired composition of the new forest determine the regeneration method (natural or artificial).
- Artificial regeneration – planting or seeding – has been applied to about 56% of the area harvested in the past 20 years; almost all of the remaining area is naturally regenerated (see notes in **Sources and information** for more details).

Area artificially regenerated and number of seedlings planted on provincial and territorial Crown lands in Canada, 2007–2017
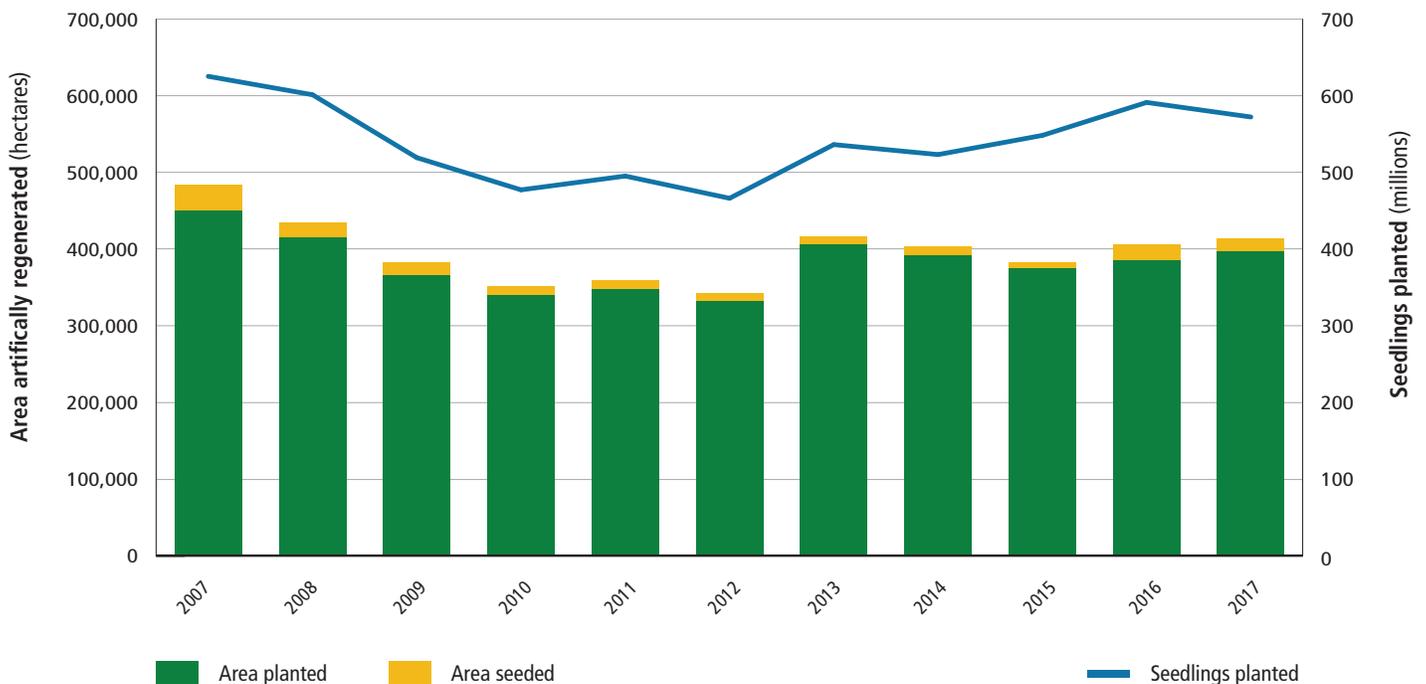
Why is this indicator important?

- 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. In the context of climate change adaptation, tree planting allows for the control of species composition and thus can be a tool to regenerate forests that may be better adapted to future climate conditions.

What is the outlook?

- Regeneration is required on all provincial and territorial Crown forest 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.

Source: National Forestry Database. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Indicator: Volume harvested relative to the sustainable wood supply

In 2017, Canada harvested 155.2 million cubic metres (m³) of industrial roundwood, well below the estimated sustainable wood supply level of 219.6 million m³.

- This amount is a decrease of about 400,000 m³ from 2016 levels, when 155.6 million m³ of industrial roundwood was harvested.
- At the same time, the estimated wood supply deemed to be sustainable declined by 3.5 million m³.
- The modest decline in harvest is a result of a large decrease in the volume of softwood timber harvested in British Columbia combined with a nearly identical increase in the volume of softwood timber harvested in the rest of Canada.

- Because the decline in sustainable wood supply was significantly greater than the decline in the volume harvested, the gap between them was slightly less than in 2016.

> 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, 1990–2017
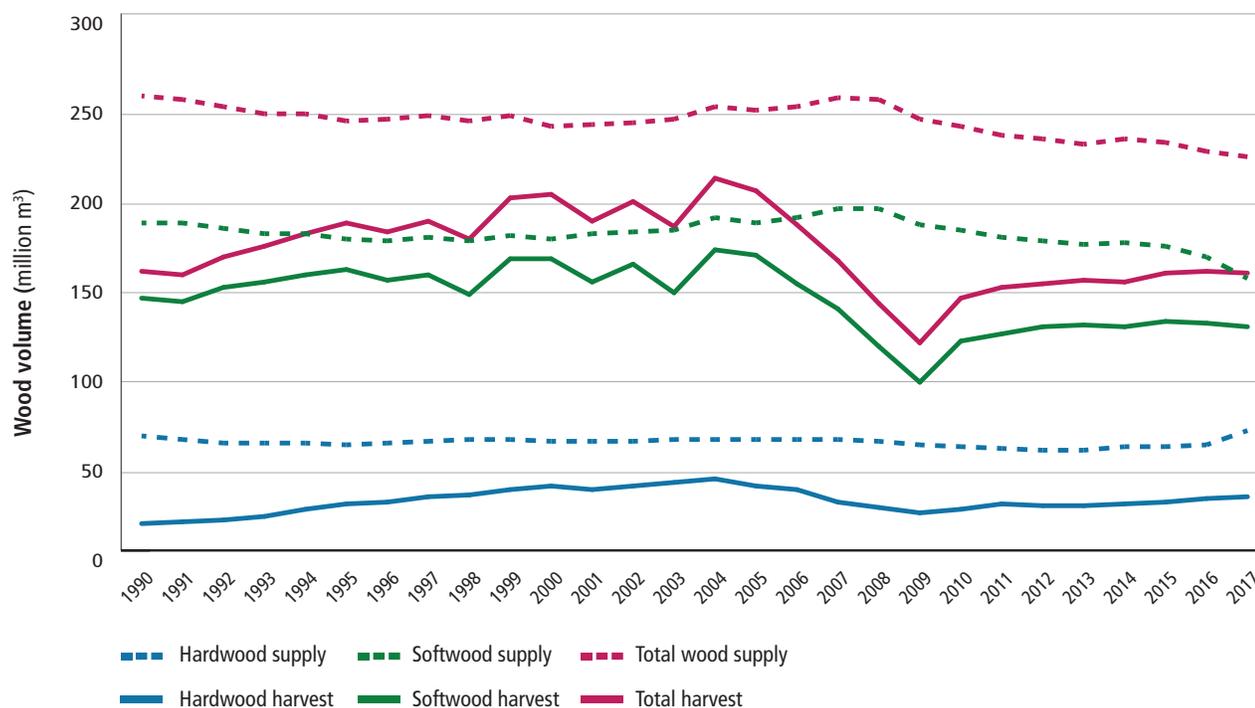
Why is this indicator important?

- 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 (AAC).
- Although 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 wood supply will likely continue to narrow as some provinces, notably British Columbia, lower their AACs while global demand for Canadian wood products remains strong.

Source: National Forestry Database. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Indicator: Forest area with long-term management plans

Of Canada's 347 million ha of forest land, more than 200 million ha are managed with a long-term (10 years or longer) management plan. This is an increase of 8% since 1990.

- In Canada, a "managed forest" is often considered to include only areas managed for timber production. However, to align with the United Nations' Sustainable Development Goals, this indicator also includes forest lands managed in protected areas.
- Forest areas without a long-term management plan may include areas with short-term management plans, private land or areas for which no management plan is developed.

- This is a new indicator for *The State of Canada's Forests Annual Report*. The reasons for changes in the area reported are being investigated and will be discussed in future reports.

- **Management plans help ensure that public forests are managed sustainably.**
- **Their development follows a strict process.**
- **Input from industry, government agencies, First Nations, the public and other stakeholders is usually required.**

Forest area with long-term management plans (thousands of hectares) in Canada

Year	1990	2000	2010	2015	2016
Forest area	185,013	188,103	187,844	188,656	200,086

Why is this indicator important?

- In Canada, forest management planning is one of the primary tools used to ensure that the country's publicly owned forests remain healthy and vibrant and are managed sustainably.
- Key to this approach is that public lands managed for forestry must, by law, have a forest management plan approved by the government before harvesting can take place. As well, parks and protected areas must have a government-approved management plan to guide conservation.
- Public participation ensures that the planning process is transparent and gives Canadians real influence in decision making.

What is the outlook?

- The forest area covered by a long-term management plan is expected to remain stable or increase slightly in the near future.
- Some increases may occur as plans are developed for new areas, including areas managed by Indigenous peoples, or as plans are developed for new parks and protected areas.

Source: Natural Resources Canada–Canadian Forest Service. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

How does disturbance shape Canada's forests?

Canada's forests are periodically affected by natural disturbances such as fire, insects and drought. These disturbances can impact and renew entire forest landscapes and, over time, will influence forest composition, structure and biodiversity.

Natural disturbances vary in severity, extent and frequency. All together, these characteristics define the natural disturbance regime of a particular region. Natural disturbances constantly change Canada's forests and are part of a dynamic landscape.

Alien invasive insects are a threat to Canada's forests

Emerald
Ash Borer

Asian Longhorned
Beetle

European
Gypsy Moth
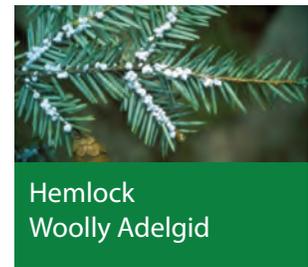
Hemlock
Woolly Adelgid

Natural disturbances vary from one region to another

Natural disturbance regimes vary from one region to another within Canada. For example, spruce budworm outbreaks are most prevalent in the balsam fir forests of eastern Canada while wildfires burned more areas annually in the boreal forest and the taiga in central Canada. Some disturbances are specific to a particular tree species (e.g. mountain pine beetle affects only pine species) while others can affect the whole landscape (e.g. fires) thus resulting in specific ecological dynamics. Disturbance severity can strongly vary, with some being stand-replacing (e.g. crown fires) and others causing only partial mortality (e.g. surface fires).

Disturbances have important ecological and socio-economic impacts

Extensive stand mortality caused by natural disturbances can have important impacts on forests by enhancing forest renewal and succession through the release of nutrients from affected trees and the reduction of competition among surviving and newly establishing trees.

Conversely, natural disturbances may have negative impacts on forest ecosystems or the people, communities and businesses who rely on forests. Exotic or non-native insects and diseases introduced through global trade (e.g. emerald ash borer, asian longhorned beetle) can

have serious negative impacts because Canada's native forests may not be adapted to them. Also, fire poses threats to human safety, property and infrastructure. Natural disturbances can also temporarily reduce the supply of timber, with socio-economic impacts on communities and citizens.

Disturbances affect the carbon cycle

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

Natural disturbances are affected by climate change

Virtually all natural disturbances are affected by climate or weather conditions. Therefore, any change in climate regimes can result in important changes to disturbance dynamics. For instance, rising temperatures over the last three decades have increased fire activity in Canada, especially in Western Canada. Future changes in precipitation may result in drought or floods and cause changes in the severity and frequency of insect and disease outbreaks. Impacts on Canada's forest and the forest sector could be significant, notably by causing timber supply shortages across the harvesting land base.

Indicator: Forest insects

In 2017, 15.6 million hectares (ha) of forests were affected by insects in Canada, which is within 1% of the previous year's value.

- The spruce budworm in Quebec has become the dominant forest pest in Canada in terms of the area impacted.
- The area impacted by mountain pine beetle is at its lowest value within the past 10 years.
- Forest tent caterpillar continues to be an important defoliator of broadleaf forests in Quebec, Ontario and the Prairie provinces.
- Western spruce budworm populations in British Columbia have reached the bottom of their outbreak cycle.

- Forest insects are agents of ecological disturbance because their feeding affects the health of trees.
- There are thousands of species of tree-feeding insects but only a few have a significant impact on forest health.
- Other disturbance agents such as drought, fire, storms, or invasive insect species can trigger outbreaks or worsen their impact.

Forest area containing defoliated trees for four insects in Canada, 2007–2017

Legend: Forest tent caterpillar · Mountain pine beetle · Eastern spruce budworm · Western spruce budworm
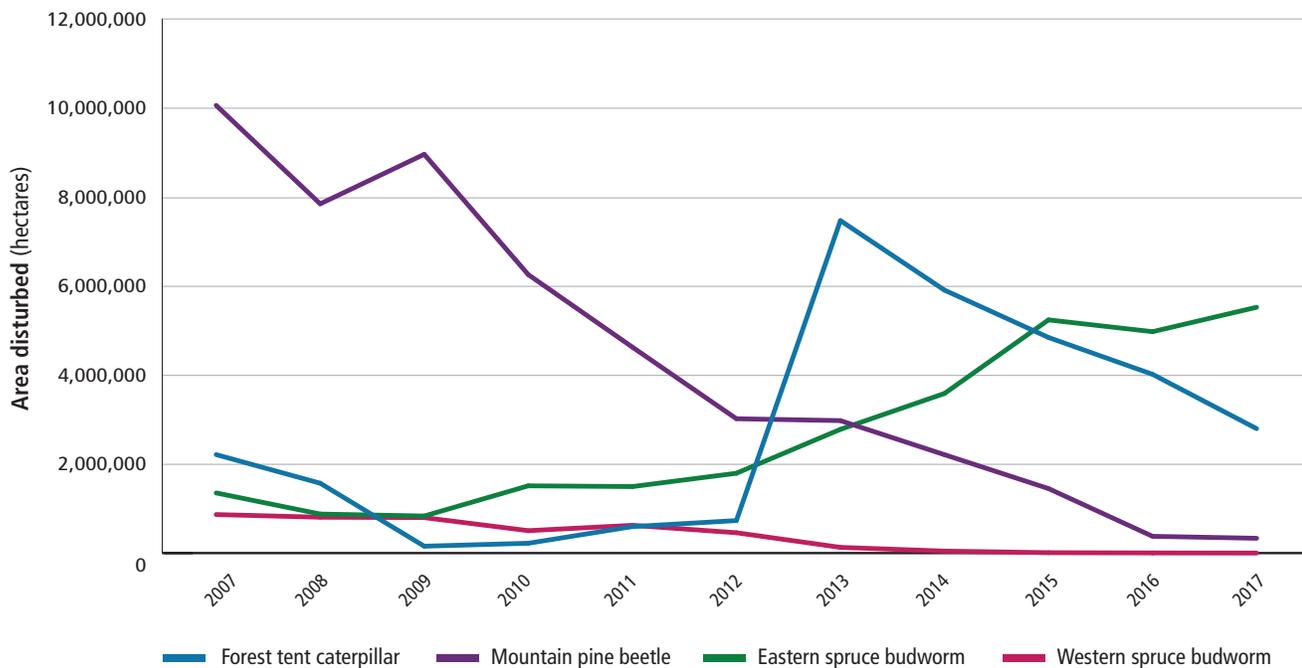
Why is this indicator important?

- Insect outbreaks are second only to wildfires in the impact they have on Canada's timber supply and carbon stocks.
- Prolonged or intense outbreaks of defoliators can cause tree mortality, but more typically forests respond through reduced growth and vigor. This stress can be the trigger that causes bark beetle populations to increase to epidemic levels and impact large areas of forests. Monitoring trends in both insect groups allows researchers and forest managers to assess overall forest health.

What is the outlook?

- The spruce budworm epidemic in Quebec remains a threat to forests, and areas defoliated are expected to continue increasing. Spruce budworm populations are down in New Brunswick for the first time since 2014. This is a positive sign for Early Intervention Strategy research, which aims to suppress growing populations early in the outbreak cycle to levels that can be held in check by natural mortality factors.
- Forest tent caterpillar populations increased only slightly in 2017 in Ontario. However, it is expected that this cyclical species will undergo a significant outbreak over the next few years, though the exact locations are still uncertain.
- The expansion of mountain pine beetle populations in western Alberta as well as their eastward spread in the boreal forest, a novel habitat for this insect, remain a concern. Forest health specialists are investigating the potential effect of extremely cold weather in February 2019 on mountain pine beetle mortality and these general trends of their population expansion.

Mature forest tent caterpillar.

A spruce budworm larva on balsam fir foliage.

Indicator: Forest diseases

Forest diseases are caused by pathogens, which are biotic agents that disrupt normal tree functions. Abiotic factors such as changing weather regimes, too much or too little precipitation, or extreme temperatures may affect their growth and development and can increase the susceptibility of trees to forest diseases.

- In natural settings, native diseases caused by native pathogens assist nutrient cycling, create habitat and enhance biodiversity.
- In commercial forests, diseases may be managed to prevent losses in tree volume and wood quality.
- Tree breeding and silviculture have been used to manage disease and optimize growth.
- Environmental conditions are important for moderating the interaction between the tree and the pathogen.

Why is this indicator important?

- In the worst case, diseased trees can die; at the very least, volume and wood quality are reduced.
- Diseases can impact a tree's growth rate, volume and wood quality and may ultimately kill the tree. Forest managers manage disease to reduce losses and enhance forest resilience.

What is the outlook?

- Climate change will alter future interactions between trees and pathogens, resulting in uncertainty over future losses to disease.
- Future climatic conditions are likely to increase tree death from drought and floods in the Prairie provinces and may induce changes in the natural distribution of tree species.
- Introduced exotic pathogens, such as *Cronartium ribicola* (the causal agent of white pine blister rust), have resulted in the significant loss of native trees.
- The oak wilt pathogen, *Bretziella fagacearum*, is present in the northern United States and *Diplodia corticola*, the causal agent of bot canker, is present in Maine. Both pathogens are geographically close to Canada, but the diseases have not been detected here.

All tree parts are affected by disease:
- **Foliar pathogens cause reduced photosynthetic capability.**
- **Stem pathogens cause structural problems that disrupt water and nutrient flow and lead to breakage or decreased wood quality.**
- **Root pathogens cause reduced water and nutrient uptake.**

Disease is not always lethal, but disease effects often reduce growth and decrease productivity.

White spruce needles infected by Chrysomyxa ledicola *(causal agent of spruce needle rust). Spruce needle rust can be common in years in which environmental conditions are favourable for the pathogen to be active. The orange aeciospores released from infected needles can create an orange film on the surface of lakes and rivers near heavily infected trees.*

Indicator: Forest fires

In 2018, there were more than 7,000 forest fires in Canada, burning almost 2.3 million ha of forest, with both of these numbers close to twenty-year averages. Though the national totals are close to average, in 2018, many fires occurred in places where large fires are unusual, including Vancouver Island, the Manitoba Interlake region, and Parry Sound, Ontario.

- In British Columbia, a record 1.35 million ha burned, much of it in stands affected by the mountain pine beetle 8 to 12 years ago. Dead trees, both standing and fallen, dry after weeks with little rain, increased the fire intensity, making the fires more difficult to control.
- 2018 was the second year in a row with record-setting fires in the BC interior, but these fires were generally further from populated areas. However, smoke darkened the sky and brought poor air quality to many towns and cities for much of August.
- 2018 was also the second year in a row with challenging emergency evacuations for remote fly-in communities in eastern Manitoba. Significant fire-related evacuations also occurred in BC, Saskatchewan, Ontario and Newfoundland and Labrador.

> Every year, firefighting resources are shared among Canadian provinces and territories through the Canadian Interagency Forest Fire Centre. In 2018, firefighters and equipment were sent to British Columbia from all across the country to assist with fire management efforts. However, in-country resources were insufficient to meet demand for most of August. As a result, firefighters from Australia, Mexico and New Zealand were also deployed in BC, along with personnel and equipment from the Canadian Armed Forces.

Forest area burned and number of forest fires in Canada, 2008–2018

Legend: Area burned — Number of fires
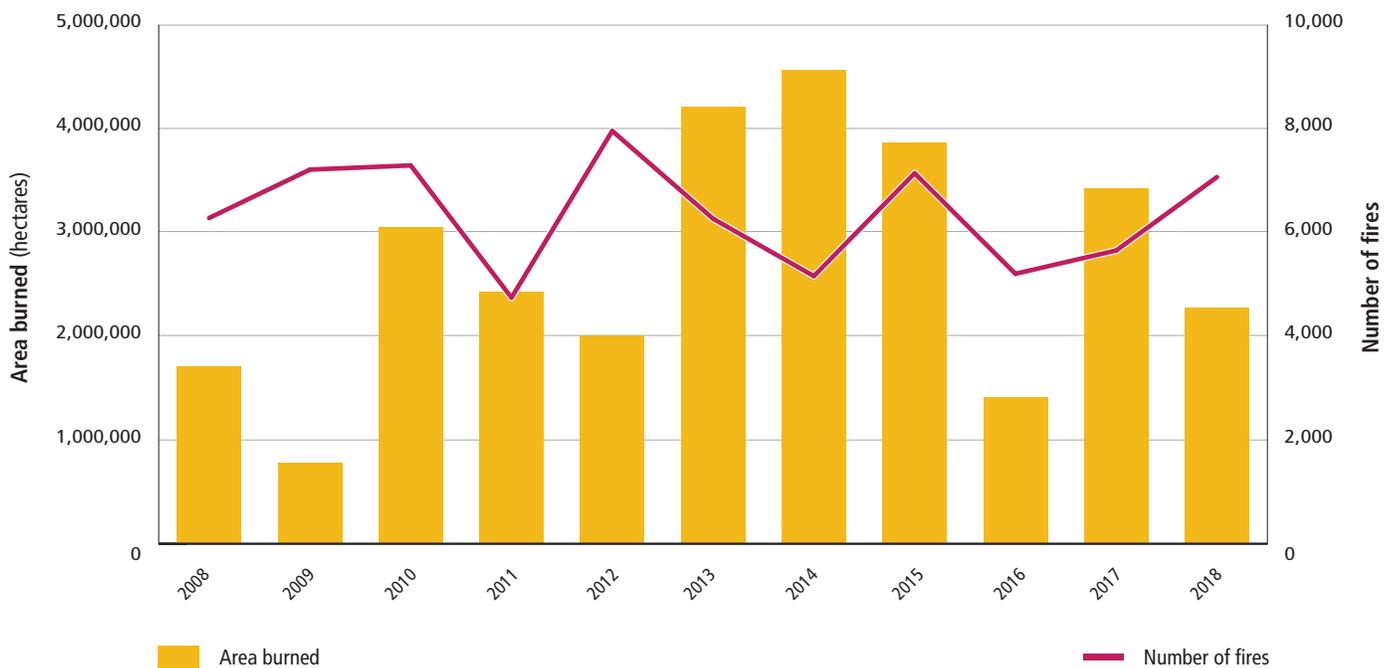
The Goode Creek wildfire near Kelowna, British Columbia in 2018. Thousands of people are evacuated each year as a result of forest fires.

Why is this indicator important?

- Forest fires are a threat to homes and businesses (e.g. tourism, logging, mining) in forested areas, trigger evacuations and disrupt people's lives and livelihoods.
- Forest fires produce large amounts of smoke, which affects human health and safety.
- Over the last 10 years, an average of $1 billion has been spent annually on fire management.
- Although wildfires threaten human values, fire plays an important and beneficial role in forest health, succession and nutrient cycling.

What is the outlook?

Forest fire occurrence varies greatly from year to year, both nationally and in any given area. However, there are factors that have caused fires to be more damaging and more difficult to control in recent years:

- Developments across the land base and the wildland-urban interface are expanding.
- There are more people living, working and visiting forested areas for recreation.
- There is a buildup of highly flammable forest fuels from drought and insect-caused mortality, as a result of climate change and other factors.
- Extreme weather events and shifting weather patterns associated with climate change increase the occurrence of drought and high winds – conditions ideal for fire spread.

Source: National Forestry Database; Natural Resources Canada–Canadian Forest Service. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Indicator: Carbon emissions and removals

In 2017, total net emissions of carbon dioxide equivalent (CO_2e) from Canada's managed forests (forest lands managed for timber production) were about 217 million tonnes (Mt).

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 removing about 20 Mt CO_2e in 2017, while large-scale natural disturbances accounted for emissions of about 237 Mt CO_2e, resulting in net emissions of 217 Mt CO_2e.

These figures include carbon monoxide emissions as well as emissions in 2017 from harvested wood products manufactured from wood harvested in Canada since 1900. Both types of emissions are reported as separate categories in Environment and Climate Change Canada's *National Inventory Report 1990–2017.*

- Forest lands managed for timber production and the emissions from wood products harvested from these lands continue to be an ongoing sink of carbon (20 Mt CO_2e in 2017).
- The area burned in managed forests in Canada in 2017 was 1.5 million ha, about double the area burned in 2016. This resulted in higher emissions than in 2016.
- Spruce budworm is having an increasingly significant impact in eastern Canada because of the large transfers of live biomass to dead organic matter (DOM) pools, resulting in indirect emissions as the DOM decays over many years.

Canada's forests both emit and absorb atmospheric carbon dioxide (CO_2). In any given year, depending on the area of natural disturbances such as forest fires, insect outbreaks and windthrow, Canada's forests will be either a source or a sink of CO_2. Data from 2017 suggests that the forests were a net source of CO_2 because of the 1.5 million ha of area burned.

Natural disturbances such as forest fires can emit large quantities of carbon dioxide.

Why is this indicator important?

- Carbon as CO_2 and as methane (CH_4) in the atmosphere are important contributors to global warming.
- Canada's forest sector contributes to both emissions and removals of carbon from the atmosphere.

Net carbon emissions in Canada's managed forest: Areas subject to human activities, 1990–2017
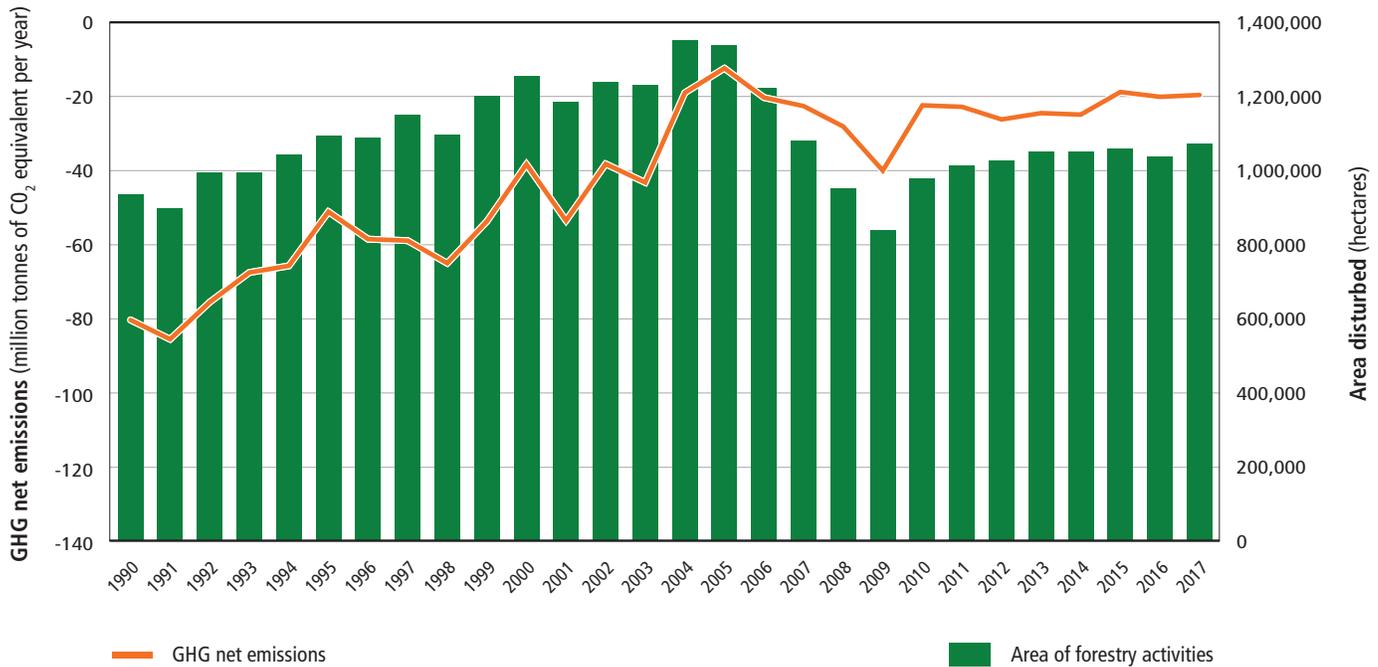
Forest management activities in Canada's managed forests, such as harvesting, slash pile burning and regeneration, as well as the use and disposal of harvested wood products, were a net sink of about 20 Mt CO_2e in 2017.

Net carbon emissions in Canada's managed forest: Areas subject to natural disturbances, 1990–2017
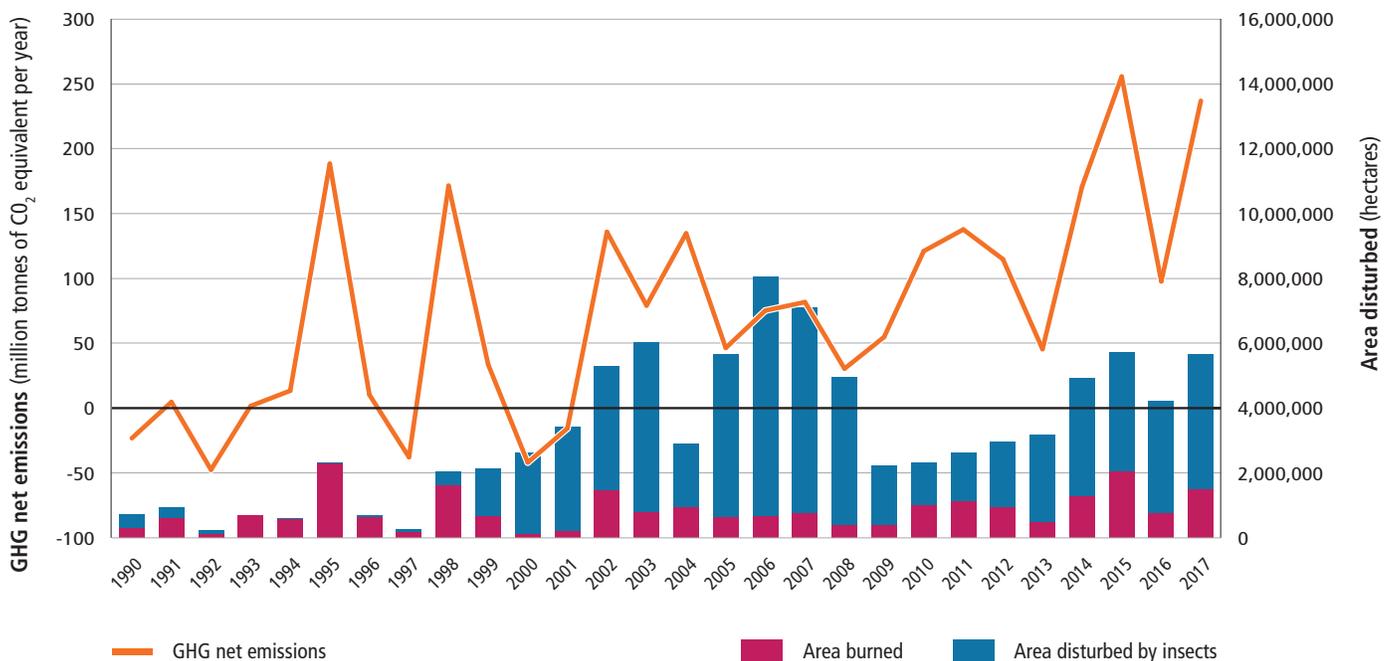
Natural disturbances in Canada's managed forests resulted in net emissions of about 237 Mt CO_2e in 2017. Forest GHG emissions were similar to those in 2015, in large part because of the 1.5 million ha of area burned in 2017.

Net carbon emissions in Canada's managed forest: All areas, 1990–2017
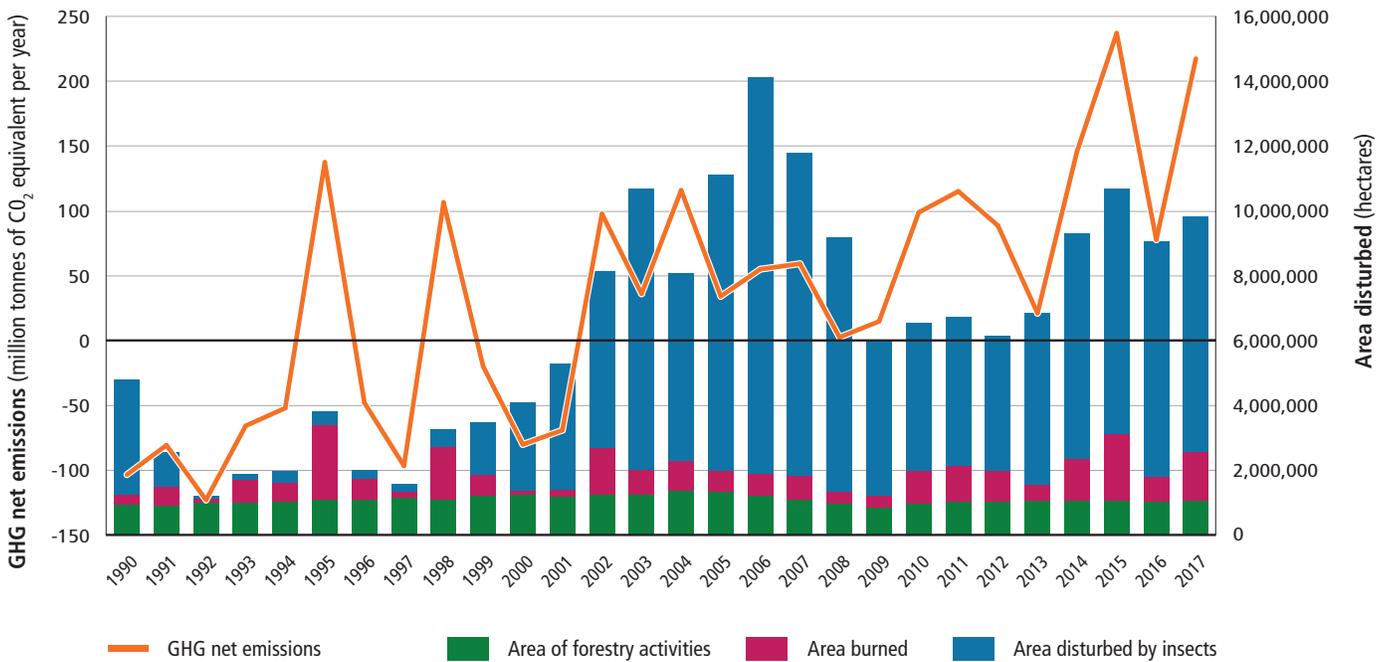
The total net emissions and removals from Canada's managed forests, taking into account both human activities and natural disturbances, were about 217 Mt CO_2e (−20 + 237 = 217) in 2017. This includes the emissions in 2017 from wood harvested in Canada since 1900 and wood products used in Canada and 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 or insect outbreaks). Given the amount of area burned in 2018, especially in British Columbia, we expect 2018 GHG emissions to be similar to those in 2015.
- Natural disturbances, mostly outside the control of humans, significantly affect the ability of Canada's managed forest to consistently absorb more CO_2 than they emit.

- Changes in forest management and the use of harvested wood products can contribute to mitigating the impacts of climate change.
- Increased use of long-lived wood products to store carbon in the built environment and use of wood products instead of emissions-intensive materials such as concrete, steel and fossil fuels provide opportunities to mitigate climate change.

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. However, the area included in carbon reporting differs somewhat from the total area under these management classifications, as seen in the "Canada's Forests: Managing for the Future" map at the beginning of this report.

The data in this indicator is consistent with UNFCCC reporting. More information about definitions and methods can be found in Canada's 2019 *National Inventory Report 1990–2017*.
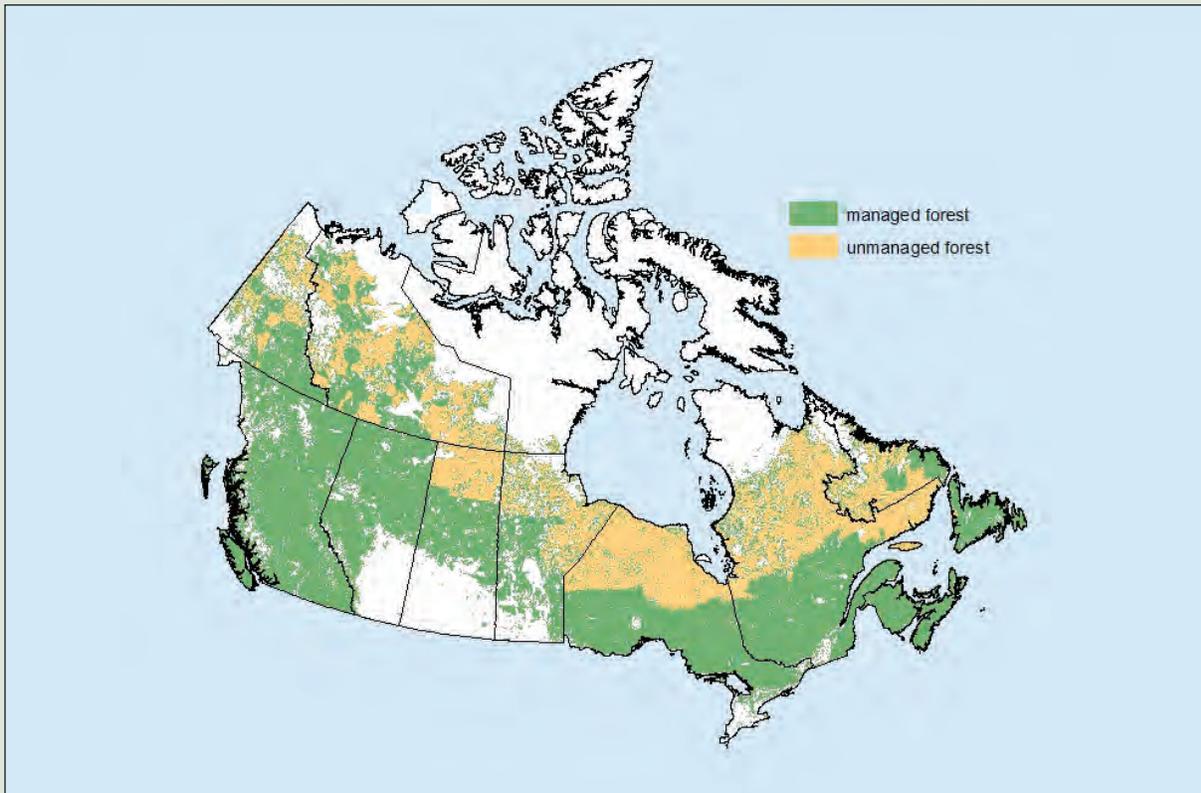
How do forests benefit Canadians?

Canadians across the country benefit from a vast array of economic, social and environmental outcomes from forests.

Key contributor to the Canadian economy

The Canadian forest sector provides quality, well-paying jobs to Canadians. Furthermore, it is a key economic engine for many communities across the country, including rural and Indigenous communities.

> 💬 **Wood products made from sustainably managed forests, as is the case in Canada, are central to the bioeconomy. In addition to being sustainable products, they are an effective way to trap carbon.**

The sector directly employed 210,615 people in 2018 – foresters, scientists, engineers, computer technologists, technicians and skilled tradespeople – and is responsible for an additional 91,874 indirect jobs in the rest of the economy. These jobs support 300 communities across the country. Many of these communities, often far from urban areas, would have few or no alternatives without the forest sector.

More than a job provider

Forests provide much more than jobs. Some of those other benefits might be harder to measure. But we know that approximately 11 million Canadians living in or adjacent to forested areas, as well as those living in urban areas, deeply value and enjoy forests.

Also, forests provide recreational and ecotourism opportunities for people living in both urban and rural areas and are important for cultural, aesthetic and spiritual reasons. More and more, remote communities across the country are taking advantage of local forest resources to support reliable and affordable bioheat systems and reduce reliance on diesel.

Home to a complex ecosystem

Forests benefit Canadians environmentally with the rich ecosystem they support. This ecosystem preserves soils, cycles nutrients and supports biodiversity. Trees and other forest plants filter pollutants from air and water, acting as natural cleansers.

By absorbing and storing carbon, forests play a key role in the carbon cycle – the constant movement of carbon from the land and water to the atmosphere and living organisms. This cycle helps maintain the global carbon balance. In addition, forests can help moderate climate change by absorbing carbon emitted by human activities such as burning fossil fuels. Trees in cities and other urban areas also help improve air and water quality and reduce surface and air temperatures.

Who works where in the forestry sector?
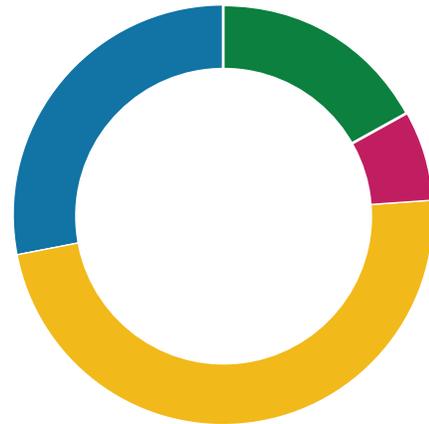
Category	%
Forestry and logging	17%
Support activities for forestry	7%
Wood product manufacturing	48%
Paper manufacturing	28%

Indicator: Employment

In 2018, Canada's forest sector employed 210,615 people, essentially stable (-0.34%) between 2017 and 2018.

- Employment in pulp and paper and wood product manufacturing decreased between 2017 and 2018, by 1.65% and 1.38%, respectively.
- The only gain in employment occurred within in-forest jobs, which grew by 2.88% between 2017 and 2018. Some of this growth may be attributed to fire-related activities.
- The pulp and paper and the wood product manufacturing industries both faced challenges in 2018. These challenges included the continuing decline in demand for paper products and lower commodity prices for wood products, which along with others, have impacted employment.

> 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 more skilled and more highly paid. (See the sustainability indicator **Average Earnings**.)

Forest industry direct employment, 2008–2018

Legend: Pulp and paper product manufacturing · Wood product manufacturing · In-forest activities
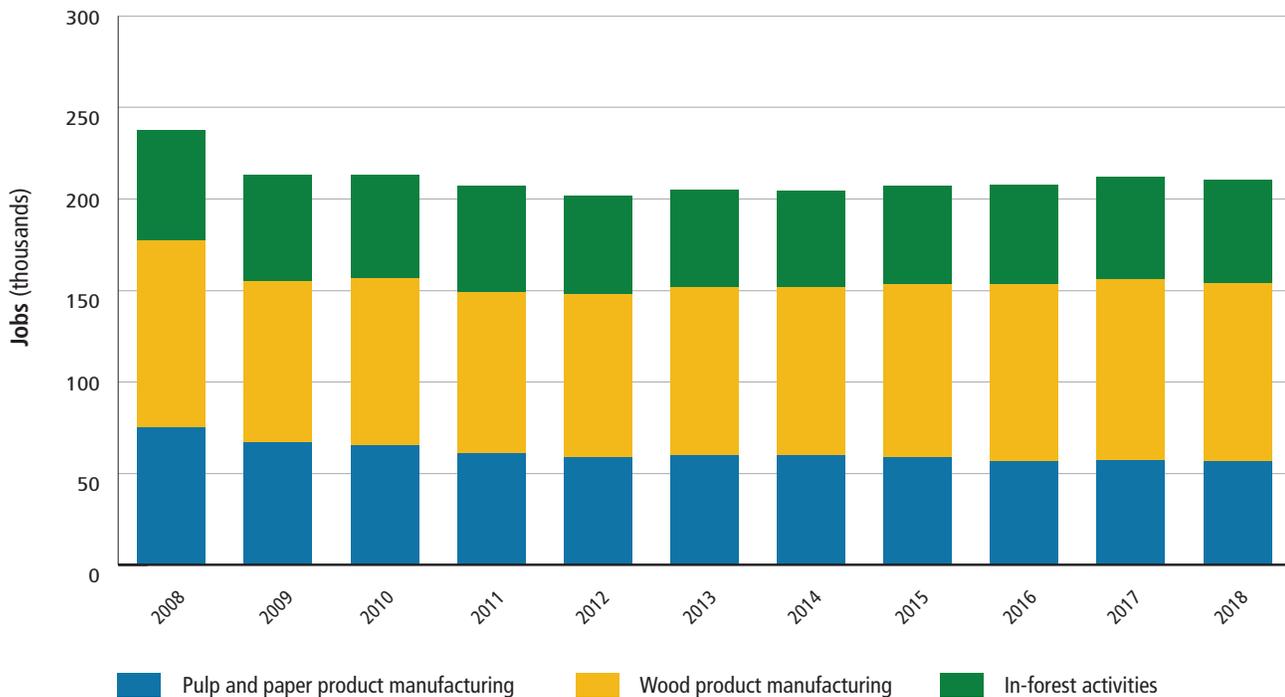
Why is this indicator important?

- The Canadian forest sector 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, in which forest-related work is often the main source of income.

What is the outlook?

- Several challenges could impact employment, such as slower economic growth forecasted for 2019 and volatile commodity prices. Also, the impact of fires and pests on the fibre supply could affect forest sector employment in the short term. Yet the positive market perspective for several forest products (packaging, lumber) could drive an increase in production and employment. The short-term outlook for forest sector employment will depend on the interplay between these drivers of production.
- In the long term, forest sector diversification through the bioeconomy (e.g. mass timber products for tall wood building construction) will create new job opportunities in Canada's forest sector.

Source: Statistics Canada. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Indicator: Average earnings

In 2018, average earnings in the forest sector decreased 3.9% compared to 2017.

- Overall, average earnings in the forest sector remain higher than earnings in the total manufacturing sector.
- Average earnings decreased by 8.8% in wood product manufacturing and by 5.1% in pulp and paper manufacturing in 2018. Average earnings in forestry and logging increased by 2.2% in 2018. Average earnings in the total manufacturing sector declined 2.3% between 2017 and 2018.

- Average earnings in the forest sector have generally improved since 2009. In recent years, Canada's forest sector has faced many challenges, including trade disputes. In 2018, these challenges, coupled with decreasing commodity prices, affected earnings in forest products manufacturing.

> **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, 2008–2018
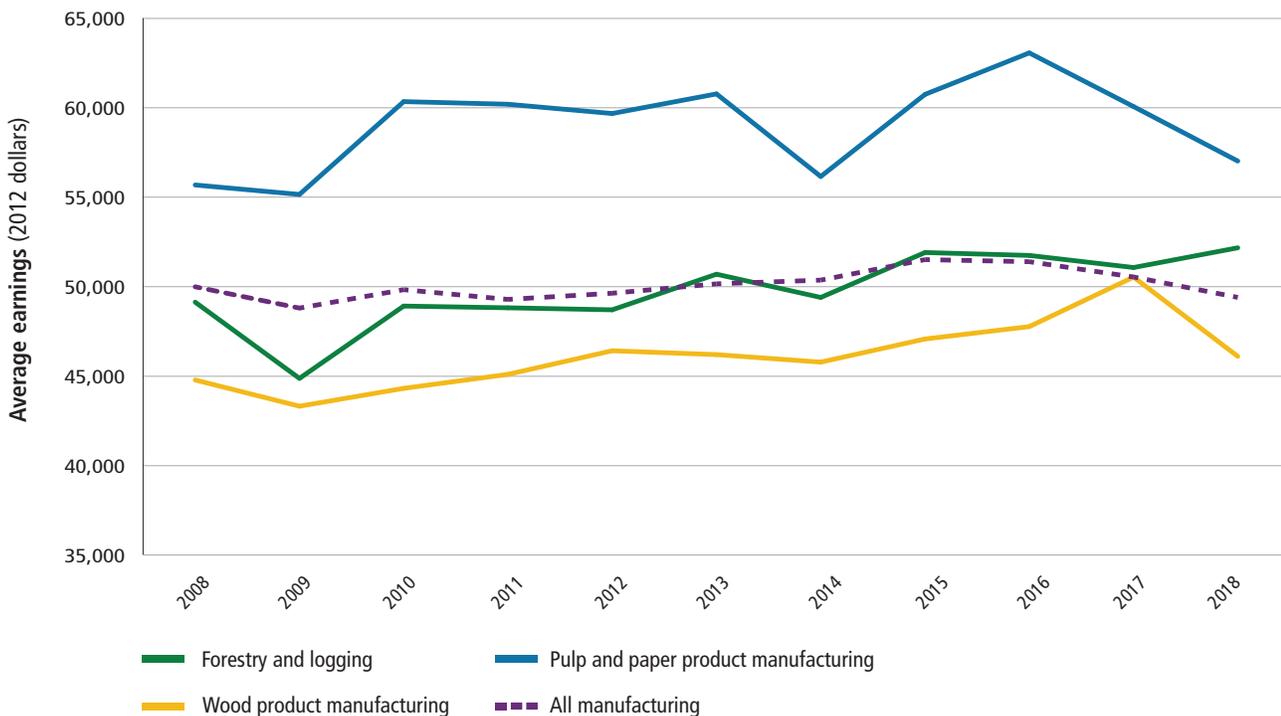
Why is this indicator important?

- 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 is not the result of inflation) shows the change in actual purchasing power of forest industry employees.

What is the outlook?

- Canada's economic growth is predicted to slow in 2019 and declining commodity prices could adversely impact forest sector earnings in the short term.
- The pulp and paper segment of the forest sector has experienced sporadic growth in average earnings, but has declined in the last two years and could continue to be negatively affected by declining market conditions. Conversely, improving lumber prices, which are expected to increase in the near- to mid-term, could positively affect average earnings in wood product manufacturing.

Source: Statistics Canada. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Indicator: Communities

Canada's forests are a rich source of economic, cultural, and environmental benefits for people across the country. These benefits are important to people and their communities in both rural and urban Canada.

- About 31% of Canadians (11 million people) live in or adjacent to forested areas.
- There are about 300 census subdivisions across Canada that rely on the forest sector for a large share of jobs and income.
- About 2% of Canada's population (700,000 people) live in these forest-reliant communities.
- Approximately 70% of Indigenous people in Canada live in or near forests, and about 11,600 Indigenous people were employed in the forest sector in 2016.

> Proximity to forests, community reliance and Indigenous employment in Canada's forest sector are examples of the importance of forests to people and their communities across Canada.

Why is this indicator important?

- When a community relies heavily on the forest sector for jobs and income, any adverse economic events affecting the sector affects not only forest sector employees, but all members of the community.
- Forests provide more than just economic benefits. Forests are often central to the health and well-being of the people who live in forest-reliant communities, providing many environmental services and recreational activities.

A pulp and paper mill in the community of Corner Brook, Newfoundland and Labrador.

What is the outlook?

- Given the nature of the Canadian forest sector, some of the economic activity will always be located near the resource, away from urban areas. As a result, the forest sector will continue be an important source of jobs and income for communities across Canada, including remote ones.
- Efforts to diversify forest products manufacturing will strengthen the sector and provide opportunities for Canadians, particularly those who live in rural areas.
- Strong demand for Canada's forest products will create new and diverse opportunities for people in forest-reliant, rural and Indigenous communities, as well as for people in other communities who benefit from living near forests and participating in the forest sector.

Source: Natural Resources Canada–Canadian Forest Service; Statistics Canada. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Seeing the forest for the trees – Teslin Tlingit Council

The Teslin Tlingit Council are similar to many communities in Northern Canada – tight-knit and community-oriented, with strong ties to the land. The Teslin Tlingit Council take pride in their ability to see the big picture – to look at immediate needs and transform them into community opportunities.

For example, when the community was considering a project which required clearing a forested area, the cheapest option for the project was to bulldoze the trees and burn them as waste. However, the Teslin Tlingit Council took a step back and saw the strategic opportunity to hire local workers to manually remove and process the trees, and use the biomass as fuel. It may have cost the project more money, but this broad thinking offset that increased cost by creating two years' worth of fuel for 15 community buildings, as well as employment for several community members.

This firm belief in engaging the community has deep historical roots with the Teslin. Blair Hogan, Executive Councillor of the Ishkitan (Frog) Clan and local business owner, says he remembers the "golden age" of prosperity in Teslin in the early 2000s. "There were no idle hands,"

Hogan says. But the recession in 2008, and subsequent strain on the forest industry, led to a large segment of the population having no opportunities to work in forestry – even though they wanted to.

Fast forward to 2013, when the Teslin posted a job opportunity for slashers – workers to clear brush and unwanted material from harvesting areas. Forty of the 170 community residents applied. Seeing a huge opportunity to re-energize the community, the Teslin re-committed to growing their forestry sector, and by 2016 had finalized their timber harvest plans and commissioned their own biomass energy strategy.

Now, in 2019, Teslin's forest industry is flourishing, with the Council currently working on $26 million of community development projects. Hogan describes it like this. "We constantly build capacity and reinvest in our community. Currently, 80-85% of all forestry labour in the community – biomass boiler technicians, harvesters, sawmill workers – are Teslin. Our philosophy is to see the bigger picture, to take the longer view, and to see how everything is interconnected."

Waste wood from the sawmill will be processed into wood chips.

Wood chips are used as fuel in biomass boilers to heat ten community buildings.

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 210,600 people across the country (2018), including an estimated 11,600 Indigenous employees (2016)
- supported 300 municipalities across Canada as a main source of jobs and revenues
- accounted for about 7% of Canada's total exports in 2018
- generated $2.9 billion in revenue for provincial, territorial and federal governments in 2017
- contributed roughly $25.8 billion to Canada's economy in 2018

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 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.

In 2018, Canada's forest industry exports grew by 7.6%.

Top export markets for Canadian forest products (2018)

Region	Share
United States	66%
China	15%
Other	9%
Japan	5%
EU	3%
India	2%

EU = European Union

An economic engine from coast to coast, from small towns to large cities

Forest operations take place in all regions of Canada except the Far North. In fact, the two provinces for which the forest sector is the most important are New Brunswick and British Columbia.

- In New Brunswick, the forest sector accounted for around 4.5% (2018) of the provincial gross domestic product (GDP).
- In British Columbia, the forest sector accounted for around 2.9% (2018) of the provincial GDP.

The Canadian forest sector is a major employer nationwide. Its economic contributions are particularly evident in many rural and Indigenous communities, where forest-related work is often the main source of income. There are about 300 such communities where forest sector jobs are crucial to ensuring economic sustainability.

However, the forest sector is also increasingly an "urban" sector. Consumer forest products and advanced bioproducts are typically manufactured closer to consumers (e.g. household paper, cabinets, wallpaper). About 35% of Canada's forest sector labour force lives in large urban centres. Statistics Canada defines large urban centres as census metropolitan areas (CMA). CMAs are formed by one or more adjacent municipalities centred on a population centre (known as the core). A CMA must have a total population of at least 100,000 of which 50,000 or more must live in the core.

A competitive industry in the global market

Globalization is increasing trade possibilities beyond Canadian producers' traditional markets, and the industry has shown its capacity to be competitive. This helped the forest industry's exports remain relatively robust throughout the economic crisis of the late 2000s, the effects of which lasted through 2012. In 2018, forest industry exports grew by 7.6%. The forest industry was one of the export sectors with the largest trade surpluses. In particular, the trade surpluses in pulp and paper products grew 18.0% and 34.3%, respectively. The trade surplus in wood products remained relatively unchanged between 2017 and 2019 (+0.9%).

Traditional forest products remain the heart of the Canadian forest sector. However, advanced bioproducts are growing in importance.

Indicator: Gross domestic product

The forest industry contributed $25.8 billion (1.2%) to Canada's nominal gross domestic product (GDP) in 2018.

- The forest industry's GDP contracted by 1.0% in 2018 while the overall economy grew at 2.3%.
- Weak demand decreased the real GDP for both wood products and pulp and paper manufacturing by 1.6% and 1.3%, respectively. Demand for wood products was strong in the first half of 2018, but declined sharply in the second half. Meanwhile, the long-term trend of declining demand for paper products continued through 2018.

- Forestry's and logging's contribution to Canada's real GDP increased slightly, by 1.0%, between 2017 and 2018.

> **Gross domestic product** (GDP) is the total value of all final goods and services produced annually in a country. Think of it as the size of a country's economy.

Canadian forest industry's GDP, 2008–2018

Nominal GDP (billions of dollars)

Legend: Forestry and logging | Wood product manufacturing | Pulp and paper manufacturing

Real GDP growth (annual %)

Legend: Total all industries | Total forest industry

Why is this indicator important?

- Contribution to nominal GDP is one of the primary indicators used to gauge the size and health of Canada's forest industry compared with the size and health of other economic sectors in a year.
- The change in real GDP shows the growth of the forest sector, taking inflation into account. In other words, it represents real year-over-year growth. Analysts can use real GDP to gauge the trend of the Canadian forest sector's contribution to the economy.

What is the outlook?

- The decrease in demand for traditional paper products is expected to continue in 2019, albeit less drastically than in 2018.
- Overall, the Canadian forest sector should grow in 2019. Stronger demand for Canadian lumber, stimulated by increased United States housing starts, and for pulp should support that growth. The growth is expected to overcome the negative impact of long-term threats to the fibre supply, such as pests and wildfire.

Source: Statistics Canada. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Indicator: Production

Forest product production levels remained quite stable between 2017 and 2018. Production of both structural wood panels and printing and writing paper grew by 2.8%, while production of softwood lumber, newsprint and wood pulp fell slightly.

- Production of structural wood panels grew for the ninth consecutive year. Between 2008 and 2018, panel production has grown 39%, approaching 2007 volumes.
- Softwood lumber production fell by 2.3% in 2018. Changing market conditions and fibre availability are largely responsible for this small decline, particularly in British Columbia where wildfires and the mountain pine beetle have affected the supply and cost of logs in the region.
- Production of printing and writing paper increased for the first time since 2013.

> 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, 2008–2018

Newsprint   Printing and writing paper   Wood pulp

Softwood lumber   Structural wood panels
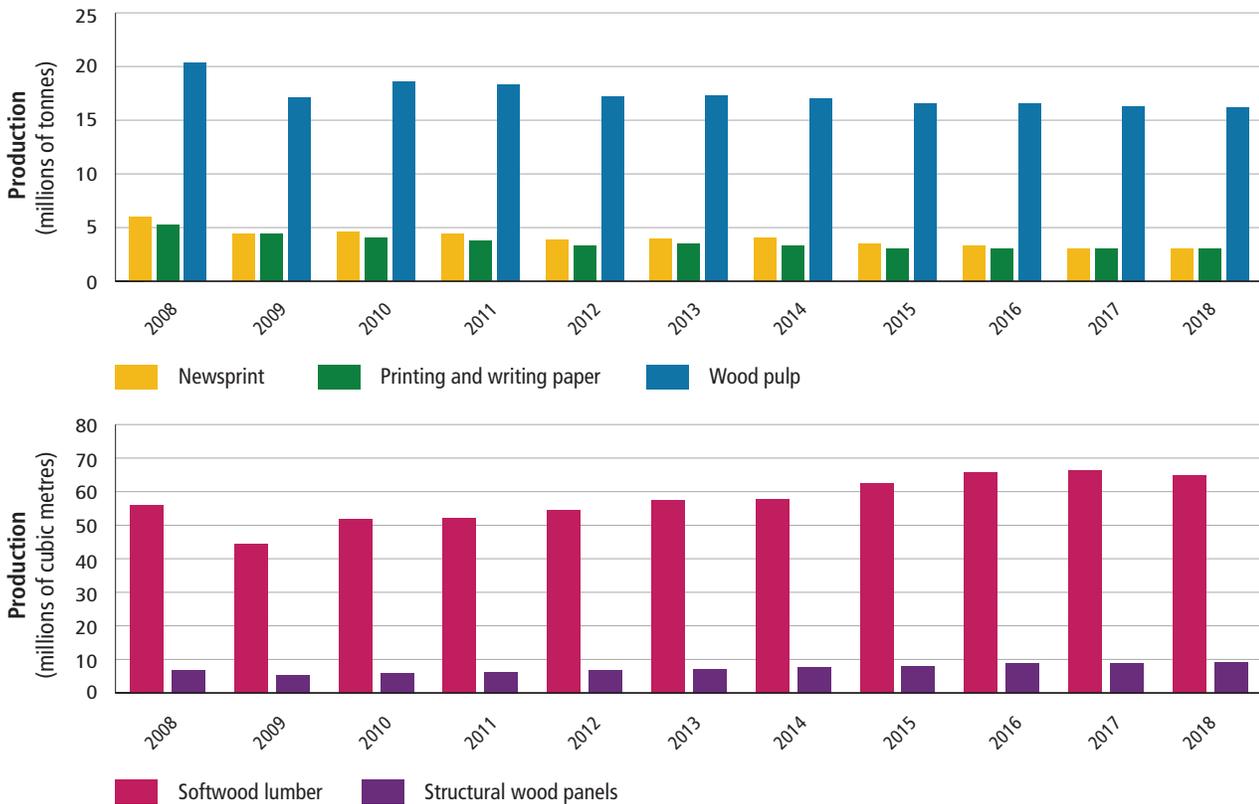
Why is this indicator important?

- 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?

- As the United States housing market continues to grow, the demand for softwood lumber and structural panels will follow suit in 2019. However, production of softwood lumber could continue to be limited by fibre shortages caused by pest outbreaks and wildfires in Western Canada. Challenges are expected for plywood producers over the year because of high log costs and increasing competition from South American and Asian producers, such as those in Brazil and Indonesia.
- Production of wood pulp is expected to remain stable or decline slightly, while printing and writing paper and newsprint production are expected to continue their decline.

Indicator: Exports

Canada's total forest product exports have grown for the sixth consecutive year, up 7.6% from the 2017 value to $38.3 billion.

- Export value of wood pulp and printing and writing papers saw the largest rise from 2017 driven by higher prices, growing 18% and 17%, respectively.
- Softwood lumber was the only major forest product to see a decline in export value (1.5%) in 2018, caused by deteriorating market conditions in the United States and production curtailments at British Columbia sawmills.

- The total export value of Canadian forest products grew 53% between 2012 and 2018.

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

Exports of Canadian forest products, 2008–2018

Legend:
- Softwood lumber
- Newsprint
- Printing and writing paper
- Structural wood panels
- Wood pulp
- Other forest products
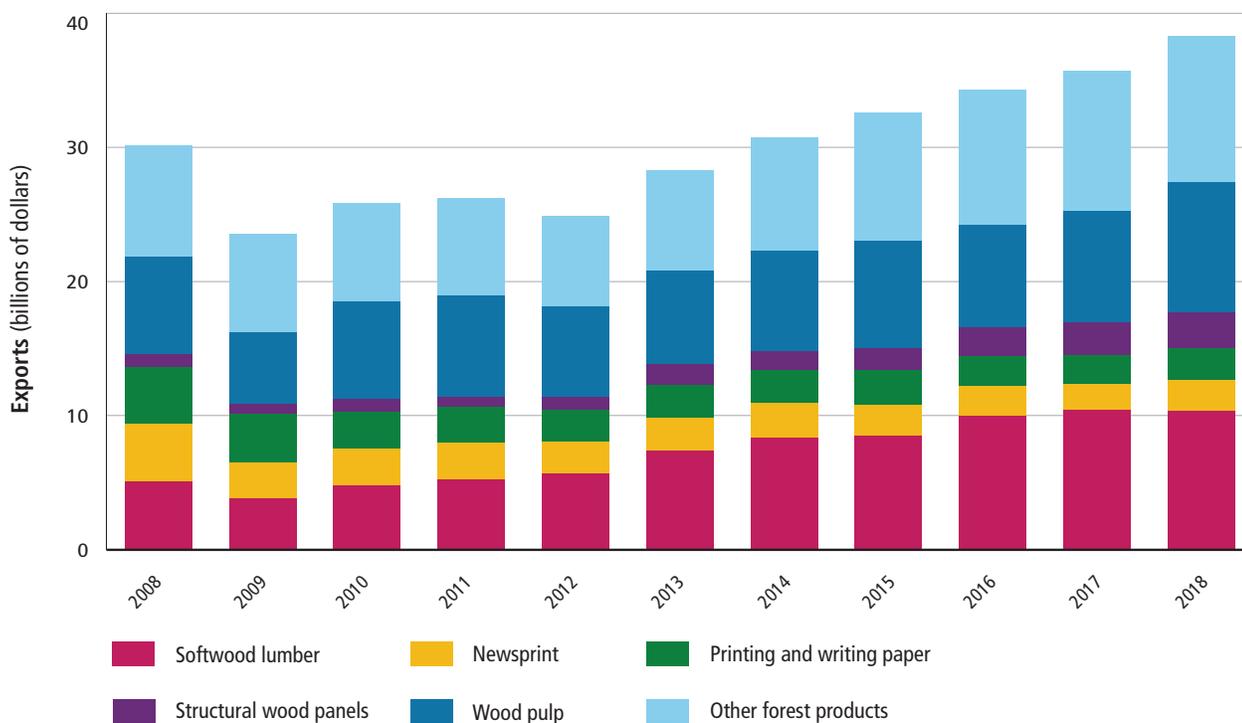
Why is this indicator important?

- 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?

- Softwood lumber and structural panel exports to the United States are expected to remain stable over the next year, while offshore lumber exports are expected to decrease slightly.
- Export values of certain pulp and paper products are expected to decline as demand growth in China slows and as most paper products continue to be replaced with digital media.

Source: Statistics Canada. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Promoting sustainable forest management through trade

As global markets evolve to incorporate consumer demand for sustainably sourced forest products, Canada has a competitive edge on the international stage.

As an export-oriented economy and a world leader in forest exports, Canada is actively engaged in the international trading system, through membership in the World Trade Organization, as well as other bilateral and multilateral trade agreements.

Canada has developed trade agreements with many new partners over the past decade. In fact, with CETA and CPTPP recently coming into force, Canada is the only G7 country to have free trade agreements with all other G7 countries.

Creating clear and transparent trading rules helps to increase the competitiveness of Canada's forest sector in three ways: by reducing or eliminating tariff barriers, by providing mechanisms to settle disputes, and by including trade-enabling provisions.

Canada's modern free trade agreements address trade-enabling factors that can benefit Canadian companies, such as regulatory cooperation, investment, trade in services and phytosanitary requirements. As part of its commitment to sustainable forest management, Canada has also started to include provisions highlighting the importance of trading in forest products derived from sustainably managed forests and legally harvested trees.

CETA: Comprehensive Economic and Trade Agreement (Canada–European Union)

CPTPP: Comprehensive and Progressive Agreement for Trans-Pacific Partnership

G7: The Group of Seven: a group of countries consisting of Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States

CUSMA: Canada–United States–Mexico Agreement

For example, CETA, CPTPP and CUSMA contain commitments to combat illegal logging and the associated illegal trade. Furthermore, both CUSMA and CETA have specific provisions that encourage trade of forest products from sustainably managed forests and highlight the important environmental functions that forests provide.

CPTPP and CUSMA also contain commitments to maintain or strengthen government capacity and institutional frameworks promoting sustainable forest management. In Canada, sustainable forest management decisions and activities are based on scientific research, rigorous planning processes and public consultation. Consequently, Canada is already a global leader in sustainable forest management, and Canadian companies have the opportunity to leverage this reputation and increase exports to international markets.

How is the forest industry changing?

The forest sector is changing in response to new business conditions and a growing demand for environmental solutions, whether they are nature-based solutions to climate change or forest products with a small greenhouse gas or water footprint.

New markets and new challenges are transforming forest industry structure

The globalization of forest markets continues to drive the transformation of the Canadian forest sector. Consequently, competition in export markets is intensifying. For instance, new entrants from Europe, South America and Russia now offer significant competition to Canadian exporters in markets where they had previously dominated. Globalization also means that international firms are interested in investing in Canada, particularly in the pulp and paper segments. Similarly, Canadian firms are investing abroad with significant investments in the United States and in Europe over the past few years.

Multiple factors provide an impetus for the forest sector to seize opportunities that will transform it into a world leader of innovative sustainable forest products. Globalization, the declining demand for some traditional products such as newsprint, growing protectionism, the cumulative effects of forest disturbances from climate change, and an increasing global commitment to clean growth all play key roles.

Low-carbon projects that meet future market demand and consumer preferences are key to supporting a forest sector transition towards the bioeconomy. Such projects include bio-plastics, bio-refineries, nano-cellulose crystals, sugars used in chemicals, and artificial intelligence for real time operations. This transition towards the bioeconomy will help the sector be more resilient to fibre supply challenges and changing markets.

> **Today, you may be wearing clothes made from rayon that started out as pulp from Canadian trees.**
>
> **Wood fibre is strengthening composite car parts, making vehicles lighter, reducing emissions and replacing plastics made from non-renewable fossil resources.**
>
> **Also cellulose from trees is found in the screens of your smart phones and the paint on your walls.**

Domestic opportunities are bringing new participants

Leveraging local resources as a means to mitigate or adapt to climate change has become a priority. Nature-based solutions that are focused on forest carbon sequestration or decreasing the risk of forest fire are attracting interest from large non-forest sector multinationals and small Canadian communities alike. Leveraging local forest resources also offers increasing opportunities for rural and Indigenous communities to develop new economic activities. For instance, with increasing Indigenous-held tenure agreements, Indigenous communities are building forest management expertise and turning to bioenergy to lessen their dependency on trucked-in diesel.

Bioproduct revenues by product type (2015)
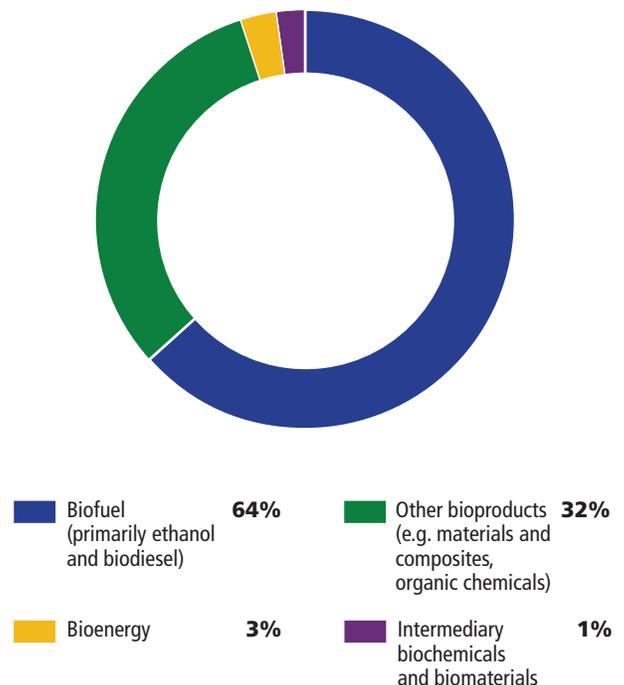
- Biofuel (primarily ethanol and biodiesel) **64%**
- Other bioproducts (e.g. materials and composites, organic chemicals) **32%**
- Bioenergy **3%**
- Intermediary biochemicals and biomaterials **1%**

Source: Statistics Canada. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Indicator: Financial performance

The forest industry's financial performance improved for the seventh consecutive year with increased operating profits and improved return on capital employed.

- Operating profits rose by 25.7% over 2017 levels.
- In 2018, return on capital employed increased to 13.1%, up from 11.2% in 2017.
- The financial performance of the forest industry benefited in 2018 from both high commodity prices for the majority of the year and strong demand for Canada's major 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, 2008–2018
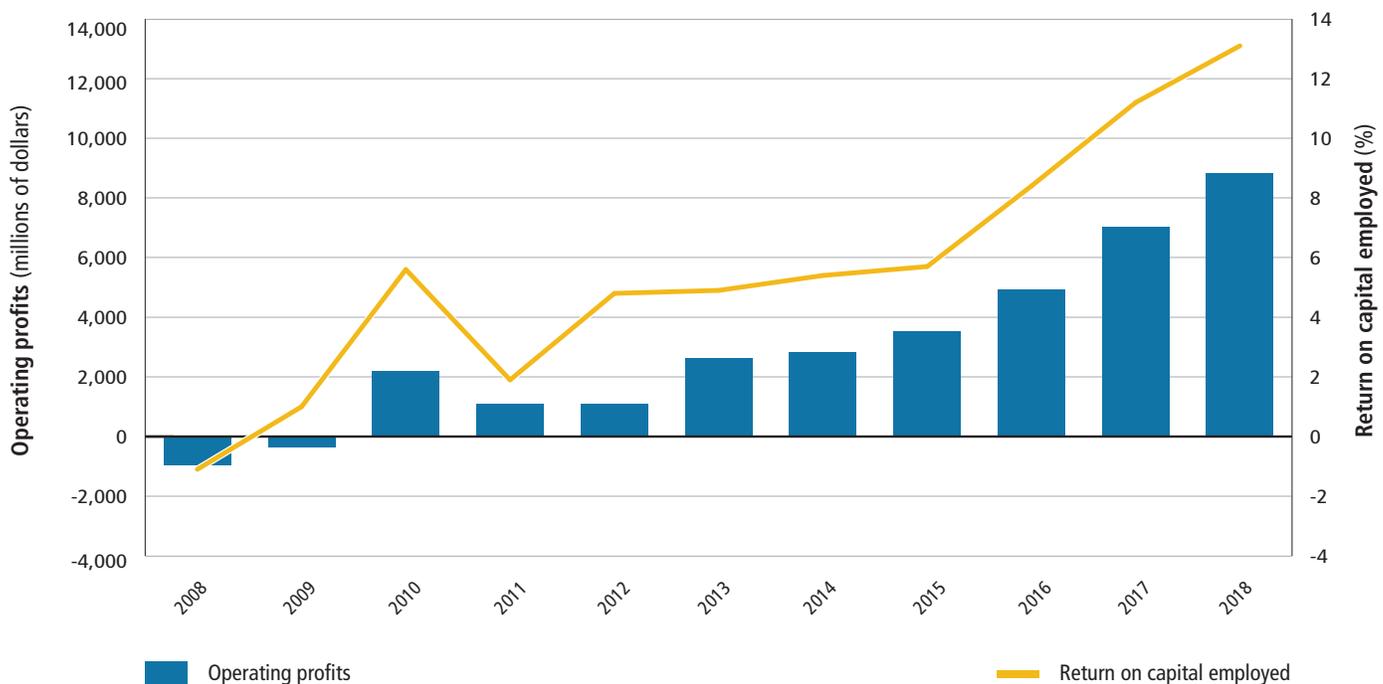
Why is this indicator important?

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

What is the outlook?

- Strong demand for wood products over the short term, along with a weaker Canadian dollar, supports a positive outlook for financial performance of the forest sector.
- However, fibre supply shortages (caused by wildfires and pest outbreaks), uncertainty about trade restrictions, and declining demand for some paper products could present challenges to the financial performance of Canada's forest industry in 2019.

Source: Statistics Canada. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Indicator: Secondary manufacturing

In 2018, the secondary wood and paper product industries in Canada generated over $5.8 billion in real gross domestic product (GDP). This represents a 3.2% decrease from 2017, and follows a 3.2% increase from 2016 to 2017. In 2018, real GDP from secondary manufacturing was 11% lower than 2008.

- Secondary wood manufacturing decreased by 1.8% in 2018, while secondary paper manufacturing fell by 4.4%.

- Secondary manufacturing accounted for 35% of the total contribution of forest product manufacturing to GDP in 2018, down slightly from 2017.

> 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, 2008–2018
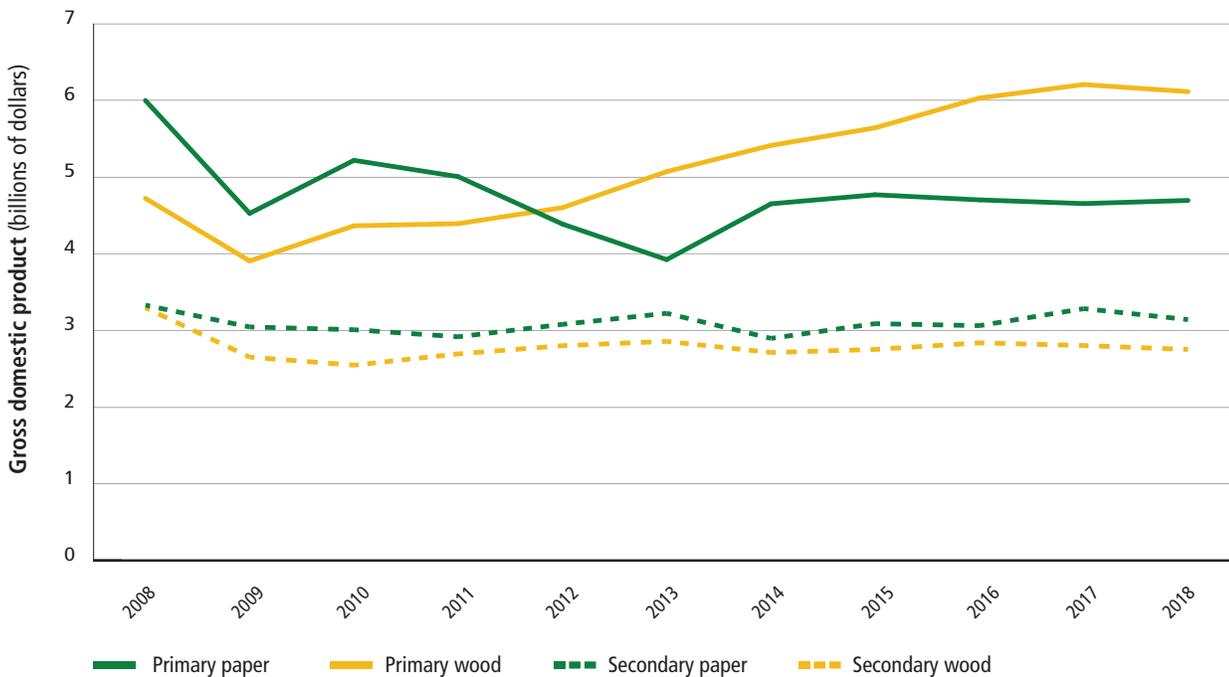
Why is this indicator important?

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

What is the outlook?

- Demand is expected to hold steady for secondary paper products as the North American economy enters a period of slower growth.

- Demand is expected to decline slightly for secondary wood products as rising interest rates and stricter mortgage lending rules continue to affect the Canadian housing market. However, the strong labour market and associated consumer spending growth may soften this decline.
- The Canadian and United States economies are expected to grow over the near term, albeit at slower rates than recent years. The outlook for secondary paper products is tempered by this slower growth. Both segments may be negatively affected by the increase in competition from low-cost international producers, and cooling in the domestic housing market will weaken demand for secondary wood products.

Source: Industry Canada; Statistics Canada. See **Sources and information** for more detail and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Indicator: Forest industry carbon emissions

Total greenhouse gas (GHG) emissions from fossil fuel use in the Canadian forest industry have decreased over the last 10 years. Energy use has remained relatively stable in recent years.

- The forest industry's ability to generate its own electricity, largely from bioenergy, has reduced its reliance on fossil fuels.
- The bioenergy share of the total energy use in the industry has been stable, accounting for 54% of energy use in the forest industry in 2016, slightly down from the 56% average observed over the 2005-2015 period.
- Between 2006 and 2016, the forest industry reduced energy use by 25% and total fossil GHG emissions (direct emissions plus indirect emissions from purchased electricity) by 38%.

> Canada measures its national emission levels annually for all sectors and assesses its emissions against targets for GHG reductions.
>
> **The forest industry has achieved both reductions in energy use through greater efficiencies and reductions in GHG emissions by reducing energy use and 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, 2006–2016

Legend: Total energy use ; GHG emissions
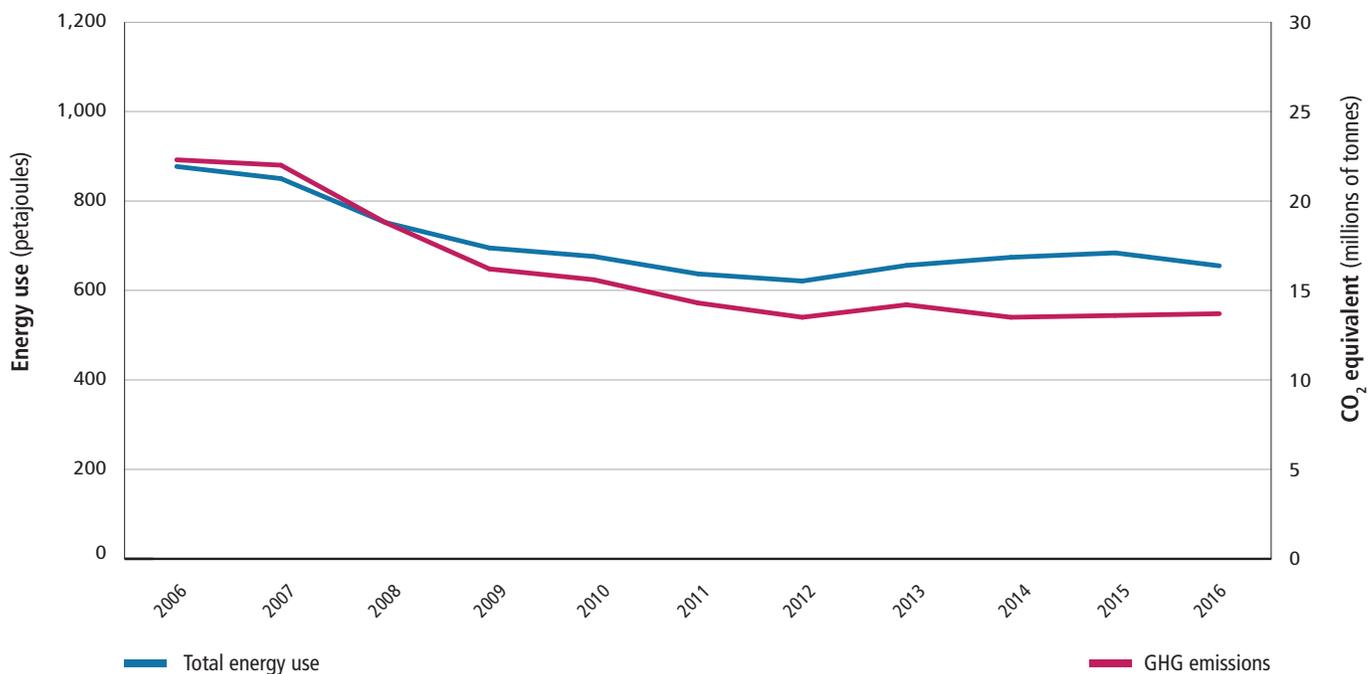
Why is this indicator important?

- Scientists agree that there is a strong link between climate change and activities that emit carbon dioxide, methane, nitrous oxide and other GHGs, such as burning fossil fuels.
- 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 implements policies to reduce GHGs.
- 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 and cfs.nrcan.gc.ca/stateoftheforests for additional data.

Statistical profiles

Canada
Population (January 2019): 37,314,442
Arboreal emblem: Maple

Forest inventory

Forest area by classification (hectares)

Forest land	347,039,050
Other wooded land	40,865,660
Other land with tree cover	8,498,940

Forest area change (hectares, 2017)

Afforestation	Not available
Deforestation (total; by sectors below)	35,386
Mining, oil and gas	13,094
Agriculture	12,280
Built-up	6,508
Hydroelectric	2,010
Forestry	1,494

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, 2017)

Area defoliated by insects and containing beetle-killed trees	15,628,659

Fire (2018)

Area burned (hectares)	2,272,274
Number of fires	7,067

Forest management

Harvesting (2017)

Area harvested (hectares)	756,295
Volume harvested (cubic metres)	156,717,595

Regeneration (hectares, 2017)

Area planted	409,559
Area seeded	17,866

Third-party certification (hectares, 2018)

Area certified	164,476,024

Protected forest (hectares, 2016)

Area protected	29,507,000

Greenhouse gas inventory

For forest lands affected by land-use change (2017)

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 (2017)

Area of managed forests (hectares)	226,000,000
Total net emissions or removals to the atmosphere, all causes (CO_2e/yr, megatonnes)	217.2
Net emissions or removals due to natural disturbances (CO_2e/yr, megatonnes)	236.9
Net emissions or removals due to human forest management activities and from harvested wood products (CO_2e/yr, megatonnes)	-19.6
Transfers from the managed forest sector to the forest products sector due to harvesting (CO_2e/yr, megatonnes)	-164.8

Domestic economic impact	
Canadian housing starts (2018)	212,843
Contribution to nominal GDP (current dollars, 2018)	
Forestry and logging industry	4,642,380,335
Pulp and paper product manufacturing industry	10,264,869,991
Wood product manufacturing industry	10,917,777,638
Total contribution to nominal GDP	25,825,027,964
Contribution to real GDP (constant 2012 dollars, 2018)	
Forestry and logging industry	4,168,000,000
Pulp and paper product manufacturing industry	7,836,000,000
Wood product manufacturing industry	8,865,000,000
Total contribution to real GDP	20,869,000,000
Revenue from goods manufactured (dollars, 2017)	
Logging industry	9,778,118,000
Pulp and paper product manufacturing industry	27,340,312,000
Wood product manufacturing industry	32,818,791,000
Total revenue from goods manufactured	69,937,221,000
Forest industry employment	
Employment (number, 2018)	
Survey of Employment, Payrolls and Hours	187,144
Canadian System of National Accounts	210,615
Natural Resources Satellite Account	233,407
Direct and indirect employment	302,489
Wages and salaries (dollars, 2017)	
Logging industry	1,606,199,000
Pulp and paper manufacturing industry	3,602,303,000
Wood product manufacturing industry	5,060,194,000
Total wages and salaries	10,268,696,000
Trade	
Balance of trade (total exports, dollars, 2018)	26,473,049,820
Value of exports (dollars, 2018)	
Primary wood products	1,486,887,228
Pulp and paper products	19,943,002,175
Wood-fabricated materials	16,919,954,993
Total value of exports	38,349,844,396
Value of imports (dollars, 2018)	
Primary wood products	585,747,658
Pulp and paper products	7,886,415,910
Wood-fabricated materials	3,404,631,008
Total value of imports	11,876,794,576

Domestic production and investment	
Production (2018)	
Softwood lumber (cubic metres)	64,741,800
Hardwood lumber (cubic metres)	1,302,100
Wood pulp (tonnes)	16,170,000
Printing and writing paper (tonnes)	3,057,000
Newsprint (tonnes)	3,000,000
Structural panels (plywood and oriented strandboard, cubic metres)	9,171,104
Capital expenditures (dollars, 2018)	
Forestry and logging industry	431,700,000
Pulp and paper product manufacturing industry	741,600,000
Wood product manufacturing industry	865,000,000
Total capital expenditures	2,038,300,000
Repair expenditures (dollars, 2017)	
Forestry and logging industry	411,000,000
Pulp and paper product manufacturing industry	1,051,400,000
Wood product manufacturing industry	1,018,200,000
Total repair expenditures	2,480,600,000
Domestic consumption	
Consumption (2018)	
Softwood lumber (cubic metres)	24,581,985
Hardwood lumber (cubic metres)	1,404,853
Wood pulp (tonnes)	6,999,576
Printing and writing paper (tonnes)	1,297,229
Newsprint (tonnes)	187,594
Structural panels (plywood and oriented strandboard, cubic metres)	2,601,389

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

British Columbia

Population (January 2019): 5,020,302
Arboreal emblem: Western redcedar

Disturbance

Insects (hectares, 2017)

Area defoliated by insects and containing beetle-killed trees	5,423,542

Fire (2018)

Area burned (hectares)	1,353,862
Number of fires	2,086

Forest management

Harvesting (2017)

Area harvested (hectares)	170,058
Volume harvested (cubic metres)	64,357,821

Regeneration (hectares, 2017)

Area planted	180,571
Area seeded	1,539

Third-party certification (hectares, 2018)

Area certified	50,352,453

Domestic economic impact

Housing starts (2018)	40,857

Revenue from goods manufactured (dollars, 2017)

Logging industry	4,768,522,000
Pulp and paper product manufacturing industry	4,773,090,000
Wood product manufacturing industry	11,539,203,000
Total revenue from goods manufactured	21,080,815,000

Forest industry employment

Employment (number, 2018)

Canadian System of National Accounts	54,085
Survey of Employment, Payrolls and Hours	52,886

Wages and salaries (dollars, 2017)

Logging industry	731,405,000
Pulp and paper product manufacturing industry	629,100,000
Wood product manufacturing industry	1,631,820,000
Total wages and salaries	2,992,325,000

Trade

Balance of trade (total exports, dollars, 2018)	12,742,821,366

Value of domestic exports (dollars, 2018)

Primary wood products	1,246,982,703
Pulp and paper products	5,299,294,578
Wood-fabricated materials	8,181,854,417
Total value of domestic exports	14,728,131,698

Value of imports (dollars, 2018)

Primary wood products	124,537,670
Pulp and paper products	893,912,563
Wood-fabricated materials	966,860,099
Total value of imports	1,985,310,332

Alberta

Population (January 2019): 4,345,737
Arboreal emblem: Lodgepole pine

Disturbance

Insects (hectares, 2017)

Area defoliated by insects and containing beetle-killed trees	1,079,333

Fire (2018)

Area burned (hectares)	59,809
Number of fires	1,288

Forest management

Harvesting (2017)

Area harvested (hectares)	96,200
Volume harvested (cubic metres)	27,124,577

Regeneration (hectares, 2017)

Area planted	74,768
Area seeded	343

Third-party certification (hectares, 2018)

Area certified	20,270,763

Domestic economic impact

Housing starts (2018)	26,085

Revenue from goods manufactured (dollars, 2017)

Logging industry	893,304,000
Pulp and paper product manufacturing industry	2,141,215,000
Wood product manufacturing industry	4,097,079,000
Total revenue from goods manufactured	7,131,598,000

Forest industry employment

Employment (number, 2018)

Canadian System of National Accounts	18,700
Survey of Employment, Payrolls and Hours	14,773

Wages and salaries (dollars, 2017)

Logging industry	187,075,000
Pulp and paper product manufacturing industry	237,612,000
Wood product manufacturing industry	615,105,000
Total wages and salaries	1,039,792,000

Trade

Balance of trade (total exports, dollars, 2018)	3,775,653,142

Value of domestic exports (dollars, 2018)

Primary wood products	21,015,158
Pulp and paper products	2,237,510,937
Wood-fabricated materials	1,893,021,540
Total value of domestic exports	4,151,547,635

Value of imports (dollars, 2018)

Primary wood products	2,211,730
Pulp and paper products	204,016,781
Wood-fabricated materials	169,665,982
Total value of imports	375,894,493

Saskatchewan
Population (January 2019): 1,168,423
Arboreal emblem: White birch

Disturbance	
Insects (hectares, 2017)	
Area defoliated by insects and containing beetle-killed trees	620,286
Fire (2018)	
Area burned (hectares)	118,985
Number of fires	416
Forest management	
Harvesting (2017)	
Area harvested (hectares)	20,703
Volume harvested (cubic metres)	3,888,287
Regeneration (hectares, 2017)	
Area planted	8,232
Area seeded	0
Third-party certification (hectares, 2018)	
Area certified	5,996,459
Domestic economic impact	
Housing starts (2018)	3,610
Revenue from goods manufactured (dollars, 2017)	
Logging industry	135,180,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	758,829,000
Total revenue from goods manufactured	Not available
Forest industry employment	
Employment (number, 2018)	
Canadian System of National Accounts	3,955
Survey of Employment, Payrolls and Hours	1,527
Wages and salaries (dollars, 2017)	
Logging industry	20,751,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	101,098,000
Total wages and salaries	Not available
Trade	
Balance of trade (total exports, dollars, 2018)	633,937,220
Value of domestic exports (dollars, 2018)	
Primary wood products	2,212,814
Pulp and paper products	355,501,292
Wood-fabricated materials	340,704,038
Total value of domestic exports	698,418,144
Value of imports (dollars, 2018)	
Primary wood products	5,636,585
Pulp and paper products	36,692,093
Wood-fabricated materials	22,152,246
Total value of imports	64,480,924

Manitoba
Population (January 2019): 1,360,396
Arboreal emblem: White spruce

Disturbance	
Insects (hectares, 2017)	
Area defoliated by insects and containing beetle-killed trees	1,068,179
Fire (2018)	
Area burned (hectares)	234,334
Number of fires	477
Forest management	
Harvesting (2017)	
Area harvested (hectares)	9,643
Volume harvested (cubic metres)	1,350,037
Regeneration (hectares, 2017)	
Area planted	2,854
Area seeded	0
Third-party certification (hectares, 2018)	
Area certified	11,091,302
Domestic economic impact	
Housing starts (2018)	7,376
Revenue from goods manufactured (dollars, 2017)	
Logging industry	46,182,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	457,965,000
Total revenue from goods manufactured	Not available
Forest industry employment	
Employment (number, 2018)	
Canadian System of National Accounts	4,410
Survey of Employment, Payrolls and Hours	3,197
Wages and salaries (dollars, 2017)	
Logging industry	12,105,000
Pulp and paper product manufacturing industry	Not available
Wood product manufacturing industry	107,187,000
Total wages and salaries	Not available
Trade	
Balance of trade (total exports, dollars, 2018)	-36,812,546
Value of domestic exports (dollars, 2018)	
Primary wood products	1,577,502
Pulp and paper products	290,822,861
Wood-fabricated materials	267,279,331
Total value of domestic exports	559,679,694
Value of imports (dollars, 2018)	
Primary wood products	6,946,385
Pulp and paper products	392,027,232
Wood-fabricated materials	197,518,623
Total value of imports	596,492,240

Ontario
Population (January 2019): 14,446,515
Arboreal emblem: Eastern white pine

Disturbance

Insects (hectares, 2017)

Area defoliated by insects and containing beetle-killed trees	1,510,810

Fire (2018)

Area burned (hectares)	265,587
Number of fires	1,327

Forest management

Harvesting (2017)

Area harvested (hectares)	138,243
Volume harvested (cubic metres)	15,813,210

Regeneration (hectares, 2017)

Area planted	45,609
Area seeded	12,545

Third-party certification (hectares, 2018)

Area certified	27,608,513

Domestic economic impact

Housing starts (2018)	78,742

Revenue from goods manufactured (dollars, 2017)

Logging industry	1,096,059,000
Pulp and paper product manufacturing industry	8,272,972,000
Wood product manufacturing industry	5,051,118,000
Total revenue from goods manufactured	14,420,149,000

Forest industry employment

Employment (number, 2018)

Canadian System of National Accounts	44,670
Survey of Employment, Payrolls and Hours	39,219

Wages and salaries (dollars, 2017)

Logging industry	187,103,000
Pulp and paper product manufacturing industry	1,238,367,000
Wood product manufacturing industry	946,997,000
Total wages and salaries	2,372,467,000

Trade

Balance of trade (total exports, dollars, 2018)	-1,431,554,089

Value of domestic exports (dollars, 2018)

Primary wood products	52,680,478
Pulp and paper products	2,935,623,303
Wood-fabricated materials	1,904,708,521
Total value of domestic exports	4,893,012,302

Value of imports (dollars, 2018)

Primary wood products	65,062,156
Pulp and paper products	4,807,928,619
Wood-fabricated materials	1,451,575,616
Total value of imports	6,324,566,391

Quebec
Population (January 2019): 8,433,301
Arboreal emblem: Yellow birch

Disturbance

Insects (hectares, 2017)

Area defoliated by insects and containing beetle-killed trees	5,317,954

Fire (2018)

Area burned (hectares)	62,529
Number of fires	593

Forest management

Harvesting (2017)

Area harvested (hectares)	202,007
Volume harvested (cubic metres)	30,013,740

Regeneration (hectares, 2017)

Area planted	73,342
Area seeded	Not available

Third-party certification (hectares, 2018)

Area certified	42,231,286

Domestic economic impact

Housing starts (2018)	46,874

Revenue from goods manufactured (dollars, 2017)

Logging industry	2,080,984,000
Pulp and paper product manufacturing industry	8,643,879,000
Wood product manufacturing industry	8,757,958,000
Total revenue from goods manufactured	19,482,821,000

Forest industry employment

Employment (number, 2018)

Canadian System of National Accounts	67,020
Survey of Employment, Payrolls and Hours	59,901

Wages and salaries (dollars, 2017)

Logging industry	323,672,000
Pulp and paper product manufacturing industry	1,041,021,000
Wood product manufacturing industry	1,328,969,000
Total wages and salaries	2,693,662,000

Trade

Balance of trade (total exports, dollars, 2018)	8,232,463,929

Value of domestic exports (dollars, 2018)

Primary wood products	109,013,203
Pulp and paper products	6,902,846,247
Wood-fabricated materials	3,429,185,680
Total value of domestic exports	10,441,045,130

Value of imports (dollars, 2018)

Primary wood products	312,719,192
Pulp and paper products	1,368,951,125
Wood-fabricated materials	526,910,884
Total value of imports	2,208,581,201

New Brunswick

Population (January 2019): 772,094
Arboreal emblem: Balsam fir

Disturbance

Insects (hectares, 2017)

Area defoliated by insects and containing beetle-killed trees	875

Fire (2018)

Area burned (hectares)	304
Number of fires	282

Forest management

Harvesting (2017)

Area harvested (hectares)	80,478
Volume harvested (cubic metres)	9,347,159

Regeneration (hectares, 2017)

Area planted	15,340
Area seeded	0

Third-party certification (hectares, 2018)

Area certified	4,234,837

Domestic economic impact

Housing starts (2018)	2,328

Revenue from goods manufactured (dollars, 2017)

Logging industry	607,655,000
Pulp and paper product manufacturing industry	1,897,428,000
Wood product manufacturing industry	1,607,643,000
Total revenue from goods manufactured	4,112,726,000

Forest industry employment

Employment (number, 2018)

Canadian System of National Accounts	11,395
Survey of Employment, Payrolls and Hours	9,630

Wages and salaries (dollars, 2017)

Logging industry	101,227,000
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, 2018)	1,655,326,511

Value of domestic exports (dollars, 2018)

Primary wood products	23,801,190
Pulp and paper products	1,183,802,472
Wood-fabricated materials	714,272,696
Total value of domestic exports	1,921,876,358

Value of imports (dollars, 2018)

Primary wood products	68,556,738
Pulp and paper products	153,440,439
Wood-fabricated materials	44,552,670
Total value of imports	266,549,847

Nova Scotia

Population (January 2019): 965,382
Arboreal emblem: Red spruce

Disturbance

Insects (hectares, 2017)

Area defoliated by insects and containing beetle-killed trees	4,753

Fire (2018)

Area burned (hectares)	253
Number of fires	190

Forest management

Harvesting (2017)

Area harvested (hectares)	27,816
Volume harvested (cubic metres)	3,292,525

Regeneration (hectares, 2017)

Area planted	5,059
Area seeded	Not available

Third-party certification (hectares, 2018)

Area certified	1,272,577

Domestic economic impact

Housing starts (2018)	4,786

Revenue from goods manufactured (dollars, 2017)

Logging industry	99,510,000
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, 2018)

Canadian System of National Accounts	4,520
Survey of Employment, Payrolls and Hours	2,735

Wages and salaries (dollars, 2017)

Logging industry	27,959,000
Pulp and paper product manufacturing industry	71,420,000
Wood product manufacturing industry	Not available
Total wages and salaries	Not available

Trade

Balance of trade (total exports, dollars, 2018)	693,478,886

Value of domestic exports (dollars, 2018)

Primary wood products	29,594,280
Pulp and paper products	544,285,864
Wood-fabricated materials	169,917,690
Total value of domestic exports	743,797,834

Value of imports (dollars, 2018)

Primary wood products	65,284
Pulp and paper products	24,959,255
Wood-fabricated materials	25,294,409
Total value of imports	50,318,948

Prince Edward Island
Population (January 2019): 154,748
Arboreal emblem: Red oak

Disturbance

Insects (hectares, 2017)

Area defoliated by insects and containing beetle-killed trees	27

Fire (2018)

Area burned (hectares)	13
Number of fires	10

Forest management

Harvesting (2017)

Area harvested (hectares)	2,777
Volume harvested (cubic metres)	342,812

Regeneration (hectares, 2017)

Area planted	309
Area seeded	0

Third-party certification (hectares, 2018)

Area certified	0

Domestic economic impact

Housing starts (2018)	1,089

Revenue from goods manufactured (dollars, 2017)

Logging industry	11,350,000
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, 2018)

Canadian System of National Accounts	510
Survey of Employment, Payrolls and Hours	Not available

Wages and salaries (dollars, 2017)

Logging industry	1,864,000
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, 2018)	26,191,918

Value of domestic exports (dollars, 2018)

Primary wood products	0
Pulp and paper products	25,786,486
Wood-fabricated materials	426,498
Total value of domestic exports	26,212,984

Value of imports (dollars, 2018)

Primary wood products	9,562
Pulp and paper products	8,658
Wood-fabricated materials	2,846
Total value of imports	21,066

Newfoundland and Labrador
Population (January 2019): 523,790
Arboreal emblem: Black spruce

Disturbance

Insects (hectares, 2017)

Area defoliated by insects and containing beetle-killed trees	1,873

Fire (2018)

Area burned (hectares)	395
Number of fires	132

Forest management

Harvesting (2017)

Area harvested (hectares)	7,810
Volume harvested (cubic metres)	1,132,835

Regeneration (hectares, 2017)

Area planted	3,469
Area seeded	3,439

Third-party certification (hectares, 2018)

Area certified	1,417,834

Domestic economic impact

Housing starts (2018)	1,096

Revenue from goods manufactured (dollars, 2017)

Logging industry	38,615,000
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, 2018)

Canadian System of National Accounts	1,095
Survey of Employment, Payrolls and Hours	46

Wages and salaries (dollars, 2017)

Logging industry	12,887,000
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, 2018)	180,976,054

Value of domestic exports (dollars, 2018)

Primary wood products	9,900
Pulp and paper products	167,501,777
Wood-fabricated materials	18,040,460
Total value of domestic exports	185,552,137

Value of imports (dollars, 2018)

Primary wood products	2,356
Pulp and paper products	4,478,198
Wood-fabricated materials	95,529
Total value of imports	4,576,083

Yukon

Population (January 2019): 40,369
Arboreal emblem: Subalpine fir

Disturbance

Insects (hectares, 2017)

Area defoliated by insects and containing beetle-killed trees	114,286

Fire (2018)

Area burned (hectares)	85,624
Number of fires	67

Forest management

Harvesting (2017)

Area harvested (hectares)	100
Volume harvested (cubic metres)	15,745

Regeneration (hectares, 2017)

Area planted	6
Area seeded	0

Third-party certification (hectares, 2018)

Area certified	0

Trade

Balance of trade (total exports, dollars, 2018)	541,071

Value of domestic exports (dollars, 2018)

Primary wood products	0
Pulp and paper products	0
Wood-fabricated materials	544,122
Total value of domestic exports	544,122

Value of imports (dollars, 2018)

Primary wood products	0
Pulp and paper products	947
Wood-fabricated materials	2,104
Total value of imports	3,051

Northwest Territories

Population (January 2019): 44,598
Arboreal emblem: Tamarack

Disturbance

Insects (hectares, 2017)

Area defoliated by insects and containing beetle-killed trees	486,741

Fire (2018)

Area burned (hectares)	15,738
Number of fires	59

Forest management

Harvesting (2017)

Area harvested (hectares)	460
Volume harvested (cubic metres)	38,847

Regeneration (hectares, 2017)

Area planted	0
Area seeded	0

Third-party certification (hectares, 2018)

Area certified	0

Trade

Balance of trade (total exports, dollars, 2018)	19,733

Value of domestic exports (dollars, 2018)

Primary wood products	0
Pulp and paper products	19,733
Wood-fabricated materials	0
Total value of domestic exports	19,733

Value of imports (dollars, 2018)

Primary wood products	0
Pulp and paper products	0
Wood-fabricated materials	0
Total value of imports	0

Nunavut

Population (January 2019): 38,787
Arboreal emblem: not yet determined

Trade

Balance of trade (total exports, dollars, 2018)	6,625

Value of domestic exports (dollars, 2018)

Primary wood products	0
Pulp and paper products	6,625
Wood-fabricated materials	0
Total value of domestic exports	6,625

Value of imports (dollars, 2018)

Primary wood products	0
Pulp and paper products	0
Wood-fabricated materials	0
Total value of imports	0

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.

Infographic: Canada's forests: Managing for the future

Stinson, G., Thandi, G., et al., A new approach for mapping forest management areas in Canada. *The Forestry Chronicle*, 2019, 95, https://doi.org/10.5558/tfc2019-017.

Infographic: Canada is a leader in sustainable forest management:

Canada Energy Regulator. Canada's Renewable Power Landscape 2017 – Energy Market Analysis. Table 1 Electric Capacity and Generation in Canada. https://www.neb-one.gc.ca/nrg/sttstc/lctrct/rprt/2017cndrnwblpwr/nwnthsrprt-eng.html

Certification Canada. Canadian statistics. http://certificationcanada.org/en/statistics/canadian-statistics/ (accessed March 10, 2019).

- Double counting of areas certified to both FSC and PEFC in 2018 have been removed from the total forest area certified for Russia, Brazil, Canada and the United States.
- Natural Resources Canada–Canadian Forest Service prepared calculations for net forest area certified in China under FSC and PEFC in 2018 based on:
  – Forest Stewardship Council. 2018. Facts & Figures December 2018. https://ic.fsc.org/file-download.facts-figures-december-2018.a-8012.pdf
  – Forest Stewardship Council. 2018. Double certification FSC and PEFC – estimations for mid-2018. https://ic.fsc.org/file-download.double-certification-fsc-and-pefc-estimations-for-mid-2018.a-8204.pdf
  – Programme for the Endorsement of Forest Certification. 2018. PEFC Annual Review 2018. https://storage.googleapis.com/pefc-platform/pefc.org/media/2019-04/d720635e-4297-4da4-a894-6ecede29871f/bfbeb3b6-8a49-5088-a665-33d7a1bc7d01.pdf

Conservation Areas Reporting and Tracking System. http://www.ccea.org/carts/

- Protected areas were identified in 2016 by using GIS data collected by the Canadian Council of Forest Ministers for a national project that mapped forest management. The information included data from the Conservation Areas Reporting and Tracking System (CARTS) and from provinces and territories on protected area boundaries and categorization.

– Canadian Council of Forest Ministers. Forest Management in Canada, 2017 Story Map. https://manitoba.maps.arcgis.com/apps/MapJournal/index.html?appid=86cdd21b2cd843888bf54787f90f2b5d (accessed November 27, 2019).
– National Forest Inventory. Map of Forest Management in Canada, 2017 version. https://open.canada.ca/data/en/dataset/d8fa9a38-c4df-442a-8319-9bbcbdc29060 (accessed November 27, 2019).
– Stinson, G., Thandi, G., et al. 2019. A new approach for mapping forest management areas in Canada. *Forestry Chronicle*, 95(2):101-112. https://doi.org/10.5558/tfc2019-017

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. Data provided by the *National Deforestation Monitoring System*, special tabulation, March 4, 2019.

Environment and Climate Change Canada. 2019. *National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.* https://unfccc.int/documents/194925 (accessed April 16, 2019).

- Environment and Climate Change Canada's *National Inventory Report 1990–2017: 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.

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. 2016. Global Forest Resource Assessment 2015. http://www.fao.org/forest-resources-assessment/past-assessments/fra-2015/en/

International Energy Agency. World Energy Statistics and Balances (2018 edition), OECD Renewable Balance. http://data.iea.org/payment/products/103-world-energy-statistics-and-balances-2016-edition.aspx

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 April 9, 2019).

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

National Forestry Database. Forest fires. http://nfdp.ccfm.org/en/data/fires.php (accessed April 9, 2019).

- The National Forestry Database sources 2018 fire data from the Canadian Interagency Forest Fire Centre (CIFFC).

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 April 9, 2019).

National Forest Inventory. https://nfi.nfis.org

- NFI baseline photo plot data collected during 2000–2006 were used to estimate the forest area within protected areas, assuming no change in forest area between 1990 and 2016. The forest area is generally stable in Canada and protected areas are typically less subject to land-use change than non-protected areas.
- The forest area is not the same as the area of tree cover. Some treed areas, such as treed urban and agricultural land areas, are not classified as forest. Some non-treed areas, such as recently harvested areas that will be replanted, are classified as forest. The area of tree cover is routinely mapped using satellite data, but land use is also taken into account when assessing the area of forest.

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

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 April 18, 2019).

Natural Resources Canada. Comprehensive energy use database. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm (accessed November 27, 2019).

- 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

Natural Resources Canada–Canadian Forest Service. Calculations for forest sector contribution to communities based on 1) Statistics Canada, 2016 Census of Population, and 2) Natural Resources Canada–Canadian Forest Service, North American boreal zone map shapefiles.

- This year, the Canadian Forest Service adopted a new method for identifying communities that rely on economic activity from natural resource sectors. See **Sources and information** for Sustainability indicator **Communities** for more detail.

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

- Natural Resources Canada–Canadian Forest Service calculations for Indigenous and immigrant employment are based on 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.
  - "Immigrant" refers to anyone who is a permanent resident or obtained Canadian citizenship in Canada, but is not a citizen by birth.

Statistics Canada. 2018. Labour Force Survey (custom tabulation, February 9, 2018).

- Gender breakdown of employment calculated from Labour Force Survey. Values shown are based on three-year averages. Values shown for the year 1990 are based on an average of the values for the years 1990, 1991 and 1992. Values shown for the years 2000, 2010 and 2015 are based on a three year average spanning the period from one year prior to one year after the year in question. Values have been rounded and adjusted to ensure categories total to 100%.

Statistics Canada. 2018. Statistical Overview of the Canadian Maple Industry 2017. http://www.agr.gc.ca/eng/industry-markets-and-trade/canadian-agri-food-sector-intelligence/horticulture/horticulture-sector-reports/statistical-overview-of-the-canadian-maple-industry-2017/?id=1524607854094 (accessed April 2, 2019).

Statistics Canada. 2018. Table 37-10-0020-01. Postsecondary graduates by institution type, sex and student status. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3710002001 (accessed May 30, 2018).

- Values reported on graduation from the agriculture, natural resources and conservation field. Field of study is defined by the Primary Groups of the Classification of Instructional Programs for Enrolments and Graduates and are adapted from the 2011 Classification of Instructional Programs (CIP), Statistics Canada's standard for the classification of instructional programs. The level of education at graduation is defined by UNESCO's International Standard Classification of Education (ISCED), which is the reference classification for organizing education programs and related qualifications by education levels and fields. The basic concepts and definitions of ISCED are intended to be internationally valid and comprehensive of the full range of education systems.

Statistics Canada. Table 36-10-0401-01 (formerly CANSIM 379-0029): Gross domestic product (GDP) at basic prices by industry. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040101 (accessed May 1, 2019).

- Natural Resources Canada–Canadian Forest Service's calculations for 2018 nominal GDP is based on Statistics Canada's Tables 36-10-0434-01, 18-10-0032-01 and 18-10-0029-01 (formerly CANSIM 379-0031, 329-0077 and 329-0074, respectively): GDP in 2012 constant prices, and estimated industry price deflators indexed to 2010.

Statistics Canada. Table 36-10-0489-01 (formerly CANSIM 383-0031): Labour statistics consistent with the System of National Accounts (SNA), by job category and industry. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610048901 (accessed May 22, 2019).

Wildlife Conservation Society Canada. Boreal Birds. https://www.wcscanada.org/Wildlife/Boreal-Birds.aspx

Article: The "second life" of trees support a low carbon future

Environment and Climate Change Canada. 2019. *National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.* https://unfccc.int/documents/194925 (accessed April 16, 2019).

- Environment and Climate Change Canada's *National Inventory Report 1990–2017: 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–Canadian Forest Service. *Dimension Lumber.* https://www.nrcan.gc.ca/forests/industry/products-applications/15839

Natural Resources Canada. Comprehensive energy use database. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm (accessed June 14, 2019).

- Data calculated using NRCan Residential End-Use Model and Electricity Energy-Use Model.

Smyth, C.E., Stinson, G., et al., (2014). Quantifying the biophysical climate change mitigation potential of Canada's forest sector. *Biogeosciences* 11: 3515-3529. https://www.biogeosciences.net/11/3515/2014/

Statistics Canada. 2019. *Report on Energy Supply and Demand in Canada* (2016 final). https://www150.statcan.gc.ca/n1/pub/57-003-x/57-003-x2019001-eng.htm (accessed June 14, 2019).

Photo credits:

- Photo of cross-laminated timber panels. Natural Resources Canada–Canadian Forest Service.
- Photo of wood pellets courtesy of Pacific BioEnergy Prince George LP.
- Photo of Origine, courtesy of Stephane Groleau.

Article: Transparent wood, 3D printing, and stealth technology

Canadian Biomass Magazine. Developing high performance plastics from wood. January 2, 2019. https://www.canadianbiomassmagazine.ca/developing-high-performance-bioplastics-from-wood-7184/

Discover. Transparent Wood Is a Surprisingly Versatile Material. May 16, 2016. http://blogs.discovermagazine.com/d-brief/2016/05/16/transparent-wood-is-a-surprisingly-versatile-material/

Natural Resources Canada–Canadian Forest Service. IFIT-Funded projects. https://www.nrcan.gc.ca/forests/federal-programs/15867

Scientific American. Stronger Than Steel, Able to Stop a Speeding Bullet – It's Super Wood! February 2, 2018. https://www.scientificamerican.com/article/stronger-than-steel-able-to-stop-a-speeding-bullet-mdash-it-rsquo-s-super-wood/

The International Lignin Institute. About Lignin. http://www.ili-lignin.com/aboutlignin.php

The Sarnia Observer. Origin Materials bio-plant moving ahead. August 23, 2018. https://www.theobserver.ca/news/local-news/origin-materials-bio-plant-moving-ahead

United States Department of Agriculture. Revolutionary carbon foam from wood. October 18, 2018. https://www.fs.fed.us/features/revolutionary-carbon-foam-wood

Photo credits:

- 3D printing machine. Photo by kynny/iStock by Getty Images.
- Plastic Bottle. Photo by MiguelMalo/iStock by Getty Images.
- Photo of engineered wood fibre mat courtesy of TTS Inc.

Article: Urban forests: a connection through time

CBC. Video game simulates survival in a future Delta devastated by climate change. September 15, 2016. https://www.cbc.ca/news/canada/british-columbia/video-game-simulates-survival-in-a-future-delta-devastated-by-climate-change-1.3762683

Forests Ontario. https://www.forestsontario.ca/

L'Alliance forêt urbaine. http://www.allianceforeturbaine.com/

LEAF – Local Enhancement & Appreciation of Forests. Recognizing a little piece of Toronto's past. November 7, 2013. https://www.yourleaf.org/blog/andrea-bake/nov-07-2013/recognizing-little-piece-toronto%E2%80%99s-past

Montreal Gazette. Opinion: Montreal shows the rest of Canada how to save urban trees. July 18, 2018. https://montrealgazette.com/opinion/opinion-montreal-shows-the-rest-of-canada-how-to-save-urban-trees

Projet Montréal. Urban canopy: Montreal has only planted 24 % of the trees planned. April 20, 2017. http://en.projetmontreal.org/urban_canopy

The Coast. Halifax's forest guardian. August 9, 2018. https://www.thecoast.ca/halifax/halifaxs-forest-guardian/Content?oid=16468836

The University of British Columbia. Future Delta 2.0 – Climate Change Video Game. http://futuredelta2.ca/

The University of British Columbia. Citizen's Coolkit on Climate Change & Urban Forestry. http://calp.forestry.ubc.ca/home/urban-forestry-toolkit/

Tourism Nova Scotia. Point Pleasant Park. https://www.novascotia.com/see-do/attractions/point-pleasant-park/1461

Photo credits:

- Child connecting with nature. Photo by stockstudioX/iStock by Getty Images.
- Autumn Colors in Montreal City. Photo by buzbuzzer/iStock by Getty Images.
- Photo of video game courtesy of Collaborative for Advanced Landscape Planning at the University of British Columbia.

Article: Women championing women in forestry

Forest Products Association of Canada. The Importance of Women In Our Workforce – Message from Tanya Wick, Tolko, VP People and Services. September 26, 2018. http://www.fpac.ca/the-importance-of-women-in-our-workforce-message-from-tanya-wick-tolko-vp-people-and-services/

Sistering Indigenous and Western Science. https://www.sinewsproject.com/

Tolko. Tanya Wick: Blazing trails for women in forestry. https://tolko.com/tolkocpt_careers/tanya-wick-blazing-trails-for-women-in-forestry/

Women In Wood. https://www.womeninwood.ca/

Photo credits:

- Photo of Katrina Van Osch-Saxon courtesy of Fleming College.
- Photo of Cindy Shaw and Nicole Heshka courtesy of Cindy Shaw and Nicole Heshka.
- Photo of Tanya Wick courtesy of Tolko Industries Ltd.
- Photo of Lacey Rose and Jess Kaknevicius courtesy of Lacey Rose.

Sustainability indicators

Photo credits:

- Photo of tree bark sampling courtesy of Roger Brett.
- Worker in helmet counts wood lumber. Photo by alexkich/iStock by Getty Images.
- Two happy travelers with backpacks walking in a winter forest. Photo by Kirzaa/iStock by Getty Images.

How much forest does Canada have?

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

- Describes Canada's deforestation monitoring system. Note that the system was initially set up for greenhouse gas inventory and forest carbon accounting purposes, so it uses the greenhouse gas inventory and carbon accounting definition of forest.

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

- Describes the methodology used to adjust the National Forest Inventory baseline estimate of forest area.

Food and Agriculture Organization of the United Nations. *Global Forest Resource Assessment 2015.* http://www.fao.org/forest-resources-assessment/en/

- This dataset was used to calculate Canada's forest area as a proportion of the world's forest area as well as forest area per capita.

Food and Agriculture Organization of the United Nations. 2018. *Global Forest Resources Assessment 2020: Terms and definitions.* http://www.fao.org/3/I8661EN/i8661en.pdf

- The definitions of forest and afforestation and other terms are described in this document. Note that Canada uses this definition of forest for most but not all purposes. A slightly different definition is used for the national greenhouse gas inventory and forest carbon accounting.

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 March 7, 2019).

- Baseline estimate of Canada's forest

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 November 18, 2019).

Photo credits:

- Rocky Mountain forest view of Mount Rundle in Banff National park. Photo by Pgiam/iStock by Getty Images.
- Evergreen tree sprouts in the ashes of a forest fire. Photo by jamievanbuskirk/iStock by Getty Images.

Indicator: Forest area

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.

- Describes Canada's deforestation monitoring system. Note that the system was initially set up for greenhouse gas inventory and forest carbon accounting purposes, so it uses the greenhouse gas inventory and carbon accounting definition of forest.

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

- Describes the methodology used to adjust the National Forest Inventory baseline estimate of forest area. This methodology was applied to forest area as well as forest area by ecozone. The description includes the afforestation data used for adjustments.

Food and Agriculture Organization of the United Nations. 2018. *Global Forest Resources Assessment 2020: Terms and definitions.* http://www.fao.org/3/I8661EN/i8661en.pdf

- Definitions of forest and afforestation and other terms are described in this document. Note that Canada uses this definition of forest for most but not all purposes. A slightly different definition is used for national greenhouse gas inventory and forest carbon accounting.

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 March 7, 2019).

- Baseline estimate of Canada's forest area.

National Forest Inventory. Standard reports, Table 4.1. Area (1000 ha) of forest and non-forest land by terrestrial ecozone in Canada. https://nfi.nfis.org/resources/general/summaries/en/html/NFI3_T4_FOR_AREA_en.html (accessed March 7, 2019).

- Baseline estimate of Canada's forest area by ecozone.

Publications referenced when considering the potential effects of climate change on forest area:

- **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. https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/impacts/changing-climate-changing-forest-zones/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

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, March 4, 2019.

Environment and Climate Change Canada. 2019. *National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.* https://unfccc.int/documents/194925 (accessed April 16, 2019).

- Environment and Climate Change Canada's *National Inventory Report 1990–2017: 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

- Natural Resources Canada–Canadian Forest Service's National Deforestation Monitoring System and National 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 include hydroelectric reservoirs.
- Deforestation by the forestry sector includes 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

Kurz, W.A., Dymond, C.C., et al. 2009. CBM-CFS3: A model of carbon-dynamics in forestry and land-use change implementing IPCC standards. *Ecological Modelling* 220, 480–504. https://cfs.nrcan.gc.ca/publications?id=29137

- Description of the NFCMARS model.

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

- Baseline estimate of Canada's wood volume.

National Forestry Database. http://www.nfdp.ccfm.org

- Areas disturbed by insects, forest fires and harvesting.

Publications referenced on the effects of climate change on forest growth, health and fire regimes include:

- **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. https://cfs.nrcan.gc.ca/publications?id=37463

- **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

Methodology used to adjust baseline estimates of wood volume

- Canada's National Forest Inventory (NFI) is completing the data processing, quality control, compilation and estimation for its first re-measurement cycle (2008 to 2017). Canada is therefore in a position to report national wood volume estimates for only one period using NFI data. NFI baseline data were collected from 2000 to 2006, and the wood volume estimate based on these data is reported here in the 2000 reporting year.
- Forecasting and backcasting from 2000 was done using above-ground biomass carbon stock estimates from Canada's National Forest Carbon Monitoring Accounting and Reporting System (NFCMARS). Changes in wood volume should be closely related to changes in above-ground forest biomass and above-ground forest biomass carbon. Wood volume in 2000 was used to calculate wood volume in all other reporting years using the change in above-ground biomass carbon stock relative to 2000, as follows:
  – Wood volume in [year] = (wood volume in 2000) x (above-ground biomass in [year] / above-ground biomass in 2000)
  – Wood volume data are typically used to derive above-ground biomass and carbon data, but the opposite was done here because the NFI has only one complete measurement cycle whereas NFCMARS has a complete time series from 1990 to 2016.
  – In NFCMARS, the Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3) uses merchantable wood volume growth increment data and converts these to biomass and then carbon, but this all happens internally in the model, and CBM-CFS3 outputs are all in units of carbon (CBM-CFS3: a model of carbon dynamics in forestry and land-use change implementing IPCC standards. 2009. Kurz et al.).
  – Note that NFCMARS does not provide data for all of Canada's forests. It is assumed here that the above-ground biomass carbon stock trend in Canada's managed forests is a good predictor of wood volume trend for Canada's entire forest (managed and unmanaged).

Photo credit:

- Hiking ancient cedars. Photo by stockstudioX/iStock by Getty Images.

Indicator: Forest area within protected areas

Conservation Areas Reporting and Tracking System www.ccea.org/carts/

- The Conservation Areas Reporting and Tracking System (CARTS) was used to identify protected areas in 1990, 2000 and 2010. GIS datasets that have protection status in CARTS were used. Because no single CARTS dataset provides comprehensive data for all three years, several CARTS versions were combined along with data from Quebec to provide as complete a dataset as possible. These data included the establishment date of protected areas and, for expanded protected areas, the expansion date and original boundaries prior to expansion. All International Union for Conservation of Nature (IUCN) category Ia, Ib, II, III and IV protected areas were included.
- Protected areas were identified in 2016 by using GIS data collected by the Canadian Council of Forest Ministers for a national project that mapped forest management. The information included data from CARTS and from provinces and territories on protected area boundaries and categorization.
  – **Canadian Council of Forest Ministers.** Forest Management in Canada, 2017 Story Map. https://manitoba.maps.arcgis.com/apps/MapJournal/index.html?appid=86cdd21b2cd843888bf54787f90f2b5d (accessed November 27, 2019).

- **National Forest Inventory.** Map of Forest Management in Canada, 2017 version. https://open.canada.ca/data/en/dataset/d8fa9a38-c4df-442a-8319-9bbcbdc29060 (accessed November 27, 2019).
- **Stinson, G., Thandi, G., et al.** 2019. A new approach for mapping forest management areas in Canada. *Forestry Chronicle*, 95(2): 101-112. https://cfs.nrcan.gc.ca/publications?id=39934

Government of Canada. *Conservation 2020*. https://www.conservation2020canada.ca/home

National Forest Inventory. https://nfi.nfis.org

- NFI baseline photo plot data collected from 2000 to 2006 were used to estimate the forest area within protected areas, assuming no change in forest area between 1990 and 2016. The forest area is generally stable in Canada and protected areas are typically less subject to land-use change than non-protected areas.
- The forest area is not the same as the area of tree cover. Some treed areas, such as treed urban and agricultural land areas, are not classified as forest. Some non-treed areas, such as recently harvested areas that will be replanted, are classified as forest. The area of tree cover is routinely mapped using satellite data, but land use is also taken into account when assessing the area of forest.

Is timber being harvested sustainably?

Certification Canada. Canadian statistics. http://certificationcanada.org/en/statistics/canadian-statistics/ (accessed April 2, 2019).

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 April 9, 2019).

- Harvests include industrial roundwood only and exclude fuelwood 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 categorized as "unspecified." Typically, this harvest occurs in mixedwood forests where neither softwood nor hardwood categories strictly apply. This harvest 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.

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 April 18, 2019).

Indicator: Area harvested

National Forestry Database. Harvest, Table 5.2 Area harvested by jurisdiction, tenure, management and harvesting method. https://nfi.nfis.org/resources/general/summaries/en/html/CA3_T12_FOROWN_AREA_en.html (accessed April 9, 2019).

- Data include provincial and territorial Crown and private forest land subject to even-aged management (clearcutting), uneven-aged management (selection cutting), and commercial thinning harvest methods.
- The 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 April 9, 2019).

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 April 9, 2019).

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 April 9, 2019).

- Data are for forests on provincial and territorial Crown lands across Canada.
- Federally and privately owned lands are excluded.
- Natural regeneration is often the most efficient approach for regenerating harvested areas. One scenario is when there is abundant existing understorey regeneration and a plentiful seed supply (e.g. lowland black spruce and tolerant hardwoods, respectively). Another scenario is 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 April 9, 2019).

- Wood supply includes allowable annual cuts for provincial and territorial Crown lands and potential harvests for federal and private lands.
- The discrepancy between the "total industrial roundwood" supply volumes and the sum of the "total industrial softwoods" and "total industrial hardwoods" supply volumes is due to a very small amount of harvest categorized as "unspecified." This supply represents some of the federal wood supply that has not been differentiated between "softwood" or "hardwood."

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 April 9, 2019).

- Harvests include industrial roundwood only and exclude fuelwood 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 categorized 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.

Indicator: Forest area with long-term management plans

Natural Resources Canada–Canadian Forest Service. 2018.

- Provinces and territories supplied the data for the total forest area with a long-term management plan, which were compiled by Natural Resources Canada–Canadian Forest Service. The data were adjusted to align with the total forest area as reported in Canada's National Forest Inventory and in the sustainability indicator Forest area in *The State of Canada's Forests 2019*.

How does disturbance shape Canada's forests?

Boucher, D., Boulanger, Y., et al. 2018. Current and projected cumulative impacts of fire, drought, and insects on timber volumes across Canada. *Ecological Applications* 28, 1245–1259. https://cfs.nrcan.gc.ca/publications?id=39205

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

Gillett, N.P., Weaver, A.J. 2004. Detecting the effect of climate change on Canadian forest fires. *Geophysical Research Letters* 31, L18211. https://cfs.nrcan.gc.ca/publications?id=24957

Hanes, C.C., Wang, X., et al. 2019. Fire-regime changes in Canada over the last century. *Canadian Journal of Forest Research* 49, 256–269. https://cfs.nrcan.gc.ca/publications?id=39501

Kurz, W.A., Stinson, G., et al. 2008. Risk of natural disturbances makes future contribution of Canada's forests to the global carbon cycle highly uncertain. *Proceeding of the National Academy of Sciences* 105, 1551–1555. https://cfs.nrcan.gc.ca/publications?id=28079

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. https://cfs.nrcan.gc.ca/publications?id=35306

Photo credits:
- Asian longhorned beetle photo by Taylor Scarr, Canadian Forest Service.
- Emerald ash borer photo by David Cappaert, Bugwood.org.
- European gypsy moth photo by USDA.
- Hemlock woolly adelgid photo by Connecticut Agricultural Experiment Station Archive, Connecticut Agricultural Experiment Station, Bugwood.org.

Indicator: Forest 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 April 9, 2019).

- 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.

Photo credits:
- Photo of mature forest tent caterpillar. Natural Resources Canada–Canadian Forest Service.
- Photo of spruce budworm courtesy of Véronique Martel.

Indicator: Forest diseases

Bérubé, J.A., Gagné, P.N., et al. 2018. Detection of *Diplodia corticola* spores in Ontario and Québec based on High Throughput Sequencing (HTS) methods. *Canadian Journal of Plant Pathology* 40, 378–386. https://cfs.nrcan.gc.ca/publications?id=39279

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

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. https://cfs.nrcan.gc.ca/publications?id=38721

Hunt, R.S., Geils, B.W., and Hummer, K.E. 2010. White pines, *Ribes*, and blister rust: integration and action. *Forest Pathology* 40, 402–417. https://cfs.nrcan.gc.ca/publications?id=32732

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. https://cfs.nrcan.gc.ca/publications?id=35306

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. https://cfs.nrcan.gc.ca/publications?id=36754

Tremblay, É.D., Duceppe, M-O., et al. 2018. Screening for exotic forest pathogens to increase survey capacity using metagenomics. *Phytopathology* 108, 1509–1521. https://cfs.nrcan.gc.ca/publications?id=39425

Tremblay, É.D., Kimoto, T., et al. 2019. High-throughput sequencing to investigate phytopathogenic fungal propagules caught in baited insect traps. *Journal of Fungi* 5 (1), 15. https://cfs.nrcan.gc.ca/publications?id=39521

Photo credit:
- Photo of infected white spruce needles by Tod Ramsfield.

Indicator: Forest fires

BC Air Quality. Air Quality Health Index – What's the Air Like Today? http://www.env.gov.bc.ca/epd/bcairquality/readings/aqhi-table.xml# (accessed August 19, 2018).

BC Government News. Wildfire activity in Bulkley and Cassiar fire zones. https://news.gov.bc.ca/releases/2018FLNR0238-001618 (accessed March 28, 2019).

British Columbia Data Catalogue. Fire Perimeters – Current. https://catalogue.data.gov.bc.ca/dataset/fire-perimeters-current (accessed March 28, 2019).

Canadian Broadcasting Corporation. 2017. Military to help evacuate 3 Manitoba First Nations at risk from wildfire. https://www.cbc.ca/news/canada/manitoba/manitoba-fire-evacuation-military-1.4267978 (accessed March 28, 2019).

Canadian Broadcasting Corporation. 2018. B.C. wildfires burned large areas affected by mountain pine beetles, experts say. https://www.cbc.ca/news/canada/british-columbia/b-c-wildfires-burned-large-areas-affected-by-mountain-pine-beetles-experts-say-1.4834829 (accessed March 28, 2019).

Canadian Broadcasting Corporation. 2018. Drought worsens as fires continue to burn throughout B.C. https://www.cbc.ca/news/canada/british-columbia/drought-worsens-as-fires-continue-to-burn-throughout-b-c-1.4800686 (accessed March 28, 2019).

Canadian Broadcasting Corporation. 2018. Eastern Manitoba First Nations evacuated as huge fire approaches. https://www.cbc.ca/news/canada/manitoba/manitoba-forest-fires-1.4674143 (accessed March 28, 2019).

Canadian Broadcasting Corporation. 2018. Kenmount Terrace residents allowed home after forest fire threatens neighbourhood. https://www.cbc.ca/news/canada/newfoundland-labrador/kenmount-fire-1.4739222 (accessed March 28, 2019).

Canadian Interagency Forest Fire Centre. 2018. Archived Situation Reports. https://www.ciffc.ca/fire-information/archived-situation-reports (accessed November 20, 2019).

Ontario Emergency Preparedness. Forest Fires – Regional fire situation. 2018. https://www.ontario.ca/page/forest-fires (accessed March 28, 2019).

National Forestry Database. Forest fires. http://nfdp.ccfm.org/en/data/fires.php (accessed April 9, 2019).

- The National Forestry Database sources 2018 fire data from the Canadian Interagency Forest Fire Centre.

National Post. 2018. Australia, New Zealand and Mexico firefighters fly in to help battle out-of-control B.C. wildfire blazes. https://nationalpost.com/news/canada/hundreds-of-b-c-wildfires-prompt-request-for-help-from-out-of-province-crews (accessed March 28, 2019).

Natural Resources Canada–Canadian Forest Service. Canadian Wildland Fire Information System – Interactive map. http://cwfis.cfs.nrcan.gc.ca/interactive-map (accessed April 12, 2019).

Natural Resources Canada–Canadian Forest Service. Canadian Wildland Fire Information System – Fire Weather Maps. http://cwfis.cfs.nrcan.gc.ca/maps/fw (accessed March 28, 2019).

Perrakis, D.D.B., Lanoville, R.A., et al. 2014. Modeling wildfire spread in mountain pine beetle-affected forest stands, British Columbia, Canada. *Fire Ecology* 10(2), 10–35. https://doi.org/10.4996/fireecology.1002010

Peter, B., S. Wang, et al. 2006. Fire risk and population trends in Canada's wildland – urban interface. In Hirsch, K.G. and P. Fuglem, eds. *Canadian Wildland Fire Strategy: Background Syntheses, Analyses, and Perspectives.* Canadian Council of Forest Ministers: Edmonton, AB, Canada.

Photo credits:

- Good Creek Wildfire 1. Photo by Pinderphoto/iStock by Getty Images.

Indicator: Carbon emissions and removals

Environment and Climate Change Canada. 2019. *National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.* https://unfccc.int/documents/194925 (accessed April 16, 2019).

- 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 estimates changes in biomass, woody debris, litter and soil carbon pools. 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. Carbon storage and emissions resulting from these products, regardless of where in the world these emissions occur, are included.
- "Managed land" includes all lands managed for production of any wood products or wood-based bioenergy, for protection from natural disturbances, or for the conservation of ecological values. Within those managed lands, "forest" includes areas of 1 ha 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 include only those areas assigned to the natural partition where tree mortality caused by insects exceeded 20% of biomass.
- 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 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_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. 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 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
  - **Kurz, W.A., Hayne, S., et al.** 2018. Quantifying the impacts of human activities on reported greenhouse gas emissions and removals in Canada's managed forest: Conceptual framework and implementation. *Canadian Journal of Forest Research* 48, 1–14. https://doi.org/10.1139/cjfr-2018-0176
  - **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. https://www.nrcan.gc.ca/forests/climate-change/carbon-accounting/13107 (accessed April 10, 2019).
  - **Ogle, S.M., Domke, G., et al.** 2018. Delineating Managed Land for Reporting National Greenhouse Gas Emissions and Removals to the United Nations Framework Convention on Climate Change. *Carbon Balance Management* 13(9). https://doi.org/10.1186/s13021-018-0095-3
  - **Natural Resources Canada–Canadian Forest Service.** Inventory and land-use change. https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/carbon-accounting/inventory-and-land-use-change/13111 (accessed April 10, 2019).

– **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

Photo credit:

- Firefighting a forest fire with white smoke. Photo by Mooneydriver/iStock by Getty Images.

How do forests benefit Canadians?

Natural Resources Canada–Canadian Forest Service. Calculations 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/our-natural-resources/forests-forestry/sustainable-forest-management/boreal-forest/north-american-boreal-zone-map-shapefiles/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. Table 36-10-0489-01 (formerly CANSIM 383-0031): Labour statistics consistent with the System of National Accounts (SNA), by job category and industry. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610048901 (accessed May 22, 2019).

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).

- 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).

Indicator: Employment

Statistics Canada. Table 36-10-0489-01 (formerly CANSIM 383-0031): Labour statistics consistent with the System of National Accounts (SNA), by job category and industry. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610048901 (accessed May 22, 2019).

- Data include NAICS 113, 1153, 322, and 321.

Indicator: Average earnings

Statistics Canada. Table 14-10-0204-01 (formerly CANSIM 281-0027): Average weekly earnings by industry, annual https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410020401 (accessed April 3, 2019).

Statistics Canada. Table 18-10-0005-01 (formerly CANSIM 326-0021): Consumer Price Index, annual average, not seasonally adjusted https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000501 (accessed April 3, 2019).

- Additional information can be found at Natural Resources Canada–Canadian Forest Service. Industry – Overview. http://www.nrcan.gc.ca/forests/industry/13311

- The data excludes overtime.
- The 2018 average earnings were calculated using the Consumer Price Index re-based to 2012 values. Data from years prior to 2018 were updated as well and will differ from what was reported in previous reports.
- Issues of *The State of Canada's Forests* prior to 2018 calculated real average earnings using GDP at market prices as the measure of inflation. In this report, the Consumer Price Index (including volatile commodities) was used again because it is a better indicator of the spending power of Canadians.

Indicator: Communities

Natural Resources Canada–Canadian Forest Service. Calculations based on Statistics Canada, 2016 Census of Population and Natural Resources Canada–Canadian Forest Service, North American boreal zone map shapefiles. https://www.nrcan.gc.ca/our-natural-resources/forests-forestry/sustainable-forest-management/boreal-forest/north-american-boreal-zone-map-shapefiles/14252

- This year, the Canadian Forest Service adopted a new method for identifying communities that rely on economic activity from natural resource sectors. The method is based on the sector dependence index (SDI), a well-established approach to assess the relative importance of a given sector to local economies. In addition to considering the share of total income generated from the forest sector, we used the SDI to establish if the forest sector provides a high number of jobs (relative to the average Canadian community). We also established if there are many other sectors that are also a source of jobs for local residents.
- Last year, we reported that the forest sector was a major source of income for 105 census subdivisions in Canada. This year we followed this new method to report that 300 Canadian communities rely on the forest sector for a significant share of economic activity.
- "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 (DA). 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
- 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," not "in the labour force" (which includes those people "unemployed").
- GIS-based analyses used the BOREAL and B_ALPINE layers.

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

- Natural Resources Canada–Canadian Forest Service calculations for Indigenous employment are based on 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 people who are First Nations (North American Indian), Métis or Inuk (Inuit). "Indigenous" also refers to people 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.

Photo credit:

- Overlook of pulp and paper mill in Corner Brook, Newfoundland. Photo by ArchonCodex/iStock by Getty Images.

Spotlight: Seeing the forest for the trees – Teslin Tlingit Council

Photo credit:

- Photos courtesy of Simon Bridge.

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 and territorial Crown land, by jurisdiction. http://nfdp.ccfm.org/en/data/revenues.php (accessed May 13, 2019).

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

- Natural Resources Canada–Canadian Forest Service calculations for Indigenous employment are based on 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 people who are First Nations (North American Indian), Métis, 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. Table 33-10-0006-01 (formerly CANSIM 180-0003). Financial and taxation statistics for enterprises, by industry type. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3310000601 (accessed May 13, 2019).

- Includes data for NAICS codes 1153, 113, 321 and 322.
- Includes data for Total Taxes and Total Indirect Taxes.

Statistics Canada. Table 36-10-0401-01 (formerly CANSIM 379-0029): Gross domestic product (GDP) at basic prices, by industry. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040101 (accessed May 1, 2019).

- Natural Resources Canada–Canadian Forest Service's calculations for 2015–2018 nominal GDP are based on Statistics Canada's Tables 36-10-0434-01, 18-10-0032-01 and 18-10-0029-01 (formerly CANSIM 379-0031, 329-0077 and 329-0074, respectively): GDP in 2012 constant prices, and estimated industry price deflators indexed to 2010.

Statistics Canada. Table 36-10-0402-01 (formerly CANSIM 379-0030): Gross domestic product (GDP) at basic prices, by industry, provinces and territories. Chained (2012) dollars. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040201 (accessed May 1, 2019).

- Includes data for NAICS codes 113, 1153, 321 and 322.

Statistics Canada. Table 36-10-0489-01 (formerly CANSIM 383-0031): Labour statistics consistent with the System of National Accounts (SNA), by job category and industry. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610048901 (accessed May 22, 2019).

Statistics Canada. Merchandise trade data (special extraction, March 11, 2019).

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

Photo credits:

- Spools of paper in warehouse of printing company. Photo by DarioEgidi/iStock by Getty Images.
- Forklift loading truck. Photo by pixelprof/iStock by Getty Images

Indicator: Gross domestic product

Nominal GDP:

Statistics Canada. Table 36-10-0401-01 (formerly CANSIM 379-0029): Gross domestic product (GDP) at basic prices, by industry. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040101 (accessed March 26, 2019).

- For nominal GDP up to (and including) 2015. Statistics Canada. Tables 36-10-0434-01, 18-10-0032-01 and 18-10-0029-01 (formerly CANSIM 379-0031, 329-0077 and 329-0074, respectively). http://www5.statcan.gc.ca/cansim/a01?lang=eng (accessed May 1, 2019).
- Natural Resources Canada–Canadian Forest Service's calculations for 2015–2018 nominal GDP are based on Statistics Canada's Tables 36-10-0434-01, 18-10-0032-01 and 18-10-0029-01 (formerly CANSIM 379-0031, 329-0077 and 329-0074, respectively): GDP in 2012 constant prices and estimated industry price deflators indexed to 2010.

Real GDP:

Statistics Canada. Table 36-10-0434-01 (formerly CANSIM 379-0031): Gross domestic product (GDP) at basic prices, by industry, monthly. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610043401 (accessed May 1, 2019).

- Real GDP in 2012 constant prices.
- Real and nominal GDP vary such that real values are adjusted for inflation and nominal values are not. Therefore, real GDP is used to account for differences between time periods (e.g. comparing 2017 and 2018 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. Table 16-10-0045-01 (formerly CANSIM 303-0064): Lumber, production, shipments and stocks, monthly. http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3030064 (accessed March 5, 2019).

- Data used for lumber production consist of total softwood production for Canada.

Photo credit:

- Industrial timber manufacturing facility. Photo by nattrass/iStock by Getty Images.

Indicator: Exports

Statistics Canada. Merchandise trade data (special extraction, March 11, 2019).

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

How is the forest industry changing?

Statistics Canada. 2015 Bioproducts Production and Development Survey. http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5073 (accessed November 28, 2019).

Indicator: Financial performance

Statistics Canada. Quarterly balance sheet and income statement, by North American Industry Classification System (NAICS) (special extraction, February 27, 2019).

- Note that financial performance improved for the seventh consecutive year instead of for six years as would be implied if comparing this year's report to last year's report. Data revisions by Statistics Canada caused this change.

Indicator: Secondary manufacturing

Industry Canada. Trade data online. https://www.ic.gc.ca/app/scr/tdst/tdo/crtr.html?productType=NAICS&lang=eng (accessed March 12, 2019).

Statistics Canada. Table 16-10-0047-01 (formerly CANSIM 304-0014): Manufacturers' sales, inventories, orders and inventory to sales ratios, by North American Industry Classification System (NAICS), Canada. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1610004701 (accessed March 11, 2019).

Statistics Canada. Table 36-10-0434-01 (formerly CANSIM 379-0031): Gross domestic product (GDP) at basic prices, by industry, monthly, Canada. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610043401 (accessed May 1, 2019).

- Real GDP in 2012 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. 2019. *National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.* https://unfccc.int/documents/194925 (accessed April 16, 2019).

Natural Resources Canada. Comprehensive energy use database. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm (accessed June 14, 2019).

- Data calculated using NRCan Residential End-Use Model and Electricity Energy-Use Model.

Statistics Canada. 2019. *Report on Energy Supply and Demand in Canada* (2016 revised). https://www150.statcan.gc.ca/n1/pub/57-003-x/57-003-x2019001-eng.htm (accessed June 14, 2019).

Photo credit:

- Sugar Maple foliage. Photo by AlpamayoPhoto/iStock by Getty Images.

Statistical profiles

Population

Statistics Canada. Table 17-10-0009-01 (formerly CANSIM 051-0005): Population estimates, quarterly. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710000901 (accessed June 25, 2019).

Forest inventory

Forest area by classification

Food and Agricultural 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 June 5, 2019).

- The base estimate of forest area for Canada comes from the National Forest Inventory (NFI) 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 1.1) and adjusting it for known increases in forest area (afforestation) and known decreases in forest area (deforestation) that occurred during the time since baseline data were collected. These adjustments are described in Canada's 2015 country report to the United Nations Food and Agriculture Organization of the United Nations for *Global Forest Resources Assessment 2015*, available at (http://www.fao.org/3/a-az181e.pdf).
- The National Forest Inventory uses the following definitions from the Food and Agriculture Organization of the United Nations (FAO):
  - *Forest land* – 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.

Forest area change

Environment and Climate Change Canada. 2019. *National Inventory Report 1990–2017: Greenhouse gas sources and sinks in Canada.* Executive summary. http://publications.gc.ca/collections/collection_2019/eccc/En81-4-1-2017-eng.pdf (accessed June 5, 2019)

- Environment and Climate Change Canada's *National Inventory Report 1990–2017: Greenhouse gas sources and sinks in Canada* uses Natural Resources Canada–Canadian Forest Service's National Forest Carbon Monitoring, Accounting and Report 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 June 5, 2019).

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 June 5, 2019).

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 June 5, 2019).

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 June 5, 2019).

Disturbance

Insects

National Forestry Database. Forest insects – 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 March 8, 2019).

- 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 defoliation.

Fire

National Forestry Database. Forest fires. http://nfdp.ccfm.org/en/data/fires.php (accessed March 8, 2019).

- National data include all burned areas within Canada's forests. Provincial and territorial data do not include fires within national parks. In 2018, 140 fires burned 74,841 hectares in national parks across Canada. Some of these fires include controlled or prescribed burning for ecological restoration purposes.
- The National Forestry Database sources 2018 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 March 8, 2019).

- 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, territorial and private forest lands.

Regeneration

National Forestry Database. Regeneration. http://nfdp.ccfm.org/en/data/regeneration.php (accessed March 8, 2019).

Third-party certification

Certification Canada. Canadian statistics. http://certificationcanada.org/en/statistics/canadian-statistics/ (accessed May 29, 2019).

- 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

Conservation Areas Reporting and Tracking System www.ccea.org/carts/

- Protected areas were identified in 2016 by using GIS data collected by the Canadian Council of Forest Ministers for a national project that mapped forest management. The information included data from the Conservation Areas Reporting and Tracking System (CARTS) and from provinces and territories on protected area boundaries and categorization.
  - Canadian Council of Forest Ministers. Forest Management in Canada, 2017 Story Map. https://manitoba.maps.arcgis.com/apps/MapJournal/index.html?appid=86cdd21b2cd843888bf54787f90f2b5d (accessed November 27, 2019).
  - National Forest Inventory. Map of Forest Management in Canada, 2017 version. https://open.canada.ca/data/en/dataset/d8fa9a38-c4df-442a-8319-9bbcbdc29060 (accessed November 27, 2019).
  - Stinson, G., Thandi, G., et al. 2019. A new approach for mapping forest management areas in Canada. *Forestry Chronicle*, 95(2):101-112. https://doi.org/10.5558/tfc2019-017

National Forest Inventory. https://nfi.nfis.org

Greenhouse gas inventory

Environment and Climate Change Canada. 2019. *National Inventory Report 1990–2017: Greenhouse gas sources and sinks in Canada*. http://data.ec.gc.ca/data/substances/monitor/canada-s-official-greenhouse-gas-inventory/NIR_-_EN_-_Chapter_8_-_Recalculations_and_Improvements.pdf (accessed June 27, 2019).

- Environment and Climate Change Canada's *National Inventory Report 1990–2017: 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 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 include ongoing removals by all areas afforested over the past 20 years.
- See the sources and information for the sustainability indicator *Carbon emissions and removals* for more detail.

Domestic economic impact

Canadian housing starts

Statistics Canada. Table 34-10-0126-01 (formerly CANSIM 027-0009): Canada Mortgage and Housing Corporation, housing starts, under construction and completions, all areas. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3410012601 (accessed May 31, 2019).

- A rate adjustment is used for economic or business data that attempts 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 more often used when economic data are released to the public.

Contribution to nominal GDP

Statistics Canada. Table 36-10-0401-01 (formerly CANSIM 379-0029): Gross domestic product (GDP) at basic prices, by industry. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040101 (accessed May 1, 2019).

- Natural Resources Canada–Canadian Forest Service's calculations for 2018 nominal GDP are based on Statistics Canada's Tables 36-10-0434-01, 18-10-0032-01 and 18-10-0029-01 (formerly CANSIM 379-0031, 329-0077 and 329-0074, respectively): GDP in 2012 constant prices and estimated industry price deflators indexed to 2010.
- 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 $29 billion (or 1.2%) of Canada's nominal GDP in 2018.

Contribution to real GDP

Statistics Canada. Table 36-10-0434-01 (formerly CANSIM 379-0031): Gross domestic product (GDP) at basic prices, by industry, monthly. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610043401 (accessed May 1, 2019).

- Real GDP in 2012 constant prices.
- Real and nominal GDP vary such that real values are adjusted for inflation and nominal values are not. Therefore, real GDP is used to account for differences between time periods (e.g. comparing 2017 and 2018 GDP).
- 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 $29 billion (or 1.2%) of Canada's nominal GDP in 2018.

Revenue from goods manufactured

Statistics Canada. Table 16-10-0117-01 (formerly CANSIM 301-0008): Principal statistics for manufacturing industries, by North American Industry Classification System (NAICS) (x 1,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1610011701 (accessed June 3, 2019).

Statistics Canada. Table 16-10-0114-01 (formerly CANSIM 301-0009): Logging industries, principal statistics by North American Industry Classification System (NAICS) (x 1,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1610011401 (accessed June 3, 2019).

- 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. Table 14-10-0202-01 (formerly CANSIM 281-0024): Employment by industry, annual. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410020201 (accessed May 29, 2019).

Statistics Canada. Table 36-10-0489-01 (formerly CANSIM 383-0031): Labour statistics consistent with the System of National Accounts (SNA), by job category and industry. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610048901 (accessed May 23, 2019).

Statistics Canada. Table 38-10-0285-01 (formerly CANSIM 388-0010): Natural resources satellite account, indicators (x 1,000,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3810028501 (accessed June 21, 2019).

- Natural Resources Canada calculations based on Statistics Canada's Table: 38-10-0285-01.
- 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 Natural 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 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).
- The calculations for indirect employment were changed in 2019 to better account for employment in the forest sector. This change affects data for 2018 and going forward. Retroactive changes to previous year's data have not been applied at this time.

Wages and salaries

Statistics Canada. Table 16-10-0117-01 (formerly CANSIM 301-0008): Principal statistics for manufacturing industries, by North American Industry Classification System (NAICS) (x 1,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1610011701 (accessed June 3, 2019).

Statistics Canada. Table 16-10-0114-01 (formerly CANSIM 301-0009): Logging industries, principal statistics by North American Industry Classification System (NAICS). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1610011401 (accessed June 3, 2019).

- 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. Table 16-10-0045-01 (formerly CANSIM 303-0064): Lumber production, shipments and stocks, monthly (x 1,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1610004501 (accessed March 5, 2019).

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

Capital expenditures and repair expenditures

Statistics Canada. Table 34-10-0035-01 (formerly CANSIM 029-0045): Capital and repair expenditures, non-residential tangible assets, by industry and geography (x 1,000,000) https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3410003501 (accessed June 4, 2019).

- 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

Consumption figures for a range of products, calculated by Natural Resources Canada.

- 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.

Tell us what you think! Visit us on the Web at
cfs.nrcan.gc.ca/stateoftheforests

cfs.nrcan.gc.ca/stateoftheforests