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THE STATE OF CANADA'S FORESTS

Annual Report 2024

CANADIAN FOREST SERVICE • SERVICE CANADIEN DES FORÊTS
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Annual Report 2024

Canada

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Minister's Message for the 2024 State of Canada's Forests Report

Canada's vast natural resources — including our iconic forests — span from coast to coast to coast. These resources are developed to the highest environmental and labour standards and are respected around the world.

Natural resources drive many of our government's top priorities, from building infrastructure and energy systems to developing the technology and partnerships we need to keep Canada's economy strong, sustainable and sovereign for generations to come.

Forests are a cornerstone of Canada's economy, generating wide-ranging benefits. In 2023, Canada's forest sector contributed $27 billion to our nominal gross domestic product (GDP) and supported nearly 200,000 direct jobs, including jobs for nearly 11,000 Indigenous people. Some 300 communities across the country depend on the forest sector for their livelihoods.

In 2023, Canada's forest sector exported more than $36 billion in products, from traditional goods to cutting-edge innovations like low-carbon technologies, biofuels and sustainable building materials.

Canada is a world leader in sustainable forest management and is confronting challenges head-on, including wildfires and climate change. With wildfires increasing in frequency and severity across Canada — impacting our health, economies, communities and wildlife — our government is taking the necessary measures by investing more than $800 million in wildfire resilience. This includes upgrading equipment and firefighter training, expanding FireSmart Canada, enhancing satellite monitoring and driving research and innovation. Canada acts decisively because that's what leadership demands.

Today, Canada is at a pivotal moment. We are taking charge of our future, asserting our economic sovereignty and showing the world what purposeful leadership looks like. This includes continued work to defend our forest sector from unjustified trade measures on Canada's softwood lumber exports. As part of this important work, Natural Resources Canada's forest sector programs are supporting industry to further diversify forest products, processes and markets. Funding provided under these programs supports the adoption of new technologies and materials, increased participation of First Nations, Inuit and Métis peoples in the Canadian economy, the promotion of innovation in building with wood and the expansion of Canada's international engagement.

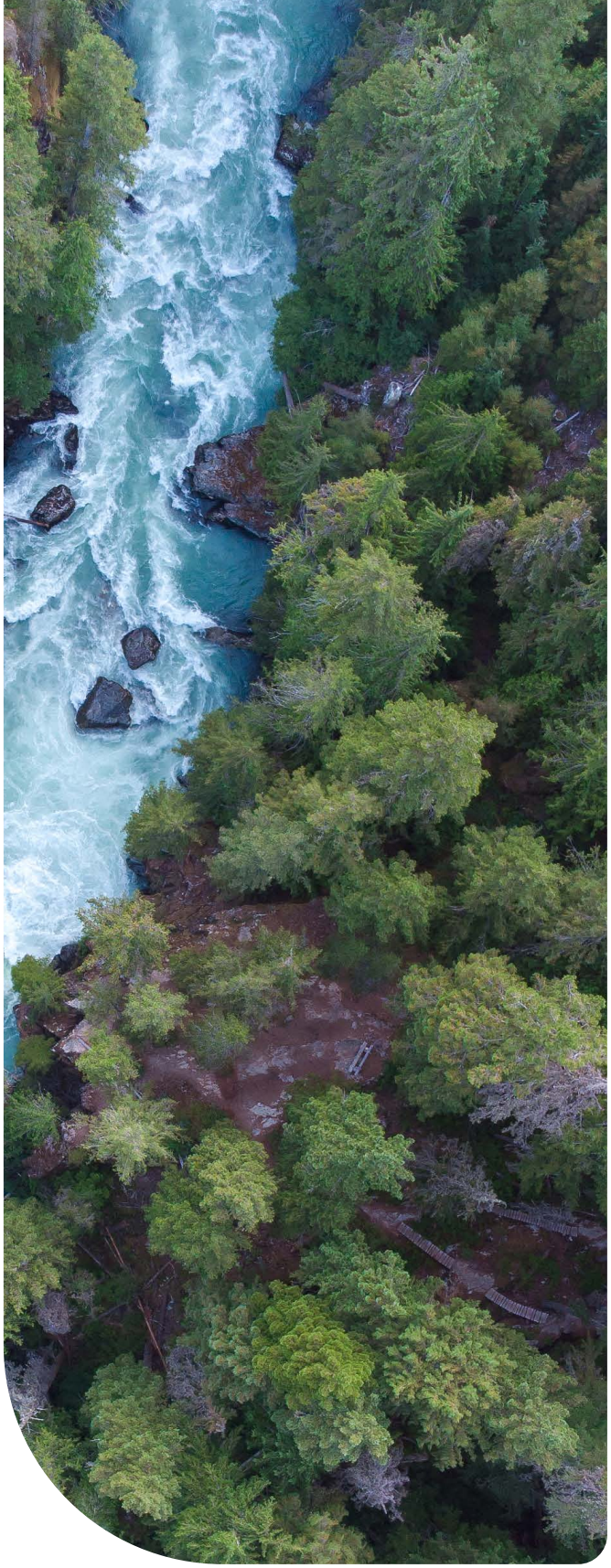
We want to seize every opportunity by using more Canadian technology, leveraging our world-class workforce and tapping into our vast forests to build what Canadians need. This will be critical when it comes to moving quickly on our promise to accelerate affordable home building using Canadian materials. The forest sector is central to our housing strategy, supporting thousands of families and communities, and it is key to our commitment to double the pace of housing construction through the *Build Canada Homes* program.

We won't do this alone — partnerships are critical: with provinces and territories, with industry and labour, and with Indigenous Peoples. We are committed to real economic reconciliation. We are focused on outcomes: enabling $50 billion in international trade, increasing Indigenous participation and strengthening Canada's domestic manufacturing capacity.

We have the resources. We have the talent. We have the drive. And we have the vision. That is why Canada will continue to lead in the global forest sector and deliver results that matter. We are committed to getting things done.

It is the time to build a Canada as strong, sustainable, resilient and rooted as our world-renowned forests.

The Honourable Tim Hodgson
Minister of Energy and Natural Resources



The State of Canada's Forests Annual Report 2024: An overview

As the Prime Minister watched the masses of timber passing by on the Ottawa River in 1871, he penned a letter to a colleague reflecting his concerns of overexploitation and fires in the Ottawa woodlands. Although nothing happened at the time, as settlement-related fires and timber sales increased on lands in western prairie provinces and the BC railway belt, similar concerns were raised in 1884 by the newly appointed forest commissionaire. The importance of forests to Canada was becoming clear, providing "essential fuel and building materials, as well as employment and the generation of wealth from the export of forest products."

In 1899, Elihu Stewart, Canada's first Chief Inspector of Timber and Forestry, "began organizing a forestry service, with a primary focus on conservation and forest propagation."

- Ken Drushka and Bob Burt (2001) -

Canada's rich forest ecosystems offer significant environmental, social and cultural benefits, as well as numerous economic opportunities. Canadians are deeply committed to upholding these important values. Sustainable forest management (SFM) ensures these benefits are maintained for present and future generations.

Year 2023 spotlighted how the frequency and severity of wildland fires, which are impacting Canadians in unprecedented ways, are escalating due to extreme weather events such as hotter temperatures, extended drought and severe thunderstorms. Despite 125 years passing since the creation of what is now called the Canadian Forest Service (CFS), the CFS continues to learn from and evolve forestry practices to combat the challenges confronting Canada's forests and the forest sector.

The State of Canada's Forests: Annual Report has been a trusted and authoritative source of comprehensive information on the social, economic and environmental state of Canada's forests and the forest sector for 34 years. Each year, the report includes thematic content about Canada's forest sector through feature stories. To explore this year's theme of "The evolution

of forestry in Canada and the 125 years of the Canadian Forest Service," this report:

- gives an overview of the dynamism of forest research across Canada
- highlights lessons learned, present and future challenges and the changes, improvements, and evolution of forest science through the eyes of current and former CFS personnel

- explores the timeline and important milestones in forests, the forest sector and the evolution of the CFS's role
- describes the way Canadian forest management practices have changed toward sustainability, in particular because of improvement to scientific knowledge and shifts in values associated with forests
- articulates the important role forest products play in fighting climate change.

These stories provide a snapshot of some of the historical and modern challenges, and opportunities facing Canada's forests and the forest sector and provide insight into where the future may lead.

Forest-related statistical data and sustainability indicators are important tools

Science-based measures called **sustainability indicators** are helpful tools for understanding the overall condition or state of Canada's forests. Indicators provide a way to consistently define, assess, monitor and report progress toward SFM. Reporting on sustainability indicators over time helps to ensure and promote the long-term sustainable management of our forests. They do so by:

- providing reliable data and essential information on the state of and trends in Canada's forests
- highlighting any need for improvement in forest management policies and practices
- supplying reliable information for discussions and initiatives related to environmental performance and trade.

The indicators included in The State of Canada's Forests Annual Report are based on the most accurate and available data from Canada's most trusted sources, including Statistics Canada, the National Forestry Database and the National Forest Inventory. These data and information are analyzed by a collection of Canada's leading experts who produce the written text for each indicator in the report. The indicators, as well as the **Forest Statistical Data** section, provide governments, industry, researchers and the public with relevant context on historical trends, ongoing status and future forecasts. These indicators demonstrate Canada's ongoing commitment to sustainably managing its forests and the forest sector.

Canada uses internationally agreed-upon indicators of sustainable forest management

Along with 12 other countries, Canada is a member of the Montréal Process, an international working group of northern and southern hemisphere nations committed to SFM. Since 1995, 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 report are inspired by, and seek to align with, this evolving and internationally relevant framework.

Sustainably managed forests contribute to global sustainable development goals

In September 2015, the 2030 Agenda for Sustainable Development was adopted by United Nations member states, including Canada. In this plan of action, the United Nations identified 17 Sustainable Development Goals. In addition to these goals, the Agenda includes 169 associated targets aimed at improving global sustainable development across social, economic and environmental dimensions as well as peace, governance and justice. Reporting on the Sustainable Development Goals is a step toward a shared understanding of the value of forests. The sustainability indicators in The State of Canada's Forests reports support:

- The United Nations' Sustainable Development Goal 15 – Life on land
- The United Nations' Global Forest Goals
  1. reverse forest cover loss
  2. improve the benefits and livelihoods derived from forests
  3. protect forests and use sustainable forest products
  4. mobilize resources

The State of Canada's Forests report is designed to be as informative and user-friendly as possible. We welcome your feedback. Contact us at cfs-stateoftheforestsetatdesforets-scf@nrcan-rncan.gc.ca, and let us know what you think.

Sustainable forest management is a process of continuous assessment, evaluation and improvement. Canada is committed to the SFM process and is assessing its current strengths, challenges and opportunities. New reporting is being developed on indicators not previously reported on a pan Canadian scale. For example, we are developing new reporting on forest-associated species diversity and on Canada's capacity to govern, guide and support SFM through its legal and regulatory frameworks and funding programs. These new indicators will be added to future State of Canada's Forests reports.

Canadian federal, provincial and territorial governments use two closely related criteria and indicator frameworks to define, measure, track and report on progress toward SFM in Canada. These are so closely related and so thoroughly integrated into Canadian institutional systems that both aren't always mentioned by name when used. Internationally, we have the Montréal Process criteria and indicators. The seven criteria and 54 indicators of the Montréal Process provide a common framework for member countries to describe, monitor, assess, and report on national forest trends and progress toward SFM. They also provide a common understanding, within and across countries, of what is meant by SFM. Domestically, we have the Canadian Council of Forest Ministers' criteria and indicators, which are an implementation of the Montréal Process criteria and indicators specifically tailored for Canada.

Forest statistical data

Current statistics on various forestry-related topics including forest inventory, natural disturbances, sustainable forest management, carbon inventory as well as economic and trade data for Canada, both nationally and by province and territory.

FOREST INVENTORY		
Forest area by classification (hectares, 2023)	Forest land	368,770,601
	Other wooded land	36,249,000
	Other land with tree cover	6,830,004
Forest area change (hectares, 2022)	Afforestation	Not available
	Deforestation (total; by sectors below)	49,248
	Agriculture	22,460
	Mining, oil and gas	14,757
	Built-up	9,537
	Hydroelectric	1,462
	Forestry	1,032
Forest type (forest land only)	Coniferous	67.8%
	Mixedwood	15.8%
	Broadleaf	10.5%
	Temporarily non-treed	5.9%
Forest ownership	Provincial	75.4%
	Territorial	13.0%
	Private	6.7%
	Indigenous	2.1%
	Federal	1.7%
	Municipal	0.3%
	Other	0.7%
Growing stock (million cubic metres, 2022)	Total volume	50,885
DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle-killed trees	13,167,661
Fire (2023)	Area burned (hectares)	17,197,201
	Number of fires	6,811

Canada

Population (January 2023)
40,528,396

Arboreal emblem
Maple

Area burned (hectares)
940% increase
1,654,255 ha (2022) to 17,197,201 ha (2023)

Wildland fires in Canada burned more area, produced more smoke, triggered more evacuations and cost more to manage in 2023 than any previous year on record

FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	668,735
	Volume harvested (cubic metres)	131,555,231
Regeneration (hectares, 2022)	Area planted	413,083
	Area seeded	10,887
Third-party certification (hectares, 2023)	Area certified	160,045,456
Protected forest (IUCN categories and primary management objectives)	Ia – Strict nature reserve (science)	0.1%
	Ib – Wilderness area (wilderness protection)	2.4%
	II – National park (ecosystem protection and recreation)	6.3%
	III – Natural monument (conservation of specific natural features)	0.0%
	IV – Habitat/species management area (conservation through management intervention)	0.3%
	V – Protected landscape/seascape (landscape conservation and recreation)	0.0%
GREENHOUSE GAS INVENTORY		
For forest lands affected by land-use change (2022)	Removals from the atmosphere due to afforestation (CO_2e/yr, million tonnes)	0.13
	Total emissions due to deforestation (CO_2e/yr, million tonnes)	16
For managed forests (2022)	Area of managed forests (1,000 hectares)	230,000
	Total net emissions or removals to the atmosphere, all causes (CO_2e/yr, million tonnes)	113.7
	Net emissions or removals due to natural disturbances (CO_2e/yr, million tonnes)	92.6
	Net emissions or removals due to human forest management activities and from harvested wood products (CO_2e/yr, million tonnes)	21.1
	Transfers from the managed forest sector to the forest products sector due to harvesting and firewood collection (CO_2e/yr, million tonnes)	143

Canada

Population (January 2023)
40,528,396

Arboreal emblem
Maple

Area defoliated by insects and containing beetle-killed trees
14% decrease
15,953,011ha (2021) to 13,167,661 ha (2022)

Insects represent more than one of every two species in Canada

DOMESTIC ECONOMIC IMPACT		
Canadian housing starts (number, 2023)		240,267
Contribution to nominal GDP (current dollars, 2023)	Forestry and logging	4,884,653,226
	Pulp and paper product manufacturing	8,812,033,465
	Wood product manufacturing	13,331,245,663
	Total contribution to nominal GDP	**27,027,932,354**
Contribution to real GDP (constant 2017 dollars, 2023)	Forestry and logging	3,390,000,000
	Pulp and paper product manufacturing	6,509,000,000
	Wood product manufacturing	11,209,000,000
	Total contribution to real GDP	**21,108,000,000**
Revenue from goods manufactured (dollars, 2022)	Logging	11,447,921,000
	Pulp and paper product manufacturing	34,382,256,000
	Wood product manufacturing	51,770,381,000
	Total revenue from goods manufactured	**97,600,558,000**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Survey of Employment, Payrolls and Hours	176,856
	Canadian System of National Accounts	199,345
	Natural Resources Satellite Account	495,101
	Direct and indirect employment	482,000
Wages and salaries (dollars, 2022)	Logging	1,829,853,000
	Pulp and paper manufacturing	4,107,307,000
	Wood product manufacturing	6,253,470,000
	Total wages and salaries	**12,190,630,000**
TRADE		
Balance of trade (total exports, dollars, 2023)		21,958,230,325
Value of exports (dollars, 2023)	Primary wood products	1,474,773,767
	Pulp and paper products	18,162,505,479
	Wood-fabricated materials	16,574,905,579
	Total value of exports	**36,212,184,825**
Value of imports (dollars, 2023)	Primary wood products	609,228,615
	Pulp and paper products	9,764,775,477
	Wood-fabricated materials	3,879,950,408
	Total value of imports	**14,253,954,500**

Canada

Population (January 2023)
40,528,396

Arboreal emblem
Maple

By the end of World War I (1918), Canada was the largest pulp and paper exporter in the world.

DOMESTIC PRODUCTION AND INVESTMENT		
Production (2023)	Hardwood lumber (cubic metres)	875,600
	Softwood lumber (cubic metres)	47,537,800
	Newsprint (tonnes)	1,763,000
	Printing and writing paper (tonnes)	2,002,000
	Wood pulp (tonnes)	12,560,000
	Structural panels (plywood and oriented strandboard, cubic metres)	8,423,373
Capital expenditures (dollars, 2023)	Forestry and logging	Not available
	Pulp and paper product manufacturing	1,298,600,000
	Wood product manufacturing	1,709,900,000
	Total capital expenditures	**Not available**
Repair expenditures (dollars, 2022)	Forestry and logging	491,100,000
	Pulp and paper product manufacturing	1,402,200,000
	Wood product manufacturing	1,264,300,000
	Total repair expenditures	**3,157,600,000**
DOMESTIC CONSUMPTION		
Consumption (2023)	Hardwood lumber (cubic metres)	1,009,690
	Softwood lumber (cubic metres)	16,973,504
	Newsprint (tonnes)	64,585
	Printing and writing paper (tonnes)	812,596
	Wood pulp (tonnes)	5,574,243
	Structural panels (plywood and oriented strandboard, cubic metres)	3,591,943

Canada

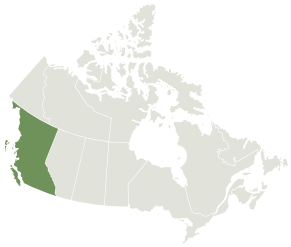
Population (January 2023)
40,528,396

Arboreal emblem
Maple

Canada is a leading global forest product manufacturer.

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	2,904,314
Fire (2023)	Area burned (hectares)	2,840,830
	Number of fires	2,269
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	112,902
	Volume harvested (cubic metres)	47,577,636
Regeneration (hectares, 2022)	Area planted	189,689
	Area seeded	32
Third-party certification (hectares, 2023)	Area certified	44,367,533
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		50,490
Revenue from goods manufactured (dollars, 2022)	Logging	5,487,690,000
	Pulp and paper product manufacturing	5,132,118,000
	Wood product manufacturing	15,799,597,000
	Total revenue from goods manufactured	**26,419,405,000**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	49,230
	Survey of Employment, Payrolls and Hours	43,959
Wages and salaries (dollars, 2022)	Logging	829,314,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	1,629,232,000
	Total wages and salaries	**Not available**
TRADE		
Balance of trade (total exports, dollars, 2023)		8,580,923,354
Value of domestic exports (dollars, 2023)	Primary wood products	1,025,407,816
	Pulp and paper products	3,636,376,530
	Wood-fabricated materials	6,392,559,988
	Total value of domestic exports	**11,054,344,334**
Value of imports (dollars, 2023)	Primary wood products	145,549,725
	Pulp and paper products	1,186,307,489
	Wood-fabricated materials	1,141,563,766
	Total value of imports	**2,473,420,980**

British Columbia



Population (January 2023)
5,581,127

Arboreal emblem
Western redcedar

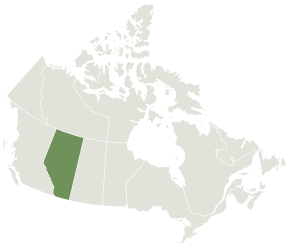
Area burned (hectares)
2,020% increase
134,032 ha (2022) to 2,840,830 ha (2023)

The Donnie Creek fire started on May 12 from a lightning strike. It was the largest fire in BC history at 619,000 ha.

Mountain Pine Beetle populations have collapsed in much of western Canada due to aggressive control measures and several cold winters.

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	587,892
Fire (2023)	Area burned (hectares)	1,951,299
	Number of fires	1,149
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	88,180
	Volume harvested (cubic metres)	24,245,347
Regeneration (hectares, 2022)	Area planted	82,327
	Area seeded	2,252
Third-party certification (hectares, 2023)	Area certified	22,534,794
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		36,022
Revenue from goods manufactured (dollars, 2022)	Logging	1,234,446,000
	Pulp and paper product manufacturing	2,854,963,000
	Wood product manufacturing	7,339,045,000
	Total revenue from goods manufactured	**11,428,454,000**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	18,060
	Survey of Employment, Payrolls and Hours	16,671
Wages and salaries (dollars, 2022)	Logging	211,805,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	775,448,000
	Total wages and salaries	**Not available**
TRADE		
Balance of trade (total exports, dollars, 2023)		3,410,052,618
Value of domestic exports (dollars, 2023)	Primary wood products	42,019,320
	Pulp and paper products	1,827,949,473
	Wood-fabricated materials	1,975,829,166
	Total value of domestic exports	**3,845,797,959**
Value of imports (dollars, 2023)	Primary wood products	10,419,158
	Pulp and paper products	256,488,058
	Wood-fabricated materials	168,838,125
	Total value of imports	**435,745,341**

Alberta



Population (January 2023)
4,756,408

Arboreal emblem
Lodgepole pine

Area burned (hectares)
1139% increase
157,547 ha (2022) to 1,951,299 (2023)

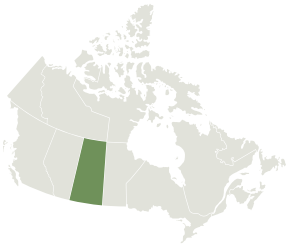
By the end of May, more than 1 million ha had burned in Alberta—an area greater than Banff National Park.

The area affected by spruce beetle declined from relatively high and stable levels for the first time since 2019.

A new canker disease of laurel willow was described in Alberta.

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	4,743
Fire (2023)	Area burned (hectares)	1,850,829
	Number of fires	462
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	21,183
	Volume harvested (cubic metres)	3,835,688
Regeneration (hectares, 2022)	Area planted	6,762
	Area seeded	0
Third-party certification (hectares, 2023)	Area certified	6,226,984
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		4,619
Revenue from goods manufactured (dollars, 2022)	Logging	168,531,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	1,280,553,000
	Total revenue from goods manufactured	**Not available**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	3,910
	Survey of Employment, Payrolls and Hours	1,687
Wages and salaries (dollars, 2022)	Logging	26,328,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	114,312,000
	Total wages and salaries	**Not available**
TRADE		
Balance of trade (total exports, dollars, 2023)		546,627,995
Value of domestic exports (dollars, 2023)	Primary wood products	4,029,591
	Pulp and paper products	299,512,983
	Wood-fabricated materials	378,633,554
	Total value of domestic exports	**682,176,128**
Value of imports (dollars, 2023)	Primary wood products	9,024,969
	Pulp and paper products	80,489,962
	Wood-fabricated materials	46,033,202
	Total value of imports	**135,548,133**

Saskatchewan



Population (January 2023)
1,218,976

Arboreal emblem
White birch

Area burned (hectares)
597% increase
265,613 ha (2022) to 1,850,829 ha (2023)

Area defoliated by insects and containing beetle-killed trees
93% decrease
63,531 ha (2021) to 4,743 ha (2022)

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	845,229
Fire (2023)	Area burned (hectares)	189,913
	Number of fires	305
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	9,091
	Volume harvested (cubic metres)	1,265,329
Regeneration (hectares, 2022)	Area planted	1,121
	Area seeded	0
Third-party certification (hectares, 2023)	Area certified	10,506,290
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		7,104
Revenue from goods manufactured (dollars, 2022)	Logging	69,237,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	815,180,000
	Total revenue from goods manufactured	**Not available**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	5,080
	Survey of Employment, Payrolls and Hours	3,984
Wages and salaries (dollars, 2022)	Logging	18,242,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	Not available
	Total wages and salaries	**Not available**
TRADE		
Balance of trade (total exports, dollars, 2023)		-104,346,169
Value of domestic exports (dollars, 2023)	Primary wood products	1,718,797
	Pulp and paper products	316,108,625
	Wood-fabricated materials	407,820,504
	Total value of domestic exports	**725,647,926**
Value of imports (dollars, 2023)	Primary wood products	10,001,804
	Pulp and paper products	638,720,615
	Wood-fabricated materials	181,271,676
	Total value of imports	**829,994,095**

Manitoba

Population (January 2023)
1,465,440

Arboreal emblem
White spruce

Area defoliated by insects and containing beetle-killed trees
62% decrease
2,226,029 (2021) to 845,229 ha (2022)

Defoliation by jack pine budworm decreased to levels last observed in 2017.

Manitoba Model Forest (MBMF), established in 1992, encompasses 1 million ha of boreal forest, which includes activities such as community development, Indigenous involvement, and youth education and training.

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	2,503,513
Fire (2023)	Area burned (hectares)	441,474
	Number of fires	743
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	111,545
	Volume harvested (cubic metres)	14,172,503
Regeneration (hectares, 2022)	Area planted	51,499
	Area seeded	7,432
Third-party certification (hectares, 2023)	Area certified	27,199,391
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		89,297
Revenue from goods manufactured (dollars, 2022)	Logging	1,068,121,000
	Pulp and paper product manufacturing	10,076,653,000
	Wood product manufacturing	8,198,349,000
	Total revenue from goods manufactured	**19,343,123,000**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	39,230
	Survey of Employment, Payrolls and Hours	37,228
Wages and salaries (dollars, 2022)	Logging	186,333,000
	Pulp and paper product manufacturing	1,398,705,000
	Wood product manufacturing	Not available
	Total wages and salaries	**Not available**
TRADE		
Balance of trade (total exports, dollars, 2023)		-1,863,005,420
Value of domestic exports (dollars, 2023)	Primary wood products	60,519,379
	Pulp and paper products	3,331,451,503
	Wood-fabricated materials	2,419,693,999
	Total value of domestic exports	**5,811,664,881**
Value of imports (dollars, 2023)	Primary wood products	99,182,109
	Pulp and paper products	5,830,855,287
	Wood-fabricated materials	1,744,632,905
	Total value of imports	**7,674,670,301**

Ontario

Population (January 2023)
15,801,768

Arboreal emblem
Eastern white pine

Area burned (hectares)
17,138% increase
2,561 ha (2022) to 441,474 ha (2023)

Area defoliated by insects and containing beetle-killed trees
29% decrease
3,510,908 ha (2021) to 2,503,513 ha (2022)

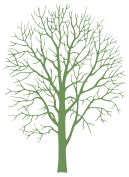
The significant outbreak of spongy moth in Ontario decreased dramatically between 2021 and 2022, with defoliation declining by over 95%.

The invasive oak wilt disease was reported for the first time in Canada from three locations in Ontario.

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	3,211,755
Fire (2023)	Area burned (hectares)	4,322,888
	Number of fires	713
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	219,809
	Volume harvested (cubic metres)	26,974,340
Regeneration (hectares, 2022)	Area planted	69,109
	Area seeded	50
Third-party certification (hectares, 2023)	Area certified	42,367,471
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		38,912
Revenue from goods manufactured (dollars, 2022)	Logging	2,546,970,000
	Pulp and paper product manufacturing	11,810,442,000
	Wood product manufacturing	14,927,835,000
	Total revenue from goods manufactured	**29,285,247,000**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	64,945
	Survey of Employment, Payrolls and Hours	57,296
Wages and salaries (dollars, 2022)	Logging	388,092,000
	Pulp and paper product manufacturing	1,280,070,000
	Wood product manufacturing	1,904,291,000
	Total wages and salaries	**3,572,453,000**
TRADE		
Balance of trade (total exports, dollars, 2023)		8,779,643,023
Value of domestic exports (dollars, 2023)	Primary wood products	212,208,671
	Pulp and paper products	6,841,684,561
	Wood-fabricated materials	4,010,123,001
	Total value of domestic exports	**11,064,016,233**
Value of imports (dollars, 2023)	Primary wood products	245,060,378
	Pulp and paper products	1,524,190,446
	Wood-fabricated materials	515,122,386
	Total value of imports	**2,284,373,210**

Québec

Population (January 2023)
8,948,540



Arboreal emblem
Yellow birch

Area burned (hectares)
14,448% increase
29,715 ha (2022) to 4,322,888 ha (2023)

In Québec, lightning storms ignited 182 wildland fires in one day at the beginning of June.

Communities in southern Northwest Territories and northwestern Québec endured hazardous smoke concentration levels (>18 times the safe PM2.5 threshold) for more than half of the summer (>60 days).

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	3,400
Fire (2023)	Area burned (hectares)	854
	Number of fires	202
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	67,253
	Volume harvested (cubic metres)	9,341,187
Regeneration (hectares, 2022)	Area planted	9,420
	Area seeded	0
Third-party certification (hectares, 2023)	Area certified	4,230,501
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		4,547
Revenue from goods manufactured (dollars, 2022)	Logging	715,575,000
	Pulp and paper product manufacturing	2,545,584,000
	Wood product manufacturing	Not available
	Total revenue from goods manufactured	**Not available**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	12,650
	Survey of Employment, Payrolls and Hours	10,483
Wages and salaries (dollars, 2022)	Logging	128,130,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	Not available
	Total wages and salaries	**Not available**
TRADE		
Balance of trade (total exports, dollars, 2023)		1,934,880,678
Value of domestic exports (dollars, 2023)	Primary wood products	86,870,785
	Pulp and paper products	1,403,672,873
	Wood-fabricated materials	797,384,764
	Total value of domestic exports	**2,287,928,422**
Value of imports (dollars, 2023)	Primary wood products	89,972,885
	Pulp and paper products	207,964,530
	Wood-fabricated materials	55,110,329
	Total value of imports	**353,047,744**

New Brunswick

Population (January 2023)
842,725

Arboreal emblem
Balsam fir

Area burned (hectares)
385% increase
176 ha (2022) to 854 ha (2023)

1912: The first federal forestry lab (entomology) is established on the University of New Brunswick campus.

1961: First replicated thinning trials in eastern North America is set up in Green River, New Brunswick (harvested in 2008).

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	167,559
Fire (2023)	Area burned (hectares)	25,093
	Number of fires	220
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	28,059
	Volume harvested (cubic metres)	2,315,054
Regeneration (hectares, 2022)	Area planted	1,587
	Area seeded	0
Third-party certification (hectares, 2023)	Area certified	1,253,849
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		7,159
Revenue from goods manufactured (dollars, 2022)	Logging	110,752,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	712,586,000
	Total revenue from goods manufactured	**Not available**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	4,105
	Survey of Employment, Payrolls and Hours	3,135
Wages and salaries (dollars, 2022)	Logging	28,656,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	Not available
	Total wages and salaries	**Not available**
TRADE		
Balance of trade (total exports, dollars, 2023)		438,732,860
Value of domestic exports (dollars, 2023)	Primary wood products	41,998,751
	Pulp and paper products	288,390,768
	Wood-fabricated materials	169,834,288
	Total value of domestic exports	**500,223,807**
Value of imports (dollars, 2023)	Primary wood products	17,303
	Pulp and paper products	34,178,997
	Wood-fabricated materials	27,294,647
	Total value of imports	**61,490,947**

Nova Scotia

Population (January 2023)
1,066,416

Arboreal emblem
Red spruce

Area burned (hectares)
642% increase
3,383 ha (2022) to 25,093 ha (2023)

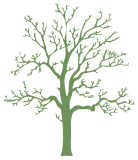
The Barrington Lake fire started on May 26 and over the next two weeks grew to become the largest in the province's recorded history.

The Tantallon fire near Halifax prompted the evacuation of 16,000 people and destroyed 150 homes.

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	220
Fire (2023)	Area burned (hectares)	8
	Number of fires	8
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	2,439
	Volume harvested (cubic metres)	333,479
Regeneration (hectares, 2022)	Area planted	23
	Area seeded	0
Third-party certification (hectares, 2023)	Area certified	0
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		1,139
Revenue from goods manufactured (dollars, 2022)	Logging	13,957,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	Not available
	Total revenue from goods manufactured	**Not available**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	660
	Survey of Employment, Payrolls and Hours	Not available
Wages and salaries (dollars, 2022)	Logging	2,344,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	Not available
	Total wages and salaries	**Not available**
TRADE		
Balance of trade (total exports, dollars, 2023)		42,527,740
Value of domestic exports (dollars, 2023)	Primary wood products	Not available
	Pulp and paper products	42,508,909
	Wood-fabricated materials	82,802
	Total value of domestic exports	**Not available**
Value of imports (dollars, 2023)	Primary wood products	Not available
	Pulp and paper products	62,652
	Wood-fabricated materials	1,319
	Total value of imports	**Not available**

Prince Edward Island

Population (January 2023)
175,853



Arboreal emblem
Red oak

The Government of Prince Edward Island manages six demonstration woodlots where private woodland owners and people can learn about forest management and silviculture.

Despite having a relatively small forest sector there was an increase in domestic exports from 2022 - 2023 of pulp and paper products (10.4%) and of wood-fabricated materials (35.1%).

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	167,209
Fire (2023)	Area burned (hectares)	21,913
	Number of fires	101
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	7,658
	Volume harvested (cubic metres)	1,430,232
Regeneration (hectares, 2022)	Area planted	2,591
	Area seeded	0
Third-party certification (hectares, 2023)	Area certified	1,358,643
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		978
Revenue from goods manufactured (dollars, 2022)	Logging	31,774,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	Not available
	Total revenue from goods manufactured	**Not available**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	1,200
	Survey of Employment, Payrolls and Hours	408
Wages and salaries (dollars, 2022)	Logging	10,437,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	Not available
	Total wages and salaries	**Not available**
TRADE		
Balance of trade (total exports, dollars, 2023)		191,534,063
Value of domestic exports (dollars, 2023)	Primary wood products	657
	Pulp and paper products	174,849,197
	Wood-fabricated materials	22,283,711
	Total value of domestic exports	**197,133,565**
Value of imports (dollars, 2023)	Primary wood products	284
	Pulp and paper products	5,517,192
	Wood-fabricated materials	82,026
	Total value of imports	**5,599,502**

Newfoundland and Labrador

Population (January 2023)
540,418

Arboreal emblem
Black spruce

Area defoliated by insects and containing beetle-killed trees
151% increase
66,500 ha (2021) to 167,209 ha (2022)

Eastern spruce budworm population levels remain low in the Maritime provinces (NB, NS, and PE), except in western Newfoundland.

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	1,827
Fire (2023)	Area burned (hectares)	373,920
	Number of fires	218
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	230
	Volume harvested (cubic metres)	22,692
Regeneration (hectares, 2022)	Area planted	76
	Area seeded	0
Third-party certification (hectares, 2023)	Area certified	0
DOMESTIC ECONOMIC IMPACT		
Housing starts (number, 2023)		Not available
Revenue from goods manufactured (dollars, 2022)	Logging	749,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	Not available
	Total revenue from goods manufactured	**Not available**
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	70
	Survey of Employment, Payrolls and Hours	Not available
Wages and salaries (dollars, 2022)	Logging	164,000
	Pulp and paper product manufacturing	Not available
	Wood product manufacturing	Not available
	Total wages and salaries	**Not available**
TRADE		
Balance of trade (total exports, dollars, 2023)		588,019
Value of domestic exports (dollars, 2023)	Primary wood products	Not available
	Pulp and paper products	Not available
	Wood-fabricated materials	588,295
	Total value of domestic exports	**Not available**
Value of imports (dollars, 2023)	Primary wood products	Not available
	Pulp and paper products	249
	Wood-fabricated materials	27
	Total value of imports	**Not available**

Yukon

Population (January 2023)
45,148

Arboreal emblem
Subalpine fir

Area burned (hectares)
119% increase
170,367 ha (2022) to 373,920 ha (2023)

Area defoliated by insects and containing beetle-killed trees
95% decrease
37,814 ha (2021) to 1,827 ha (2022)

The aspen running canker disease that was first described in Alaska in 2022 was found in the Yukon in 2023.

DISTURBANCE		
Insects (hectares, 2022)	Area defoliated by insects and containing beetle killed trees	2,770,000
Fire (2023)	Area burned (hectares)	4,163,438
	Number of fires	304
FOREST MANAGEMENT		
Harvesting (2022)	Area harvested (hectares)	386
	Volume harvested (cubic metres)	41,774
Regeneration (hectares, 2022)	Area planted	Not available
	Area seeded	Not available
Third-party certification (hectares, 2023)	Area certified	0
FOREST SECTOR EMPLOYMENT		
Employment (number, 2023)	Canadian System of National Accounts	205
	Survey of Employment, Payrolls and Hours	Not available
TRADE		
Balance of trade (total exports, dollars, 2023)		Not available
Value of domestic exports (dollars, 2023)	Primary wood products	Not available
	Pulp and paper products	38
	Wood-fabricated materials	Not available
	Total value of domestic exports	**Not available**
Value of imports (dollars, 2023)	Primary wood products	Not available
	Pulp and paper products	Not available
	Wood-fabricated materials	Not available
	Total value of imports	**Not available**

A group of wildland fires merged near the British Columbia—Alberta—Northwest Territories border to become the largest burned area in Canada since 1950 at over 1 million ha.

Northwest Territories

Population (January 2023)
44,760

Arboreal emblem
Tamarack

Area burned (hectares)
589% increase
604,032 ha (2022) to 4,163,438 ha (2023)

Area defoliated by insects and containing beetle-killed trees
127% increase
1,217,800 ha (2021) to 2,770,000 ha (2022)

Almost 70% of the population of the territory was evacuated out of their homes in late August ,including 20,000 residents of Yellowknife.

TRADE		
Balance of trade (total exports, dollars, 2023)		Not available
Value of domestic exports (dollars, 2023)	Primary wood products	Not available
	Pulp and paper products	Not available
	Wood-fabricated materials	Not available
	Total value of domestic exports	**Not available**
Value of imports (dollars, 2023)	Primary wood products	Not available
	Pulp and paper products	19
	Wood-fabricated materials	71,507
	Total value of imports	**Not available**

Nunavut

Population (January 2023)
40,817

Although Nunavut is mostly tundra, based on National Forest Inventory estimates, it has 0.15% of the 284 Mha of boreal forest in Canada within its boundary.

How much forest does Canada have?

Canada is home to 369 million hectares (ha) of forest, or 3.69 million km^2, which is close to 9% of the world's total forest. To get a sense of the area of Canada's forests, the land area of India is about 297 million ha. Canadians depend on and value these forests for many different uses including recreation, conservation, traditional Indigenous practices and sustainable timber harvest. Strict rules require harvest areas to be regenerated either through planting or natural regrowth. Canada's National Deforestation Monitoring System reports that over the last 34 years, less than half of 1% of Canada's forest has been deforested.

What is a forest?

Canada's National Forest Inventory (NFI) uses the United Nations Food and Agriculture Organization definition of forest area:

- land not predominantly under agricultural or urban land use
- spanning an area greater than 0.5 ha
- with trees taller than 5 m and tree canopy cover of more than 10%

OR

- land that has the capability to support trees taller than 5 m with more than 10% canopy cover

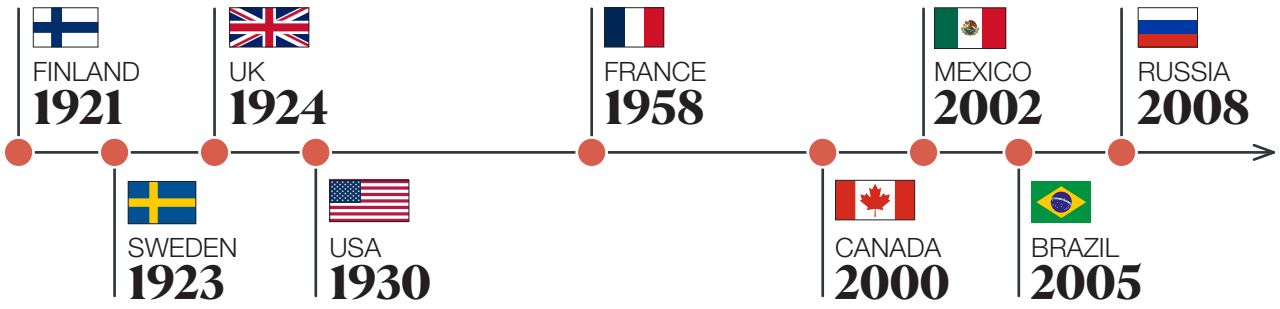
Forest area is still considered to be forest after a temporary loss of tree cover, such as after wildfire or clearcut harvesting. Changes in forest area result from:

- 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, such as agriculture or urban expansion
- Natural forest expansion or dieback

How do we monitor the change in our forests?

The Canadian Forest Service (CFS) works with provincial and territorial partners to maintain Canada's national forest monitoring and reporting capabilities via the NFI, the National Forest Information System, the National Forestry Database and the National Forest Carbon Monitoring Accounting and Reporting System. Remote sensing also plays a crucial role enabling increasingly more detailed forest monitoring over large areas.

Select National Forest Inventories around the world

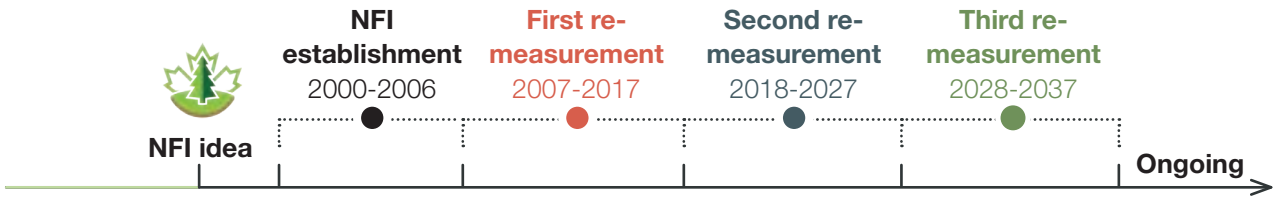


The technology and programs that Canada uses to monitor forests and how they change have evolved since the creation of the CFS 125 years ago. While each province and territory have long-standing programs to monitor forests in their jurisdictions, the NFI is only 24 years old. In comparison, Sweden, the United Kingdom (UK), and several other countries have decades of data collected through their NFIs. Canada's relatively young NFI was created to ensure our forest monitoring uses a statistically robust sampling approach by using a national plot network with consistent methodology. The NFI replaced older monitoring methods such as the Canadian Forest Inventory (CanFI), which relied on data submissions from various sources and did not include large areas of northern forests.

Canada's NFI was created to provide recurrent estimates and show changes over time for many forest attributes across the country. Forest change is determined by comparing the values between two points in time, which helps us understand trends. Shortly after Canada's NFI was created, the CFS could publish point estimates of many forest attributes. However, only recently has enough data been collected to publish information on forest change. This is a major milestone for our NFI! Using data collected between 2000 and 2017, we can estimate changes in Canadian forests over that period. This is the time between the "establishment" and "first remeasurement" periods as seen below.

As the NFI continues to collect new monitoring data through the second remeasurement period and beyond, previously published values will be revised as older data and methods are replaced. For more information on how the NFI estimates change in forest attributes, see the Sources and information section.

Canada's National Forest Inventory measurement periods



See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Forest area

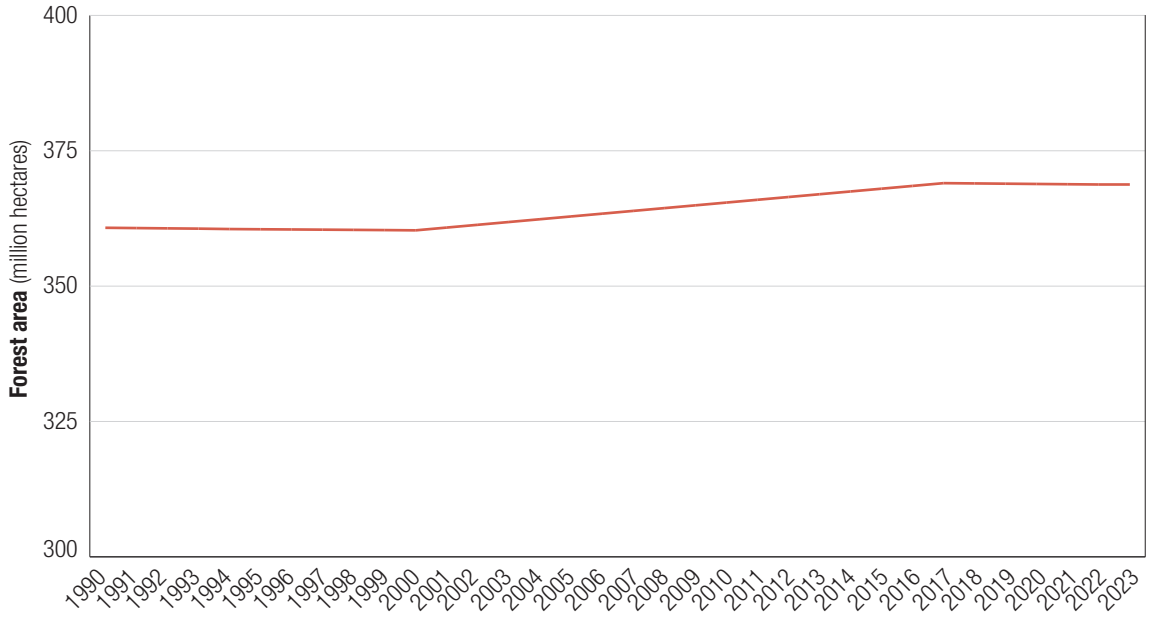
Canada has 369 million ha of forest area with many unique forest types. Over the 125 years that the Canadian Forest Service (CFS) has existed, some of this forest has undergone noticeable change and some of it appears relatively unchanged. Forests in areas prone to natural disturbance may have burned and naturally regenerated two or three times in the past 125 years, while forests in other locations may be more than five times older than the CFS!

- Compared with total forest area, both afforestation and deforestation in Canada are small. Canada's forests have seen less than half of 1% deforestation since 1990.
- The deforestation that occurs is due to agriculture, mining, oil and gas, forest roads and landings, urban development, and hydroelectric development. There is less recorded afforestation than deforestation in Canada.
- Canada uses the internationally agreed to definition of forest area, established by the United Nations Food and Agricultural Organization, to ensure consistency across countries when reporting this important forest attribute.

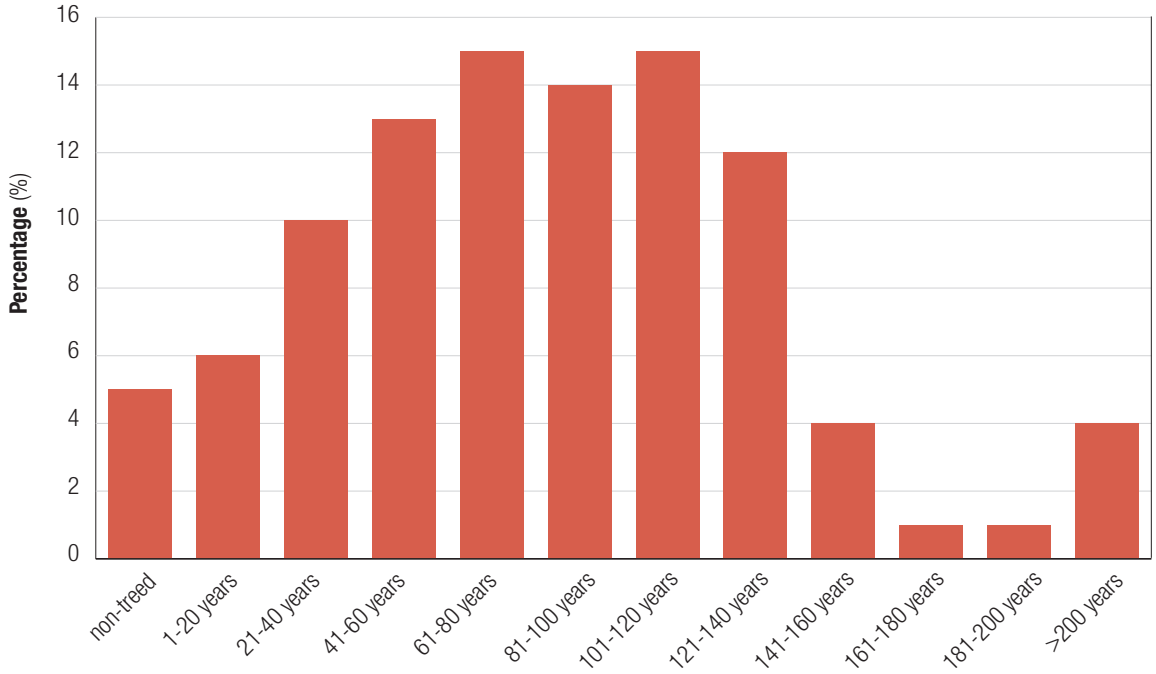
You are probably aware of recent wildland fires, forest pest outbreaks and discussions around harvest levels. Have you wondered how they affect forest area? While these examples may have an impact on tree cover and other forest conditions, they only affect forest area when the forest cover losses are not followed by natural regeneration or reforestation. Forest area loss occurs due to permanent events like deforestation or natural forest regeneration failure.

- While forest area in Canada is relatively stable, the tree cover within is more dynamic due to wildland fires, insect infestations, harvest activities and forest cover re-growth.

Canada's estimated forest area, 1990–2023



Percentage of forest land by age class in Canada



Forests are dynamic ecosystems and continuously undergo cycles of growth, disturbance and regrowth. Where natural disturbances occur frequently, such as in fire-prone landscapes, these cycles repeat more frequently and there are fewer old stands, even in the absence of human disturbance. In areas less exposed to large forest disturbances like on islands and along lakeshores, where water acts as a fuel break, forest scan remain undisturbed for centuries and older stands can develop. In the absence of major disturbances (e.g., wildfire or clear-cutting), old-growth forests continue to evolve through small-scale disturbances such as the death of individual trees.

Improved data reveal positive trend in forest area

Continued investments and enhancement of the National Forest Inventory (NFI) positions Canada to report, for the first time, forest area trends based on statistically robust repeat pan-Canadian forest measurements.

In previous State of Canada's Forests reports, Canada used the best available data on forest area at a single point in time, from the NFI, together with the best available data on deforestation and afforestation, from deforestation monitoring and available afforestation records, to report on forest area changes between 1990 and present.

As a result of the addition of new data, the NFI now reveals that previously unreported increases in forest area are occurring in Canada's forests. The trend is very small relative to the overall size of Canada's forest. The probable causes for the observed modest increase in forest area include a combination of: natural infilling of former gaps in the forest, natural expansion at forest margins, the establishment of trees in areas that previously could not support them, the reclassification of areas recovering slowly from previous fires or disturbances which were mistakenly identified as non-forested, afforestation efforts, and land use designation changes where treed agricultural land has been designated as forest.

Consistent with the NFI data, recent research studies based on satellite measurements only have observed small increases in forest cover, that is, natural forest infilling and expansion as an important driver of increases. For the scientific community, trends in forest area (and forest cover) will continue to be an area of active investigation.

Why is this indicator important?

- Understanding changes in total forest area in Canada is an important part of monitoring sustainable forest management. Healthy and functioning forest area provides habitats for biodiversity and many important ecosystem goods and services.

- The international community continues to put great emphasis on understanding global forest area changes. Although Canada's forest area has been relatively stable in recent history, it remains important to monitor the effects of human activities and climate change.

What is the outlook?

- Natural increases and decreases in forest area tend to occur gradually where and when growing conditions or disturbance patterns allow. National forest monitoring, through the NFI, enables us for the first time to report these changes at the national scale. Changes to natural ecosystem processes induced by climate change may accelerate this historically slow process.
- Forest area is expected to remain generally stable. Rates of human-induced change are likely to remain low (See the indicator **Deforestation and afforestation** for more information).

How government initiatives support sustainable forest management

- The federal government's Forest Systems Information and Technology Enhancement (ForSITE) program will enhance the forest information available to support forest management decisions for sustainable and resilient forests and to publicly report on forest inventory and management practices.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Deforestation and afforestation

Canada's annual deforestation rate has slightly decreased over the last three decades. In 2022, 49,250 ha of forest were converted to non-forest land uses, compared to 64,000 ha in 1990.

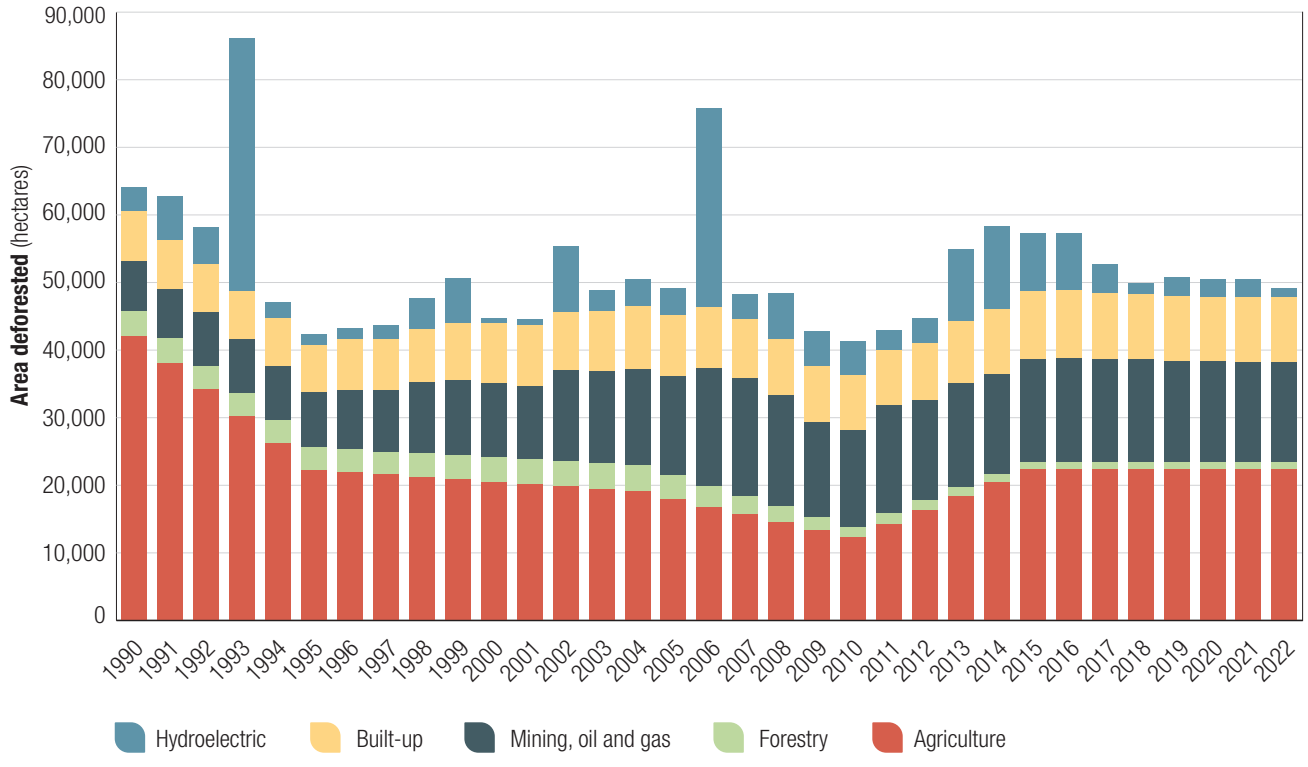
- Canada has 9% of the world's forest but is responsible for only 0.37% of global deforestation since 1990.
- The main drivers of deforestation in Canada continue to be agricultural, oil and gas expansion, and mining.
- The development of hydroelectric reservoirs causes noticeable spikes in annual deforestation due to the flooding of forests, as seen in 1993 and 2006.
- Deforestation in the forestry category arises from new permanent forestry roads and other persistent clearings such as sizeable landings.

The National Deforestation Monitoring System (NDMS) tracks changes from forest land to other land uses across Canada. Deforestation does not include forest harvest when forests are being regrown on the site.

The NDMS can show trends by time, region and industry sector type.

- The low annual area of recorded afforestation is much smaller than the annual area of deforestation, which in turn is much smaller than the total area of Canada's forests.

Estimated area of annual deforestation in Canada, by industrial sector, 1990–2022



Why is this indicator important?

- Forest loss affects biodiversity, soil, air and water quality, and the availability of wildlife habitat. Forests also store more carbon than other terrestrial ecosystems and can be managed to mitigate climate change, for example, by increasing the area of forest through afforestation or by avoiding deforestation.

What is the outlook?

- The deforestation rate in Canada is expected to remain steady at its current levels.
- Ongoing and planned initiatives for planting trees in both urban and rural areas are expected to increase the afforested land area in coming years. The contribution of this activity to ecosystem services such as restoring habitat and carbon sequestration is increasingly recognized.

How government initiatives support sustainable forest management

- The federal government's 2 Billion Trees Program is a 10-year funding program that works through partnerships in support of incremental tree planting (through both afforestation and reforestation plantings) by 2031.

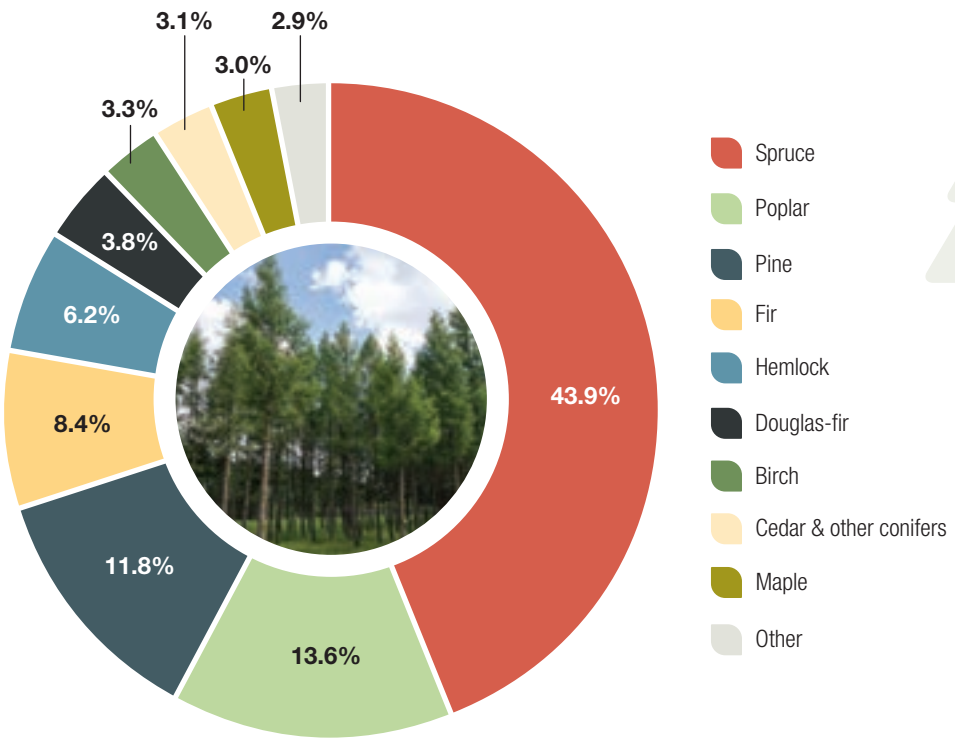
See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Wood volume

The National Forest Inventory (NFI) estimates that there are 50.4 billion cubic metres (m^3) of wood in Canada's forests. The provinces, territories and the Canadian Forest Service contribute data on wood volume to the NFI, which allows various national summaries of this important forest attribute, including:

- 72% of Canada's wood volume on forest land is in coniferous forest types. The remaining is in broadleaf (14%) and mixed wood (14%) forest types.
- 50% of Canada's wood volume is in forest stands between 61 and 120 years old. The remaining volume is in younger forests which contain less volume, and older forests, some of which have high volume and others that are sparsely treed.

Canadian wood volume on forest land: volume by species groups



Canada's top ten tree species groups on forest land by wood volume. Spruce and poplar, the top two, combine for over half of Canada's wood volume.

Estimated wood volume (million cubic metres) in Canada

Year	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	2022
Wood volume	47,802	47,737	47,292	48,404	49,516	50,629	50,851	51,074	50,778	50,676	50,741	50,368	50,357

How are national volume estimates improving?

Continued investments and enhancement of the NFI positions Canada to report, for the first time, wood volume trends based on statistically robust repeat pan-Canadian forest measurements.

In previous State of Canada's Forests reports, Canada used the best available data on wood volume at a single point in time, from the NFI, together with the best available data on wood volume trends in Canada's managed forests that were derived from the National Forest Carbon Monitoring Accounting and Reporting System, to report on overall wood volume changes between 1990 and present.

The new trend data from the NFI reveal previously unreported overall wood volume increases. This increase may be driven in part by forest area increases observed in NFI data. Forest cover increases have also been observed in studies by government and academic researchers.

Why is this indicator important?

Having a thorough understanding of how volume is distributed throughout the forest land base enables scientifically sound decision making. Canadian planners and policy analysts depend on understanding wood volume for:

- Protecting wildlife: A biologist can use wood volume as an indicator for identifying forests that are suitable habitat for species of interest. Understanding the total volume of specific species in a watershed, for example, or what percent of volume is in a specific age class may be helpful information for this task.
- Emergency planning: Wildland fires continue to impact many forests and people across the country. To keep Canadians safe, planners can make prevention and mitigation decisions if they know how dense a forest is, or how much volume of fire-prone tree species is located near a community.
- Sustainable forest management: Provincial and territorial governments set the allowable annual cut (AAC) for their jurisdictions. The AAC states how much volume can be harvested in each area and what types of species, age and tree health that volume must come from.

What is the outlook?

- Wildland fires and other natural disturbances will continue to impact wood volume across Canada's forests. These events will increase dead tree volume, cause volume loss in some areas, shift the age class distribution as older stands are replaced by younger stands post-disturbance and alter tree species composition.
- Climate change will continue to alter how and where forest wood volume is distributed throughout Canada. Some areas may see an increase or decrease in volume due to the shift in climatic conditions.
- Wood volume can influence where Canadians live. Communities that have access to volume for products in emerging markets, such as bioenergy or mass-timber construction, may see an increase in jobs and population. Rural communities which have had their mill supply impacted by wildland fires, pests, or increases in wood supply restrictions may see a reduction in the forest sector-related jobs and population.

How government initiatives support sustainable forest management

- The federal government's Forest Systems Information and Technology Enhancement (ForSITE) program will enhance the forest information available to support forest management decision for sustainable and resilient forests and to publicly report on forest inventory and management practices.

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How are Canada's forests harvested sustainably?

Sustainable forest management (SFM) seeks to maintain and enhance the ecological, social and economic benefits of forests, ensuring their availability for present and future generations. Canada adheres to these principles in managing its forests. In 2022, about 669,000 ha of forest were harvested in Canada, representing roughly 0.2% of the total forested area. Over the past decade, the percentage harvested has always been lower than 0.4% of the managed forest area.

Ownership and management of Canada's forests

Nearly 90% of Canada's forests are publicly owned, being managed by provincial or territorial governments through their respective forestry laws. These forests are governed by various regulations and policies that align with SFM principles, particularly through ecosystem-based management planning.

Determining harvested volumes

Forest management is a multidisciplinary effort, involving ground surveys, remote sensing, and growth models to assess forest composition, age, structure, and growth rates. This information is used to calculate the sustainable volume of wood that can be harvested while maintaining ecosystem functions like carbon sequestration and wildlife habitats. Research is ongoing to develop continuous forest inventory frameworks, which aim to grow the current inventory based on the latest remote sensing technologies. Scientists are also incorporating climate factors into growth models to better understand and account for climate impacts on forest growth.

Research is underway to develop adaptive silviculture for climate change in white pine stands of the Great Lakes-St. Lawrence forest region, as well as in other Canadian ecosystems.

Forest management plans and strategies

Forest management plans define the current and desired conditions of forest lands, along with strategies to achieve sustainable management goals, considering biodiversity, climate change and natural disturbances such as pest outbreaks, and wildfires. Forest management plans are developed by registered professional foresters in compliance with laws and regulations of each province and territory. The planning process involves consultation with Indigenous Peoples and stakeholders, increasingly integrating Indigenous knowledge and traditional practices into decision-making.

Challenges and opportunities from climate change

Canadian forests face significant challenges from global climate change. Changing climate affects the ability of some tree species to regenerate and alters forest ecosystems. However, it also creates opportunities, making Canadian forests more hospitable for tree species, such as white oak, whose established ranges do not currently extend this far north. Assisted migration scenarios are being developed and tested to relocate tree species from their native climates to new areas projected to have similar conditions in the future, aiming to preserve ecosystem functions, productivity and health.

Enhancing forest productivity and adaptation

Depending on jurisdictions, natural regeneration is usually prioritized and plays a substantial role in forest renewal. In addition to managing forests to favour natural regeneration, planting new trees often results in higher productivity through tree-breeding programs and better use of available growing space. Tree planting, in combination with natural regeneration, also gives control over forest composition, enabling ecosystems to adapt to future climate conditions and global environmental changes. Researchers and practitioners are developing silviculture practices to address climate change and the associated increased disturbances risks including wildfires, drought, windthrow, parasitism and disease. Innovative Climate-Smart and FireSmart silviculture practices aim to support a sustainable forest-based bioeconomy, reduce carbon emissions and maintain resilient forest ecosystems.

Climate-Smart silviculture aims at practices that will:

- ensure healthy, resilient growing forests
- reduce emissions from the forest sector operations
- maximize storage and substitution with wood products
- protect stored forest carbon

In addition, fire-smart silviculture practices will contribute to mitigate the risks and impacts of wildland fires that affect communities and infrastructure.

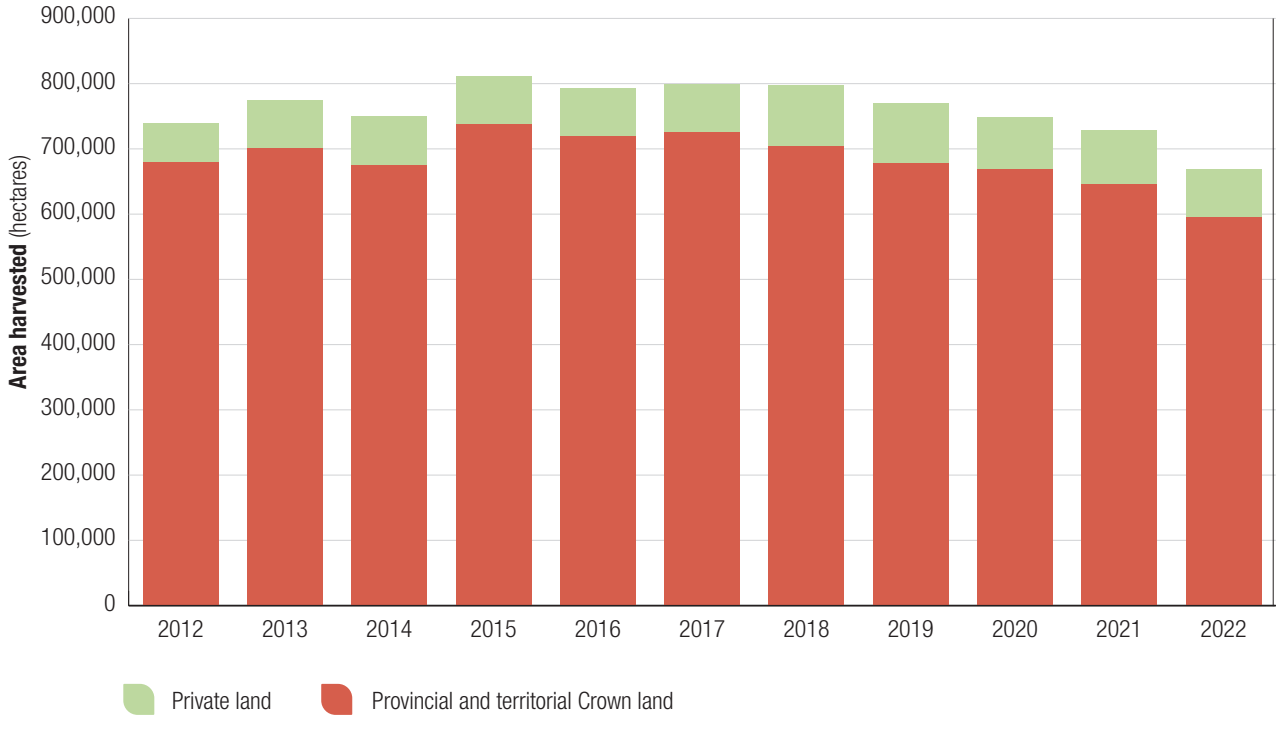
See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Forest area harvested

By tracking the total area harvested annually, it is possible to assess the level of industrial activity taking place in Canada's forests. This measurement helps estimate the long-term sustainability of harvesting activities. During the last decade, the percentage of forest area harvested has always been lower than 0.4% relative to managed forest area and around 0.2% relative to the total forest area.

- In 2022, the area of forest harvested was estimated at nearly 669,000 ha. This is the lowest recorded level over the last ten years. It was a total drop of more than 8% compared to 2021, which is double the drop observed since the start of the pandemic in 2019.
- Greatest drops in area harvested were observed in British Columbia (-21%, 30,000 ha), New Brunswick (-15%, 11,800 ha) and Ontario (-8%, 9,400 ha).
- Among the many factors that contributed to this drop in harvests, in British Columbia there is a harvest drop in areas impacted by the mountain pine beetle and an increase in areas affected by forest fires.
- Across Canada, the rise in interest rates on mortgage payments, combined with significant fluctuations in lumber prices, have slowed down the residential construction market in North America, resulting in a drop in demand for wood products.

Forest area harvested on private and Crown land in Canada, 2012–2022



Why is this indicator important?

- Forest area harvested is one of the biggest indicators in terms of economic activity associated with the Canadian forestry sector.
- Areas harvested are generally correlated with the processed volume as well as the economic benefits of the forestry sector in communities that depend on it.
- Harvested area is a metric of human disturbance from natural resources development.

What is the outlook?

- Despite the end of the COVID-19 pandemic, employment in the forestry sector has dropped slightly compared to 2021, suggesting this industry is also being affected by the labour shortage. Such a drop in labour adds to the impact on the capacity to harvest in forests and explains the drop in forest area harvested.
- The price of softwood lumber should stabilize with the recovery in post-pandemic activities and increase demand for wood products and forest harvesting.
- Stabilized lumber prices and mortgage rates should help increase housing starts in the residential sector, which should stimulate forest harvesting.

How government initiatives support sustainable forest management

Each year, natural disturbances, such as pests and wildfires, impact the area available for harvest. These events are difficult to predict and forest managers must adjust their harvesting objectives in response to such events. However, there is support from multiple levels of government to assist in mitigating the impacts of wildfire and insect outbreaks while simultaneously creating economic opportunities for forestry and bioenergy production. One example is the Forests for Tomorrow (FFT) program, which is led by the Government of British Columbia. A second example is the federal government's 2 Billion Trees (2BT) program, which supports reforestation efforts within wildfire-impacted areas.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

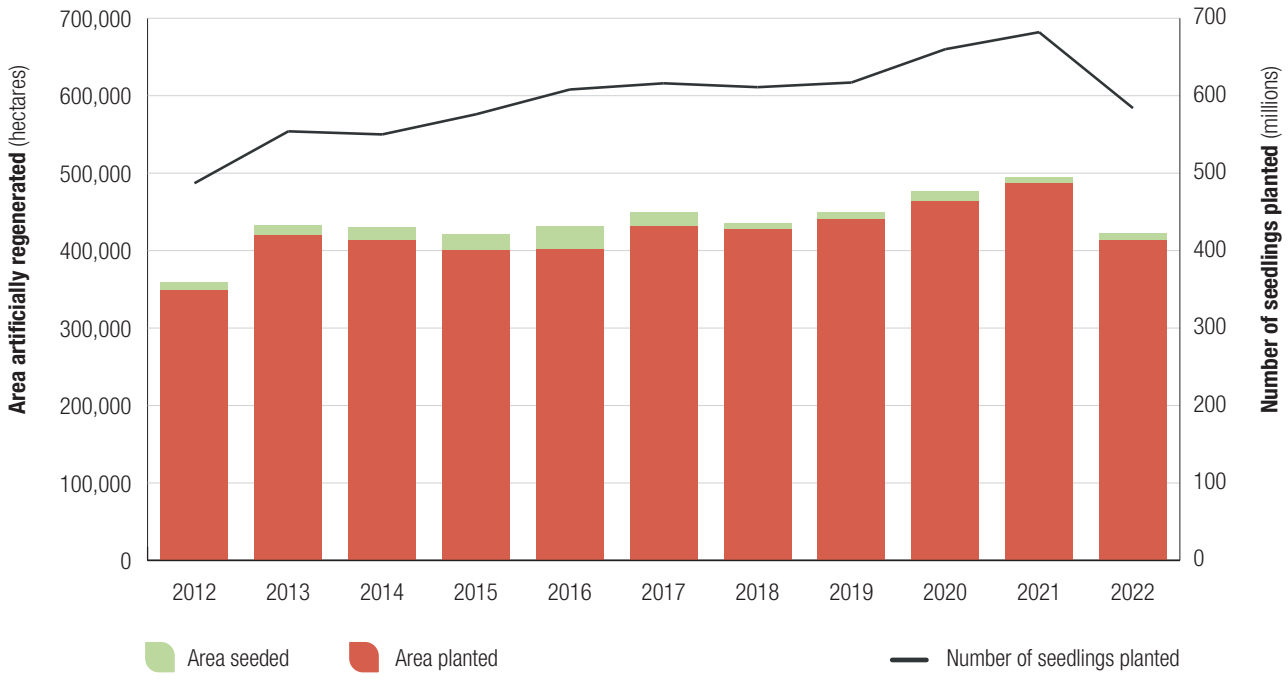
Indicator: Forest regeneration

In 2022, 423,000 ha of provincial forest lands in Canada were regenerated by planting and direct seeding. Of these lands, 98% were planted with 584 million seedlings, and 2% was regenerated with direct seeding.

- The area planted and the number of seedlings planted each declined by close to 15% in 2022 from highs reached in 2021, but the 2022 levels were only 4% lower than the 10-year average.
- Regionally, the largest decline in tree planting was in British Columbia. After 2020 and 2021, two years of record tree planting levels to aid in wildfire recovery, in 2022 tree planting declined to 2016 levels.

- Successful regeneration is required following forest harvesting on public lands.
- Forest type and silviculture system determine the regeneration method (natural or artificial).
- Artificial regeneration—planting or seeding—has been applied to 60% of the area harvested in the past 20 years
- Wildfire recovery may be aided by artificial regeneration.

Area artificially regenerated and number of seedlings planted on provincial and territorial Crown lands in Canada, 2012–2022



Why is this indicator important?

- Regeneration activities ensure that harvested areas, and sometimes those that experienced natural disturbances like wildfire and pests, 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. Most artificial regeneration is for the establishment of coniferous trees, on appropriate sites and when natural regeneration is not successful, such as after a severe wildland fire disturbance.

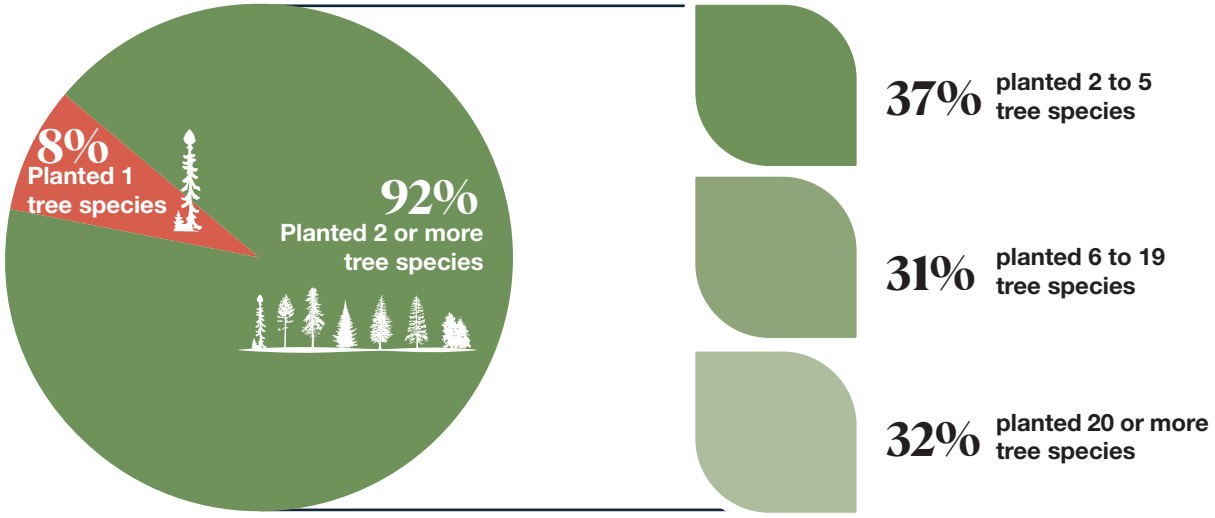
What is the outlook?

- Regeneration rates are most strongly related to recent harvest levels. These levels are influenced by market conditions but are within the bounds of sustainable forest management.
- British Columbia accounts for nearly 50% of the national artificial regeneration activity in Canada. Due to the reduction of salvage operations in mountain pine beetle affected stands, harvest rates have declined and will likely reduce forestry-related tree planting in British Columbia. However, natural disturbances such as wildland fires also influence tree planting activities. Tree planting increased to record levels in 2020 and 2021 to help recover from the 2017 and 2018 wildland fires in the province. Levels then declined in 2022. Going forward, we can expect that spikes in tree planting may occur depending on the impact of future wildfire seasons. Nationally, there is likely going to be an increase in tree planting following the extreme fire season of 2023.

How government initiatives support sustainable forest management

- The 2 Billion Trees Program (2BT) will bolster the total area and number of seedlings planted across Canada, with efforts on public lands mostly related to reforestation following natural disturbances and forest restoration efforts.
- Since 2021, 2BT-funded projects have planted over 250 species at more than 4,482 sites across Canada. 92% of these projects planted more than 2 types of trees (see image below).

Tree diversity in the 2BT-funded plantation projects



See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

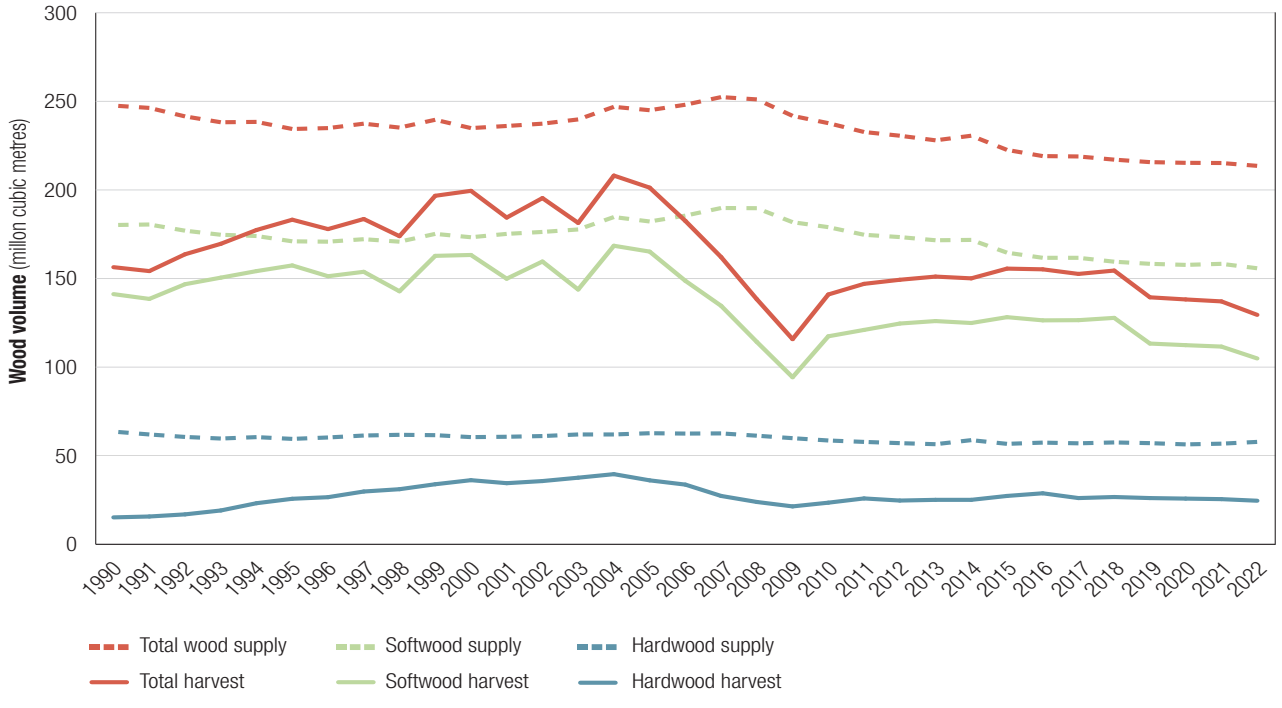
Indicator: Volume harvested relative to the sustainable wood supply

In 2022, Canada harvested 129.5 million cubic metres (m^3) of industrial roundwood (tree felled and debranched), which is well below the estimated sustainable wood supply level of 213.6 million m^3.

- The harvested industrial roundwood volume decreased by 7.6 million m^3 from 2021 levels. At the same time, the estimated wood supply deemed to be sustainable declined by 1.5 million m^3.
- The gap between the volume of industrial roundwood harvested and the sustainable wood supply is widening. The harvested proportion of wood supply in 2022 is 6.4% lower than the average over the last decade (2012–2021).

Sustainable wood supply refers to the volume of timber that can be harvested annually from federal, provincial, territorial, and private lands, while meeting long-term environmental, economic and social objectives as set out in legislations that regulate timber harvesting. Wood supply refers to industrial roundwood supplies only.

Annual harvest versus supply deemed sustainable for harvest, 1990–2022



- Canada continues to harvest at levels that are below the level deemed to be sustainable for long-term wood supply.
- The decrease in harvest is mostly attributable to the net decrease in timber volumes harvested in British Columbia, Québec and Alberta.
- As part of the path to Indigenous reconciliation, and in recognition of the inherent rights of Indigenous Peoples, Canada has been in the process of redistributing timber harvesting rights. Between 2003 and 2020, the allowable annual cut (AAC) for Indigenous Peoples increased from 4.5% to 9.9%.

Why is this indicator important?

- Forest managers and jurisdictions track the volume of industrial roundwood harvested each year to ensure it falls within long-term sustainable levels, as set out in provincial legislation and policies that regulate harvesting on provincial lands.
- Harvests from provincial Crown lands are regulated by the AAC that each province sets. 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 provincial Crown land base.

What is the outlook?

- Demand for Canadian wood products will remain strong, driven by the demand for new housing, the high quality of Canadian pulp and the increased use of wood fibre in new bioproducts.
- Harvest levels are expected to remain below the sustainable wood supply.
- The sustainable wood supply will continue to decline over the next several years, since AACs in many jurisdictions are reduced in response to the impact of insect outbreaks (e.g., mountain pine beetle, spruce budworm), hurricanes, severe wildland fires, and the measures protecting woodland caribou habitat and old-growth forests.

How government initiatives support sustainable forest management

- The Canadian Forest Service develops knowledge, tools and approaches aimed at increasing forest resiliency, thereby reducing the risks to the forest fibre supply of Canada.
- The National Forest Inventory, and the National Forestry Database, which are collaborative efforts involving federal, provincial and territorial government agencies, help assess Canada's forests health and sustainable forest management. They provide reliable sources of national information on the extent, composition and characteristics of forests, and monitor changes to forest ecosystems over time through data on forest wildland fires, insect outbreaks and forest harvesting.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

How does disturbance shape Canada's forests?

Forest composition changes continuously through natural processes such as species migration, inter-specific competition, succession and natural disturbances. Disturbances, such as wildland fires, drought, windthrow, parasitism and disease are increasing in frequency and magnitude due to accelerated invasive species introductions and climate change. Natural Resources Canada (NRCan) research is improving our ability to predict, adapt to, and reduce the impacts of forest disturbance.

Major sources of disturbance

Climate change refers to long-term changes in global weather patterns such as average temperature or precipitation. Although these changes in statistical averages seem gradual, they reflect changes in the frequency and intensity of extreme weather events, such as extensive flooding that followed severe rain in southern British Columbia in 2021, or the record-breaking number of wildland fires across the country in 2023. Novel species interactions or range shifts that occur in response to climate change can also drive new insect or disease outbreaks.

Introductions of invasive alien species have escalated in recent decades due to increased global trade and travel. The impacts of these introductions are difficult to predict. Invasive alien insects and diseases must contend with novel environments to which they may be poorly adapted. On the other hand, local forest ecosystems and tree species may lack effective defences against these invaders. In Canada, the management of native forest insects and diseases must be accompanied by a constant effort to prevent the introduction of invasive alien species and to contain or eradicate established invaders such as spongy moth and white pine blister rust.

Photo by Matthew Brown, UBC.

Mountain pine beetle (MPB) attacked canopy in the red stage seen from top of the Kennedy Siding Flux Tower in Interior British Columbia.

The historic range (before 2000, dark grey) and expanded range (after 2000, light grey) of MPB in Canada.

Individual disturbances can build on one another, compounding their effects on forest health and the surrounding environment. For example, forest stands lost to drought or insect outbreaks can supply increased fuel for wildland fires and often leave the landscape more susceptible to erosion. This is what happened when a MPB outbreak peaked across British Columbia in the early 2000s, facilitated by factors such as mild winter temperature. The MPB spread across the Rocky Mountains into the Prairies, decimating pine forests in these regions. It also amplified the likelihood of other disturbances through the production of increased wood fuel. Furthermore, it altered the hydrology, affecting soil stability in mountainous terrain. Tree mortality has transformed lodgepole pine forests in this region from a net carbon sink to a source, further contributing to climate change.

The government supports progress toward a resilient future

NRCan research and programs in Canada are improving our ability to predict, adapt to, and reduce the effects of forest disturbance. Here are some examples:

- The Canadian Food Inspection Agency works with NRCan and other stakeholders to regulate invasive species and the import and export of Canadian forestry products.
- The 2 Billion Trees Program supports the regeneration of forests that have temporarily lost their tree cover due to natural disturbances.
- The Wildfire Resilient Futures Initiative supports activities to transform the way Canada manages wildfires, recognizing that we need to take proactive steps to prepare for wildfires and to reduce risks before they occur.
- The WildFireSat satellite mission, a collaboration between NRCan, the Canadian Space Agency and Environment and Climate Change Canada, will be the world's first purpose-built, public satellite system for monitoring fires, providing daily information on all active wildfires to support rapid fire management decisions.
- The Forest Systems Information and Technology Enhancement program will improve information related to forest carbon and forest integrity, to support decisions about strengthening and sustaining Canada's forest resources.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

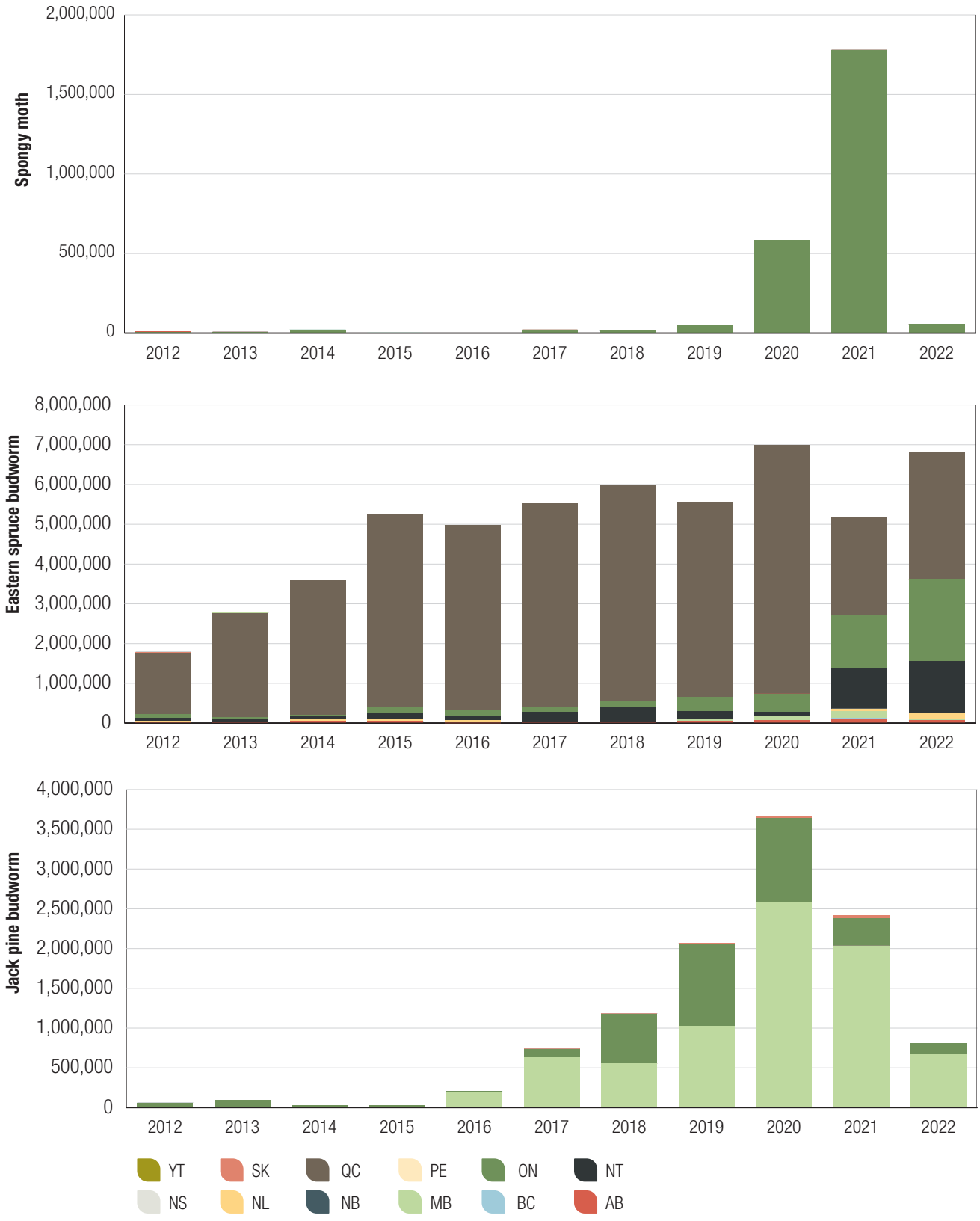
Indicator: Forest Insects

In 2022, 13.1 million ha of Canada's forests were affected by insects, a 13.7% decrease from 2021.

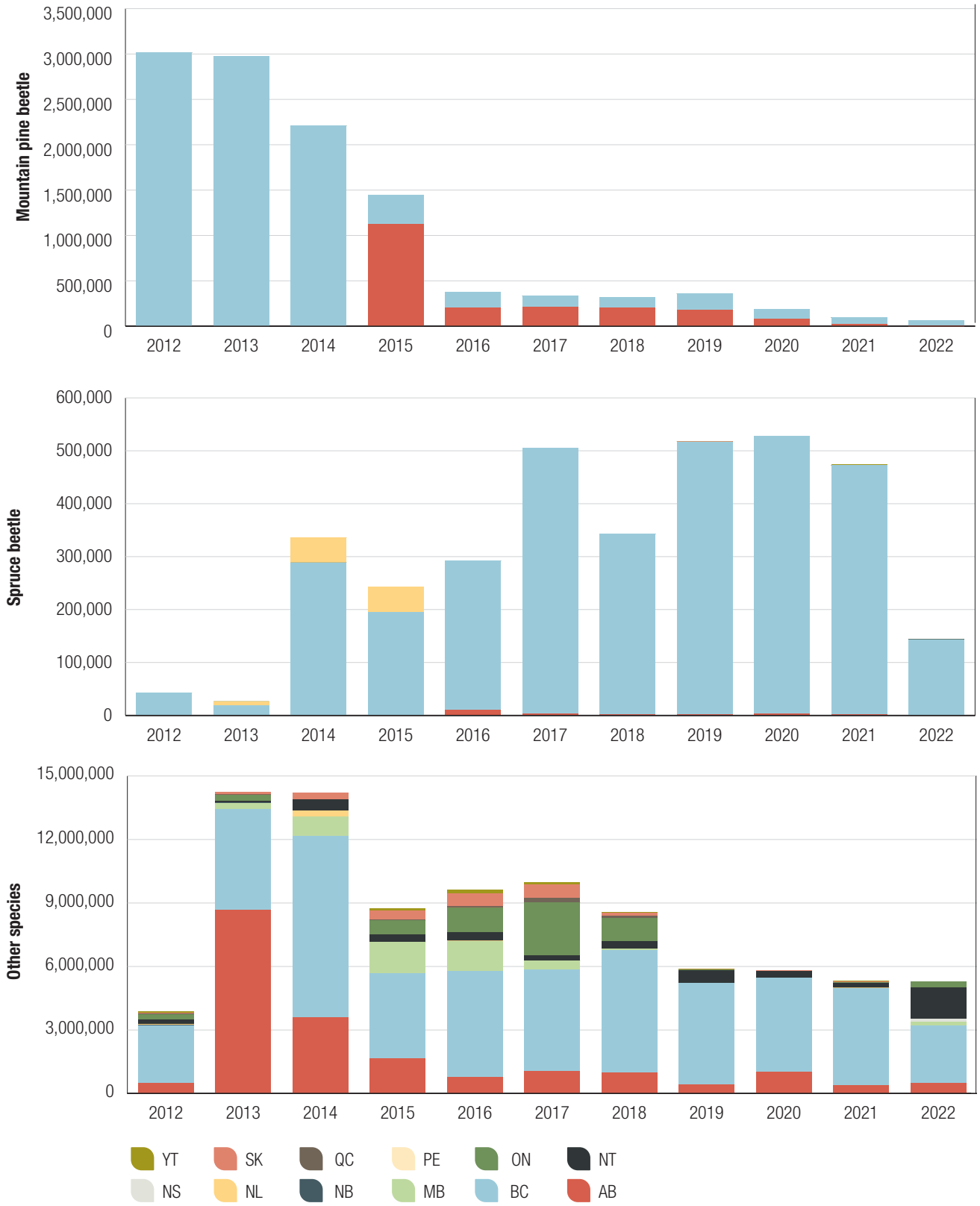
- The significant outbreak of spongy moth in Ontario decreased dramatically between 2021 and 2022, with defoliation declining by over 95%. Defoliation in other provinces with known populations of spongy moth, such as Québec, was minimal.
- Defoliation by eastern spruce budworm rebounded to approximately 6.6 million ha, similar to the 2020 defoliation levels. The rebound was driven by increases in defoliation in Québec, Ontario and the Northwest Territories. Defoliation also increased in Newfoundland and Labrador.
- Defoliation by jack pine budworm decreased to levels last observed in 2017. This decline was driven primarily by decreases in outbreaks spanning the Ontario-Manitoba border.
- The area affected by spruce beetle declined from relatively high and stable levels for the first time since 2019. Damage was nearly all centred in British Columbia and Alberta, with some tree mortality in Yukon.
- Approximately 6 million ha were affected by other insect pests in 2022. This number is similar to that of 2021. However, increases in defoliation were seen in Ontario, Nova Scotia, Manitoba and the Northwest Territories.

Insects represent a large proportion of all living things on Earth, with over half of all animals described being an insect. In Canada, there are almost 39,000 described insect species and additional 35,000 estimated undescribed species. Altogether, insects represent more than one out of every two species in Canada.

Forest area (in hectares) containing defoliated or beetle-killed trees for key insects in Canada, 2012–2022



Forest area (in hectares) containing defoliated or beetle-killed trees for key insects in Canada, 2012–2022



Why is this indicator important?

- Insects fulfill innumerable vital ecological roles in Canada's forests, with many insect species being closely associated with trees. Variations in their densities are common over time; however, some insects, including wood borers and defoliators, may reach population densities that can cause ecologically and economically significant effects. Negative effects include timber loss, alteration of carbon stocks, destruction of recreational areas and increases in wildland fire risk. These effects can expand beyond local and provincial jurisdictions to become regional or national issues. Forest health monitoring conducted by the provinces and territories, and, if necessary, effective management programs are essential for mitigating these risks.
- Invasive species introduced from other countries continue to be a threat to Canada's forests. While these species are often not significant pests in their native ranges, when they arrive in a new range free of their normal controls (e.g. predators, parasites and diseases), they can establish, spread rapidly and disrupt ecosystem functioning. Trees in their new range also may have no defences against these species, which can enable them to rapidly increase in abundance and devastate tree health. Invasive species have reached extremely high population levels, such as the 1.8 million ha spongy moth outbreak in Ontario in 2021. Detection, monitoring and interception programs are critical in preventing invasive species from being introduced or established in Canada. Regulatory controls that restrict the movement of infested products or transport of invasive organisms can reduce the spread of invasive species, though these may have regional, national and international effects on trade, market access, raw material supplies and the movement of goods.

What is the outlook?

- Spongy moth populations are expected to remain low after the significant decrease in defoliation observed in 2022. Spongy moth abundance is greatly affected by the prevalence of pathogens, especially a virus and a fungus, as well as some parasites that contribute to population collapses. The abundance of these natural enemies increased in tandem with rising spongy moth population until it peaked in 2021. With a population cycle at approximately 10 years, increases in defoliation may be unlikely in the next few years. This may change if weather conditions, such as hot, dry summers favour the insect and dampen the effect of the fungus.
- Eastern spruce budworm levels remain relatively high in parts of its range. Spruce budworm outbreaks continue in the border area between northwestern Québec and northeastern Ontario, and in eastern Québec. The population levels remain low in the Maritime provinces (NB, NS, and PE), except in western Newfoundland where suppression efforts continue.
- Tree mortality caused by spruce beetle will likely continue to remain lower than previous years.
- Mountain pine beetle populations have collapsed in much of western Canada due to aggressive control actions and several cold winters, although ongoing infestations continue in northwestern and southeastern British Columbia.
- The threat of invasive species will continue to be important in relation to protecting Canada's forests. Presently, several species threaten important components of Canada's forests. Hemlock woolly adelgid has established in the southwest part of Nova Scotia, where it is expected to continue to spread and cause increasing levels of hemlock mortality. Although this insect is not as widespread in Ontario, hemlock woolly adelgid is expected to expand its range in the province via long-range dispersion by birds and other means. Ongoing tree mortality caused by emerald ash borer threatens both managed and wild ash species across the native range of ash trees in Canada. Significant research in species biology, monitoring tools and management methods for these insects is needed to develop strategies for these, as well as many other species to protect Canada's forests from these threats to forest health.

How government initiatives support sustainable forest management

- With continued treatment via the Early Intervention Strategy, as well as the increase of regulatory factors such as natural enemies in the populations, densities of the Eastern spruce budworm are expected to decrease relatively soon in the Maritime provinces.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Forest diseases

New or unknown forest diseases can appear because of being recently introduced into Canada from other countries or because of being unnoticed due to historically low levels of infection. In 2023, several diseases were reported for the first time in Canada or in new regions in Canada.

- The invasive oak wilt disease was reported for the first time in Canada from three locations in Ontario.
- The sooty bark disease of maple, that is endemic to the Great Lakes region of North America and associated with droughts and heat waves, was officially reported for the first time in British Columbia.
- The aspen running canker disease, that was first described in Alaska in 2022, was found in the Yukon.
- A new canker disease of laurel willow was described in Alberta.

Tree diseases are caused by pathogens, which are often fungi. However, fungi also provide many important benefits to forests including increasing water and nutrient uptake in trees, driving nutrient cycling as decomposers of wood, leaves and other materials, and as sources of food for microorganisms and animals.

Sooty bark disease symptoms on the stem of a dead sycamore maple in Victoria, British Columbia.

Sycamore maple, an exotic species in Canada, is among the most susceptible species to this disease. Currently, it is uncertain whether native maple species are vulnerable to sooty bark disease, but Natural Resources Canada's ongoing research on bigleaf and vine maple will help answer this question.

Why is this indicator important?

- Alien and native invasive forest diseases can cause widespread and severe damage to Canadian forests, threatening biodiversity, ecosystem services, forest-based industries and trade.
- Climate change can exacerbate diseases by causing conditions that weaken trees, expand the range of pathogens and promote infection.

What is the outlook?

- A changing climate will bring some uncertainty for Canadian forest health. For example, cool, wet springs promote leaf diseases while hot, dry summers aggravate root diseases.
- Expanding global trade increases the risk of biological invasions by pests and pathogens that may be present on traded commodities.

How government initiatives support sustainable forest management

- The Canadian Forest Service collaborates with the Canadian Food Inspection Agency to reduce the risk of pathogens in wood imports and exports and conducts research to reduce the effects of pathogens in commercial forests across Canada.
- Surveillance and early detection of forest pathogens are essential. Canada invests in research for proactive surveillance which includes the development of DNA-based detection tools and a network of aerial spore traps to intercept and respond to pathogens of concern.
- The Government of Canada has embarked on a collaborative project with the provincial governments of British Columbia, Alberta and Québec, supported by the 2 Billion Trees program to identify pathogen-free seed to ensure healthy seedlings for planting.
- Through good forest management practices, pathogens are managed by the provinces through matching tree species to the climate and soils, genetic improvement programs, and removal of dead trees.
- Canada is investing in research and tools that can be deployed to combat forest health challenges including genomics-based identification and surveillance, breeding trees for disease resistance, tolerance to drought and other stresses, assisted migration, and biological control agents.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Forest fires

Wildland fires in Canada burned more area, produced more smoke, triggered more evacuations and cost more to manage in 2023 than any previous year on record.

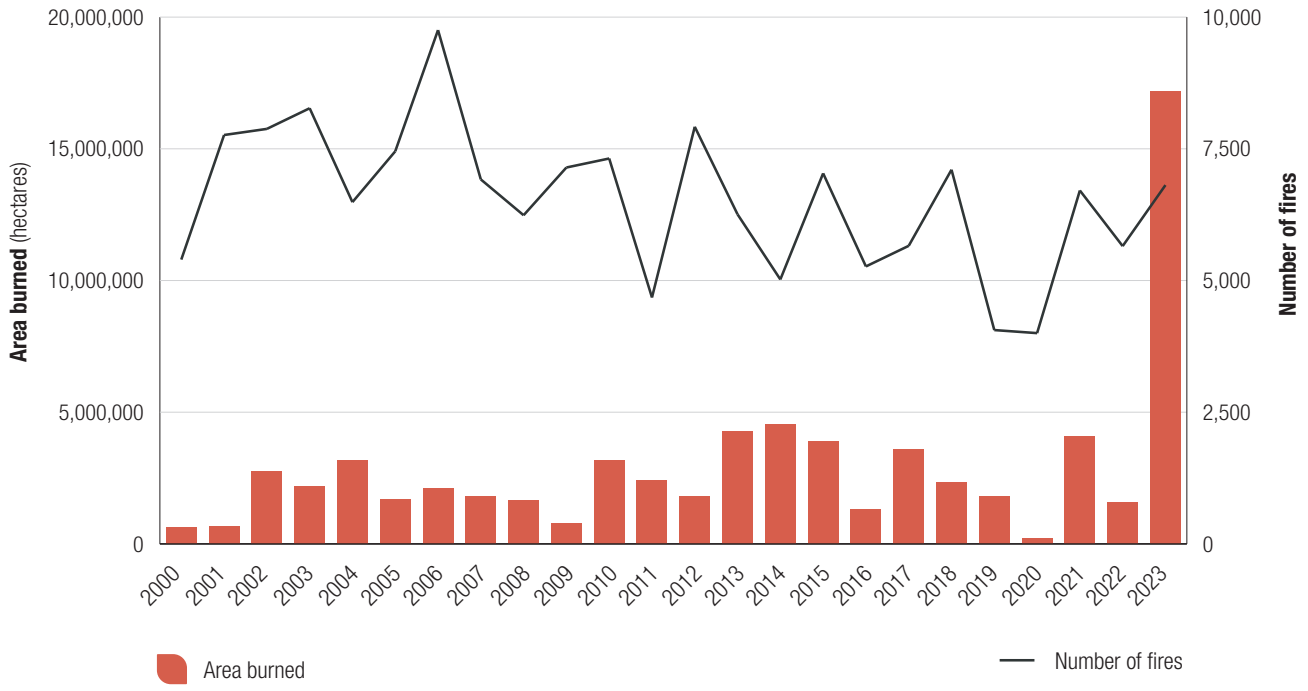
- Low snowpack, above-average temperatures, early snowmelt, and a dry spring brought fire-conducive conditions to much of the west, as did rapid drying in the east in May.
- The fire season started early, with the first large fire near Evansburg, Alberta, at the end of April. By the end of May, more than 1 million ha had burned in Alberta—an area greater than Banff National Park.
- In Nova Scotia, the Barrington Lake fire started on May 26 and over the next two weeks grew to become the largest in the province's recorded history. At the same time, the Tantallon fire near Halifax prompted the evacuation of 16,000 people and destroyed 150 homes.
- In British Columbia, a lightning strike started the Donnie Creek fire on May 12. This fire burned all summer and into October. At 619,000 ha, it was the largest fire in British Columbia history and one of several wildland fires that survived the winter and re emerged in the spring of 2024.
- In Québec, lightning storms ignited 182 wildland fires in one day at the beginning of June. By the end of the season, more than 4.5 million ha of forest burned in the province—more than the previous 20 years combined. Smoke from these fires inundated parts of Ontario and the northeastern United States.
- A group of wildland fires that were close to each other near the British Columbia Alberta Northwest Territories border merged to become the largest burned area of the year at over 1 million ha—the largest in Canada since 1950.
- The entire population of Canada was subjected to poor air quality at some time during the summer, with communities in southern Northwest Territories and northwestern Québec enduring hazardous smoke concentration levels (>18 times the safe PM2.5 threshold) for more than half of the summer (>60 days).

Burned area mapping

During the fire season, the area burned is estimated from fire perimeter maps made using a variety of methods, ranging from detailed (airborne infrared) to approximate (satellite hotspots). Using these methods, the total area burned in 2023 was 17.2 million ha. However, many of these perimeters include "islands" of unburned forest, water bodies, and barren land. Higher-resolution mapping using Sentinel and Landsat imagery indicates that the total burned area for 2023 was 15.0 million ha. Either way, this area is:

- larger than the island of Newfoundland
- almost twice the size of Lake Superior
- more than seven times the 20-year average
- double the previous record set in 1989
- more than 4% of Canada's total forest area

Forest area burned and number of forest fires in Canada, 2000–2023



- Fire suppression efforts involved 5,800 Canadian firefighters, 2,100 personnel from the Canadian Armed Forces and 5,500 firefighters from 12 countries.
- Tragically, eight firefighters lost their lives in the line of duty, more than any year since 1971.
- A record 232,000 people from 200 communities were evacuated from their homes over the course of the season: some more than once. The largest evacuation order affected the 20,000 residents of Yellowknife. Along with other evacuated communities in the Northwest Territories, almost 70% of the population of the territory was out of their homes in late August. Meanwhile, the 2,100 residents of Fox Lake, Alberta, experienced the year's longest duration evacuation—74 days.
- The most destructive fires were in British Columbia's Okanagan Valley in late August. The McDougall Creek fire near Kelowna and the Bush Creek East fire in the Shuswap, together destroyed over 400 structures and caused $720 million in insured damages.

Why is this indicator important?

- Wildland fires can damage or destroy homes and businesses, trigger evacuations, and disrupt people's lives and livelihoods.
- Wildland fires produce large amounts of smoke, reducing air quality and visibility.
- An average of $1 billion is spent annually on fire management; the costs in 2023 were significantly higher.
- Research suggests that the extent of losses and the number of evacuations that First Nations populations experience could drastically increase in the coming decades. This may translate into major consequences, including structural and cultural losses, more land alterations, and more inherent social disruptions due to evacuations.
- Many First Nations reserves are located in forests prone to wildland fire and are often particularly vulnerable to emergencies due to their remoteness, limited access or limited ability to evacuate by road. Indigenous Peoples are 30% more likely to be impacted by wildland fires compared to non-Indigenous Canadians.

What is the outlook?

Wildland fire occurrence and spread vary significantly from year to year, but there are reasons why costs, damage and difficulty of control are increasing:

- There are more homes, businesses and infrastructure in the wildland-urban interface.
- There are more people living and working in forested areas and visiting forested areas for recreation.
- Increasing variability in climate results in more incidents of drought and high winds—conditions ideal for fire spread.

A look into the 2024 fire season: As of October 2024, fire management agencies reported that the total area burned was 5.4 million hectares, which is significantly below the 2023 total, but still well above the long-term, 25-year average. The most damaging fire of the season burned in Jasper National Park in July, triggering the evacuation of 25,000 people, consuming one-third of the buildings in the town of Jasper, and causing an estimated $1.23 billion in insured losses.

How government initiatives support sustainable forest management

- The Government of Canada is investing funds to support community preparedness and fire protection strategies in First Nations communities which are often located in remote areas at higher risk.
- Investing in Canada's capacity to prepare for and respond to wildland fires. This includes funding in support of wildland fire prevention and mitigation, and the modernization of national wildfire information and decision-support systems.
- Investments by the federal government include support to train community-based firefighters as well as firefighters who are trained to work in urban areas affected by wildfires. There is also support for provinces and territories to procure specialized firefighting equipment.
- The development of a wildland fire dedicated satellite system, WildFireSat, will significantly enhance the ability to detect and monitor wildfires across the country, especially in Northern Canada (targeted to be used in 2029).

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Forest carbon emissions and removals

In 2022, the total net greenhouse gas (GHG) emissions—reported as carbon dioxide equivalent (CO_2e)—from Canada's managed forests and forest products were about 114 million tonnes (Mt). Managed forests are forest lands managed for timber production, conservation or fire suppression.

This total net emissions value is calculated by adding emissions/removals caused by human activities in Canada's managed forests to emissions/removals caused by natural disturbances in Canada's managed forests.

- In 2022, human activities in Canada's managed forests, including the use and disposal of forest products, accounted for emissions of about 21 Mt CO_2e in the atmosphere. Natural disturbances accounted for emissions of about 93 Mt CO_2e, resulting in net emissions of about 114 Mt CO_2e.
- Wildland fires are a significant driver of emissions from Canada's managed forests.

Canada's forests absorb carbon and emit atmospheric carbon dioxide (CO_2), methane (CH_4), carbon monoxide (CO) and nitrous oxide (N_2O). In any given year, depending on the area of natural disturbances such as wildland fires, insect outbreaks and windthrows, Canada's forests can either be a source of GHGs or a sink of atmospheric carbon.

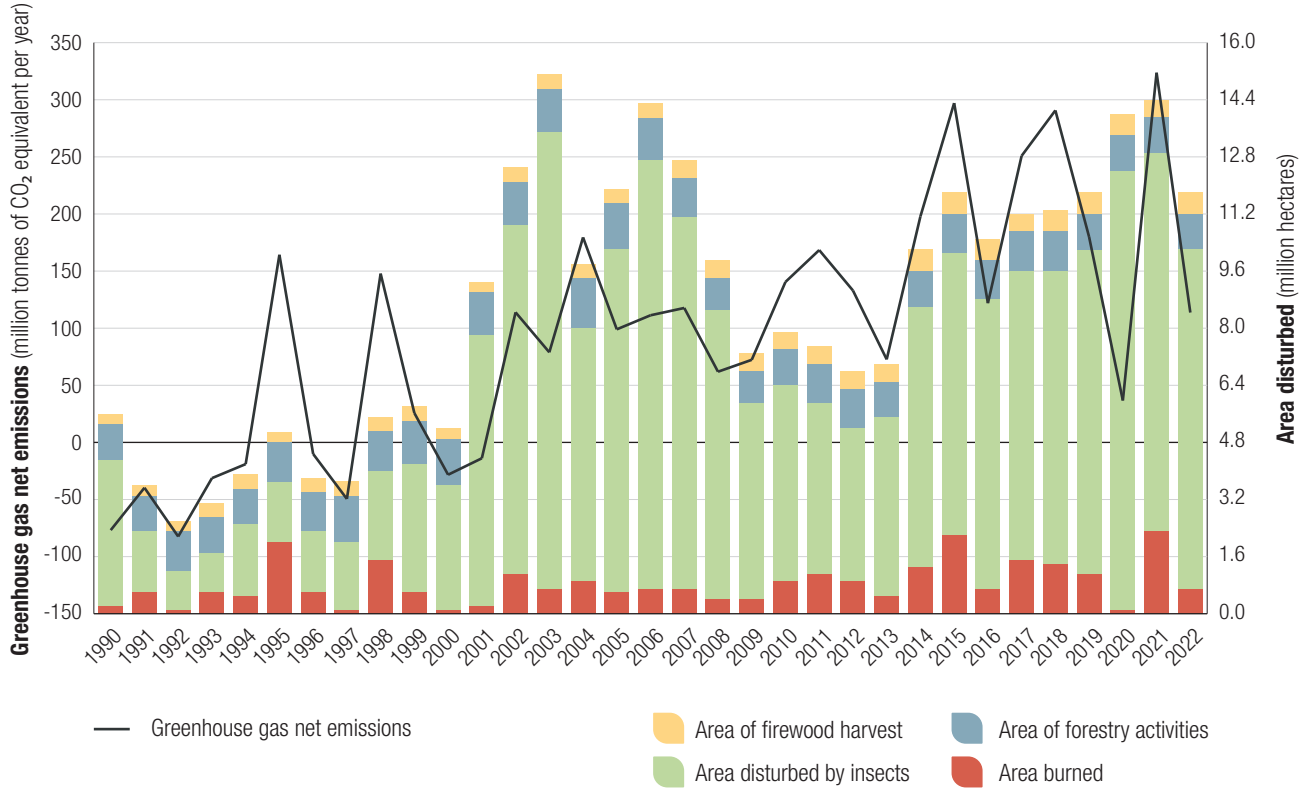
Canada takes an approach that distinguishes forest emissions and removals in the managed forest into two components:

- Those under the influence of **human activities**
- Those associated with **natural disturbances** beyond human control

In keeping with international guidelines, Canada's National GHG Inventory Report (NIR) focusses on the human activity component. The State of Canada's Forests report provides a comprehensive estimate of emissions/removals for both components, including additional gas types not required in the NIR.

This year, Canada made a major improvement to its managed forest carbon estimates, reflecting new data that tells us pre-1990 harvested area is smaller than previously assumed. For more details, see the Sources and information section.

A **Net carbon emissions in Canada's managed forests: All areas, 1990-2022**

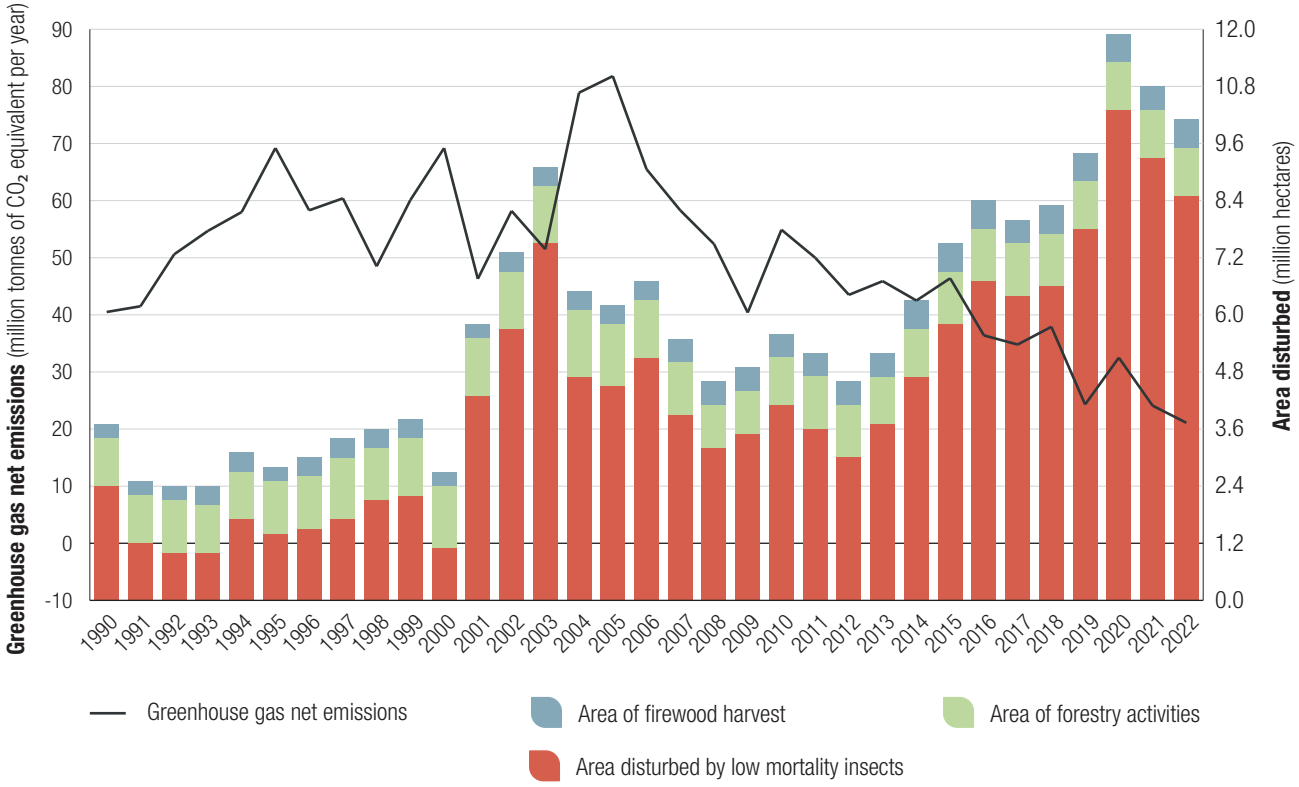


A The total net emissions and removals from Canada's managed forests, taking into account both human activities and natural disturbances, were about 114 Mt CO_2e in 2022, making the forests a net source in 2022.

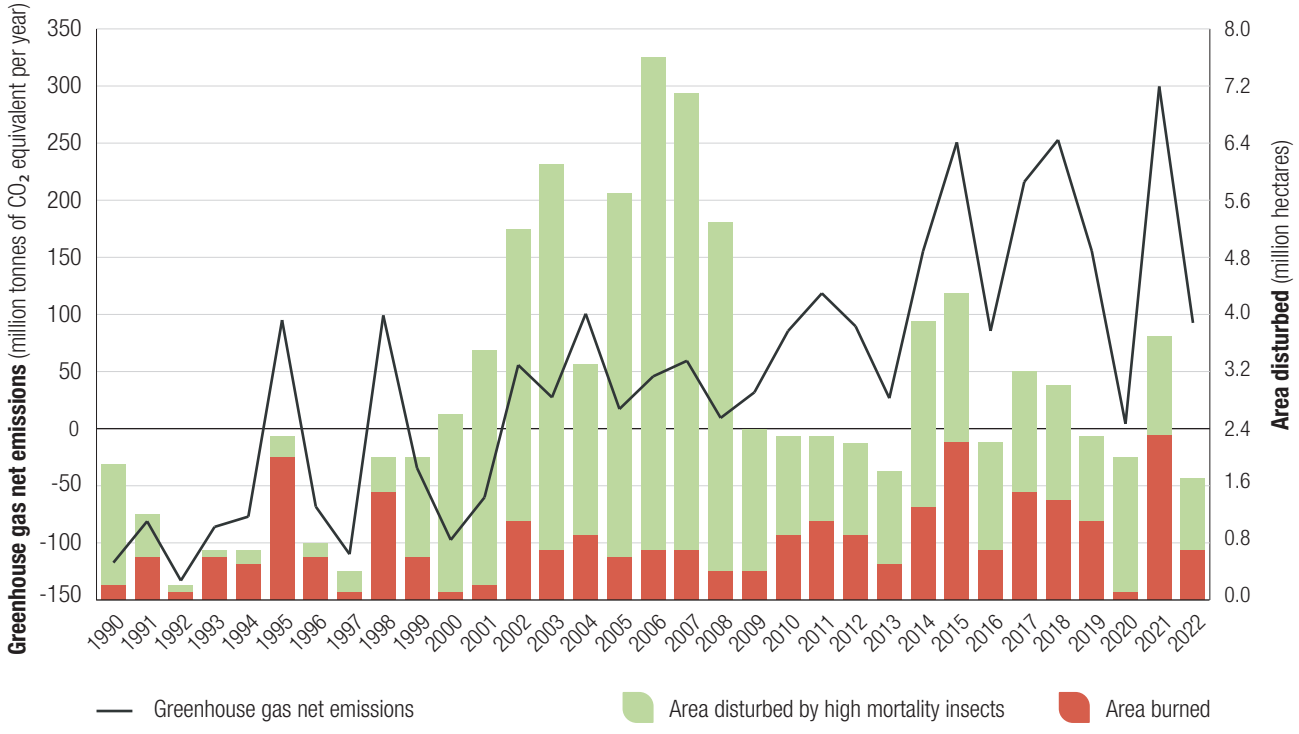
B Human activities in Canada's managed forests, such as harvesting, slash pile burning, prescribed burning, regeneration and firewood collection, as well as the use and disposal of harvested wood products, were a net source of about 21 Mt CO_2e in 2022.

C Emissions from natural disturbances display high interannual variability. In 2021, about 300 Mt CO_2e were emitted, and in 2022, about 93 Mt CO_2e were emitted.

B **Net carbon emission in Canada's managed forests: Areas subject to human activities, 1990-2022**



C **Net carbon emission in Canada's managed forests: Areas subject to natural disturbances, 1990-2022**



Why is this indicator important?

- Emissions of CO_2, CH_4, CO and N_2O from forest land are important contributors to global warming.
- Canada's forest sector provides renewable resources to the Canadian economy, resulting in emissions and removals, while also providing employment, aesthetic values, clean water, wildlife habitat and many other ecosystem services.

What is the outlook?

- The impacts of climate change on Canada's future forest GHG balance are difficult to predict but will be characterized by large inter-annual variability.
- The area burned by wildland fires in 2023 was the largest in Canadian history. Wildfire will continue to be a significant driver of emissions from Canada's forests.
- Natural disturbances significantly impact the ability of Canada's managed forests to consistently absorb more CO_2 than they emit.
- Changes in forest management and the 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 can provide climate change mitigation opportunities.
- The data and models that are used to generate estimates of forest carbon emissions and removals are improved on an ongoing basis as new science and new measurements become available.
- The data and science that support continuous improvement of estimates are developed in partnership with academia, industry, non-governmental organizations and all orders of governments.
- Examples of recent consultations include the 2023 Blueprint for Forest Carbon Science in Canada and the 2023 in-country review by the United Nations Framework Convention on Climate Change Expert Review Team.
- Federal and provincial governments are investing in programs aimed at reducing fuel loads in Canada's forests and to improve firefighting capabilities.

How government initiatives support sustainable forest management

- The new Forest Systems Information and Technology Enhancement (ForSITE) program is an investment in core operations to improve the Canadian Forest Service (CFS) capacity on national forest monitoring data and reporting. This will improve information on forest carbon and forest health, support Canada's reputation and actions for sustainability, and facilitate market access for forest products.
  - o ForSITE leverages the federal government's existing role in developing and sharing nimble, responsive, accurate, verified and climate change-informed forest and carbon data for all of Canada's forests.
  - o The program will increase transparency and accessibility of forest monitoring, GHG estimation, accounting and reporting information, improving public confidence (both domestic and internationally) in Canada's forests management practices.
- The NRCan program, Enhancing Forest Climate Change Adaptation and Mitigation Strategies, will help to develop and disseminate knowledge and tools to improve the forest and forest sector adaptation to climate change. It will deliver analyses and projections for how forest carbon accounting and mitigation actions can make long-term contributions to meeting Canada's greenhouse gas emission reduction targets.
- The federal program Green Construction through Wood promotes the use of wood in innovative buildings. Increased use of long-lived wood products store carbon in the built environment and use of wood products instead of emissions-intensive materials such as concrete, steel and fossil fuels can provide opportunities to mitigate climate change.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

How do forests benefit Canadians?

Forests play an important role in sustaining life by serving as essential habitats for biodiversity, sequestering carbon and providing ecological services. They hold significant social, cultural, and recreational value by offering resources such as food, medicine, and spiritual solace while sequestering greenhouse gas emissions and providing the inputs that support jobs in key sectors in Canada's economy, such as forestry, housing construction and bioenergy and bioproducts.

All these benefits are part of the bioeconomy. The bioeconomy supplies sustainable biomass for use in products and services that provide good jobs, enhance human well-being, sustain ecosystems, and help meet global environmental commitments.

Forests are a key contributor to life

Canadians environmentally benefit from forests given the rich ecosystems they support. Home to abundant and diverse life forms such as animals, plants and microbes, forest ecosystems preserve soils, support biodiversity and cycle nutrients. Trees, forest soils, and forest plants also act as a natural cleanser by filtering pollutants from water and air.

Furthermore, forests directly benefit the lives of Canadians by playing a critical role in mitigating climate change and serving as a valuable tool for climate adaptation. Over the past forty years, forests have absorbed approximately one quarter of the carbon resulting from human activities such as burning fossil fuels and land use changes. Carbon uptake by forests reduces the rate at which carbon accumulates in the atmosphere and thus reduces the rate at which climate change occurs. Forests and trees may also act as natural infrastructure to mitigate flood damage, protect against erosion and landslides, and provide Canadians with shade, wind protection and cooler air temperatures.

Forests hold social, cultural, spiritual and recreational significance

Human health is linked to forest health. Time spent in forests may have positive benefits for mental health and overall wellness. Forests encourage physical activity and provide recreational and ecotourism opportunities for people living in rural and urban settings, including camping, hiking, biking, snowshoeing and wildlife viewing. Moreover, forests act as a source of sustenance and spiritual nourishment, offering food, medicine, shelter and a sanctuary for the spirit.

Forests also have cultural significance for many First Nations, Métis and Inuit Peoples. Historically, forest-based Indigenous communities depended on the abundant natural resources found within forests for subsistence, obtaining food, medicine, shelter, and materials for crafting tools and other necessities. Many of these practices continue into present day.

Forests help meet the needs of Canadians

Sustainably managed forests provide essential goods for Canadians now and for future generations, such as lumber, furniture, toilet paper and sanitary products, and packaging products. Forests also provide opportunities to accelerate low carbon building solutions and housing construction through innovative manufacturing and wood-based construction such as mass timber, panels and prefabricated (prefab) construction. These materials are part of the bioeconomy.

Forests present opportunities to boost the economic sustainability of the forest sector and the bioeconomy in Canada; they provide enormous potential to produce bioenergy, which is particularly important in rural and Indigenous communities. Canada's forests also provide diverse revenue sources through value-added bioproducts, such as textiles, industrial chemicals, pharmaceuticals and personal care products. The bioeconomy can also benefit Canadians by reducing our dependence on fossil fuels, reducing Canada's net greenhouse gas emissions.

Forests support communities through diverse employment opportunities. In 2023, Canada's forest sector employed 199,345 people (a 1.6% decrease from 2022). In addition, according to the last Census (2021), approximately 19% of the forest sector workers are women (over 34,000), 13% are immigrants, 12% are visible minorities and 6% are Indigenous (over 11,000). The forest sector supports approximately 300 forest-reliant communities, many of which are Indigenous.

The forest sector employment in rural and Indigenous communities is important for Canada's overall economic health. Supporting Indigenous-led forestry projects is one of many ways to promote reconciliation, self-determination and economic development in Indigenous communities.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

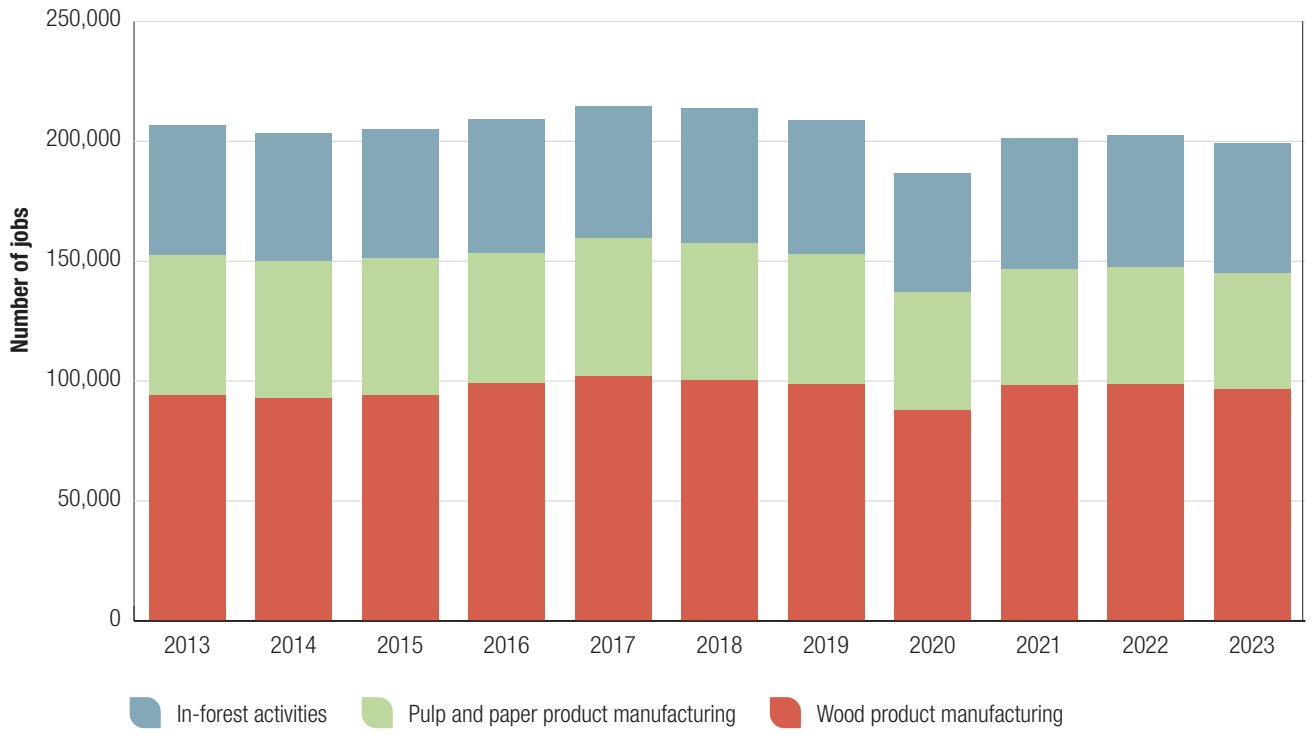
Indicator: Forest sector employment

In 2023, Canada's forest sector employed 199,345 people, which is a 1.6% decrease from 2022. According to the last census (2021), approximately 19% of the forest sector workers are women, 13% are immigrants, 12% are visible minorities and 6% are Indigenous. In 2021, over 11,000 Indigenous people worked in the forest sector.

- Employment in the forest sector has remained fairly stable since 2021.
- The forestry and logging subsector saw the largest decrease in employment in 2023 at 4.4%, reflecting long-term fibre supply shortages that are particularly challenging in British Columbia.

Wood product manufacturing, a category that includes facilities like sawmills, has the largest proportion of forest sector jobs, employing 48% of forest sector workers. As a result, closures of mills and other manufacturing facilities can cause large impacts across the forest sector and local communities.

Forest sector direct employment, 2013–2023



- Jobs in support activities for forestry, which includes employment in forest conservation and reforestation services, timber cruising, and fire fighting activities, saw the only increase in employment of the forest sub-sectors. Rising by 3.8% since 2022, this change reflects the increased forest maintenance and wildfire management required during 2023.

Why is this indicator important?

- The forest sector is an important employer in Canada and contributes to the economic and social welfare of the country and many of its communities.
- The forest sector employment is particularly important for many rural and Indigenous communities, where it often presents a large source of income.

What is the outlook?

- Increased funding for housing initiatives is expected to strengthen the forest sector employment in 2024 to meet increasing demand for wood-based construction materials.
- Shortages of skilled tradespeople continues to be a challenge to the forest sector, which is caused in part by reduced apprenticeship enrollment during the COVID-19 pandemic and an aging workforce. However, apprenticeship registration has been increasing since 2020, exceeding pre-pandemic levels for many trades.
- The forest sector's transformation to increase efficiencies in the use of timber and energy, reduce negative environmental impacts, and shift production to higher-value green products will create new forest sector opportunities for Canadians.

How government initiatives support sustainable forest management

- There are various provincial and federal programs that support employment in the forest sector. The federal Indigenous Forestry Initiative is one example of how the Government of Canada helps to increase the participation of Indigenous Peoples in the Canadian economy and improve economic outcomes for Indigenous Peoples throughout Canada.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

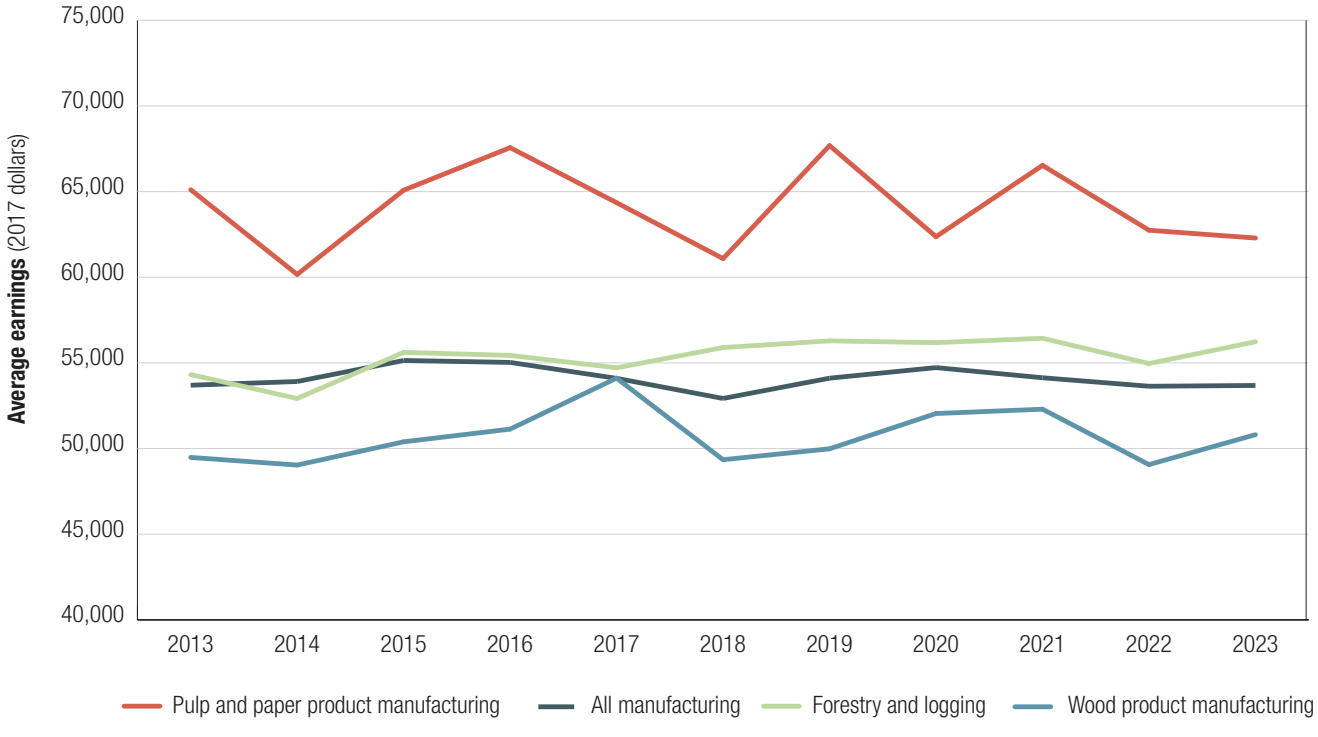
Indicator: Forest sector average earnings

In 2023, the average employment earnings of workers across the forest sector increased by 1.5% from 2022 levels to approximately $56,400 annually (in 2017 dollars) and decreased 3.4% from the 10-year peak achieved in 2021. While average earnings are volatile year-over-year, they have generally followed a stable upward trend since 2001.

Average employment earnings refer to the average net annual income per person directly employed in the forest sector and excludes overtime pay.

- In 2023, employment earnings from wood product manufacturing and from forestry and logging activity were up 3.6% and 2.3% (in 2017 dollars), respectively, compared to 2022. Elements that put upward pressure on wages include productivity gains (e.g., technology and equipment improvements), strong domestic and international demand for wood-based products and raw wood materials and increased lumber prices.
- Over the same period, average earnings of workers in the pulp and paper product manufacturing subsector were down very slightly (-0.7%). Elements that put downward pressure on wages include increased production costs due to inflation and supply chain disruptions (e.g. wildland fires). Rising costs of inputs could reduce profit margins, which could lead to reductions in earnings.

Average earnings in the forest sector compared with all manufacturing sectors, 2013-2023



- Overall, average earnings in the forest sector remained slightly higher than average earnings across all manufacturing jobs.

Why is this indicator important?

- Trends in the forest sector average employment earnings highlight the importance of the forest sector to the economy and to the social well-being of Canadians when compared with other industries.
- Real wage growth, (i.e., changes to wages after adjusting for inflation), reflects the change in actual purchasing power of employees in the forest sector.

What is the outlook?

- In the short term, commodity price performance and changes in production costs due to variations in energy prices, inflation and logistics factors could impact compensation levels.
- In the long term, improving productivity and the expansion of the bioeconomy and other high value forest products could support growth in specialized technical positions with enhanced skills and educations, and may increase pay rates.

How government initiatives support sustainable forest management

- There are various federal and provincial programs that support employment in the forest sector. These programs contribute to a resilient forest sector, fostering employment opportunities and economic stability.
- The federal Forest Innovation program aims to improve the sustainability and economic productivity of Canada's forest sector by supporting the advancement of new products, and improved processes and technologies.
- The federal Green Construction through Wood Program encourages innovative wood-based building technologies and low-carbon construction materials.
- The Investments in Forest Industry Transformation Program supports projects that facilitate the development and adoption of innovative technologies and products, with a focus on the bioeconomy.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Forest communities

Forest resources in Canada sustain the natural landscape and the livelihoods for communities across urban and rural areas offering environmental, economic and cultural benefits.

- Roughly one third of Canada's population resides in or near forested areas.
- There are approximately 300 forest-reliant communities in Canada, where the forest sector serves as a vital source of employment and income.
- Communities characterized by lower sectoral diversity, where the forest sector contributes 14% (moderately reliant) to 26% (highly reliant) of total income, consider the forest sector a vital source of both employment and income (based on Census 2021).

Canada's forest sector plays an important role in the economic and cultural landscape, particularly in rural and Indigenous communities, where it is one of the primary employers. With millions of people living in forested areas, forests continue to provide essential economic, cultural and health benefits to communities across the country.

Communities are municipalities or similar local areas where people live and work. Employment in the forest sector at the local level develops community self-reliance, economic resilience and opportunities for a diversified economy.

- Forest-reliant communities account for around 2% of Canada's population, totalling approximately 615,000 people.
- According to the most recently available Census (2021), over one million First Nations, Métis and Inuit people live in or near forests and over 11,000 are employed in the forest sector.

Why is this indicator important?

- Forest-reliant communities in Canada are stewards of forested landscapes. They participate in sustainable forest management (SFM), monitor wildlife and manage wildland fires. These activities are important to the delivery of local forest mitigation and adaptation initiatives. Additionally, communities near forests rely heavily on the forest sector for employment and income. Any downturns in the sector affect not only its employees but the entire community's social and economic well-being.
- Forests hold cultural significant for numerous First Nations, Métis and Inuit communities, playing integral roles in their health and overall well-being, beyond just economic benefits. Furthermore, forests provide residents of forest-reliant communities with various environmental services and recreational opportunities.

What is the outlook?

- The forest sector will find new opportunities from the increased demand for solid wood products for residential construction.

- A skilled and resilient forest workforce is crucial for Canada's transition to low-carbon economy. Continuous efforts in recruiting, training and retaining workers to sustain the sector is required. Providing education and capacity-building initiatives can help strengthen forest-dependent communities. Diversification of forest products through bioeconomy and innovation can help empower these communities to thrive and adapt in a changing world.

How government initiatives support sustainable forest management

- In 2024, the Government of Canada unveiled its National Housing Strategy, targeting the construction of 3.87 million new homes by 2031.
- Since 2017, the Green Construction through Wood (GCWood) program has been successfully encouraging the use of innovative wood-based building technologies in construction projects, including generating awareness and implementation of innovative wood building systems with First Nations across Canada. For example, the Tsleil-Waututh First Nation's Administration and Health Centre in British Columbia is a primary structure that is all wood. It showcases the values of the community's cultural heritage that is embodied in the design solutions and were developed through an integrated collaborative design process with the entire Tsleil-Waututh community.
- Since 2017, the Indigenous Forestry Initiative (IFI) has been successfully accelerating Indigenous entry to the sector, supporting Indigenous businesses, skills training, and capacity building for Indigenous-led forest sector projects. For example, one project in Ontario resulted in 40 First Nation participants receiving training as truck drivers, millwrights or heavy equipment mechanics, developing skills to succeed in the forest products sector.
  - The IFI continues to evolve to better align with Indigenous priorities, most recently broadening its mandate to include targeted support for forest stewardship. The program's new grants stream has the potential to directly increase Indigenous participation in forest management planning and SFM policy discussions.
- Ensuring diverse perspectives in forest sector dialogues is important, as communities in Canada that depend on forests continue to experience the effects of climate change and natural disturbances, such as frequent and severe wildfires and pest infections, impacting forest health.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

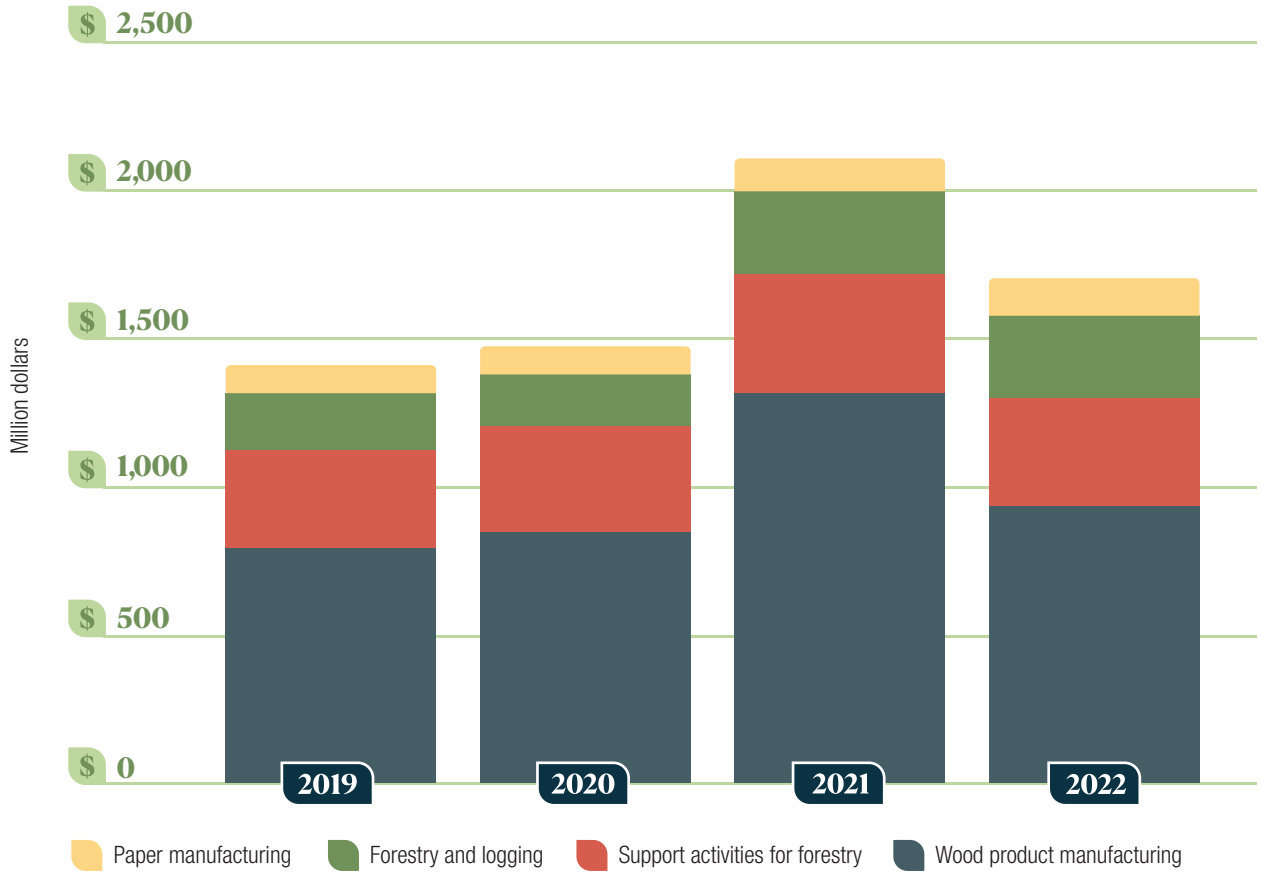
How does the forest sector contribute to Canada's economy?

The forest sector is an important contributor to Canada's economy, serving as a source of prosperity for communities and workers across Canada. In 2023, the forest sector contributed $27 billion to Canada's nominal gross domestic product (GDP) and directly employed 199,345 people. A total of $36.2 billion of forest products were exported.

Forest sector contributions across Canada

Forest sector operations serve as an important source of jobs and income across Canada. Of the 199,345 people directly employed in the forest sector, approximately 11,000 are Indigenous (2021).

Composition of gross domestic product from environmental and clean technology products attributable to the forest sector, 2019 to 2022



The forest sector generates about $2.3 billion in revenue for provincial and territorial governments (2020) through stumpage charges, taxes and various other fees. The largest employment contributions are in Québec (33% of the national forest sector jobs), British Columbia (25%), and Ontario (20%) followed by Alberta, Atlantic Canada, Manitoba, Saskatchewan and the territories. The forest sector is a key economic contributor in many remote, rural and Indigenous communities. According to the 2021 census, over two fifths of Canada's forest sector workers live in rural and remote communities.

Forest sector contributions to environmental and clean technology products in Canada

The forest sector, as a part of the bioeconomy, is an increasingly significant contributor to the environmental and clean technology products sector in Canada. For example, wood residues and forest biomass are converted into renewable energy sources such as pellets, liquid biofuels and biogas. Other bioproducts involving forest sector products include bioplastics and textiles. The value of environmental and clean technology products attributable to the forest sector increased from $1.4 billion (2.0%) in 2019 to $2.1 billion (2.9%) in 2021, though it decreased to $1.7 billion in 2022 (2.1%). Wood product manufacturing was the driver of this decline from 2021–2022, decreasing from a contribution of 63% of the total value to 55%. This was likely due to a return to normal levels of demand for environmental and clean technology-qualifying wood products following the elevated demand in 2021 owing to the COVID-19 pandemic. The environmental and clean technology sector accounted for 3.1% of Canada's GDP in 2022.

Innovation in Canada's forest sector

New and innovative forest products like cross-laminated timber, biofuels and forest product-based biodegradable packaging materials are an increasingly important part of Canada's economy. These bioeconomy innovations help support government objectives, including reaching net-zero emissions by 2050 and building efficient, affordable housing using more sustainable materials. The Government of Canada supports this net-zero transition and innovation through programs such as the Investments in Forest Industry Transformation program, which provides support to projects developing and commercializing new and more efficient building materials, and the Green Construction through Wood program, which supports innovative wood-oriented construction technologies like mass timber buildings.

Canadian forest bioproducts in the global market

Canada is a leading global forest product manufacturer. The forest sector is highly export-oriented and Canadian-made forest bioproducts are valued worldwide in a variety of industries. Canada is the global leader in the export of softwood lumber, oriented strandboard, northern bleached softwood kraft pulp and newsprint. Most exports go to the United States (76% by value), China (10%) and Japan (3%). Beyond these countries, Canada continues to take advantage of new opportunities in other global markets in Asia and Europe to diversify our export partners.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Forest sector gross domestic product

In 2023, the forest sector contributed $27.0 billion (0.9%) to Canada's nominal GDP, representing a 22% reduction compared to 2022. Real GDP for the forest sector also contracted 8% year-over-year.

For comparison, nominal GDP for Canada's total economy shrank by 0.5% in 2023, yet real GDP rose by 1.3%.

- Prices for some key forest products were significantly lower in 2023, such as softwood lumber and oriented strand board. The lower prices contributed to the outsized drop in the forest sector's nominal GDP compared to the real GDP.
- In the wood product manufacturing subsector, real GDP shrank 7%, in part due to lumber production curtailments and sawmill closures, most notably in British Columbia.
- Real GDP in the pulp and paper manufacturing subsector decreased 10% from the previous year. Several pulp facilities curtailed production or closed operations during the year as the structural decline in demand for some paper products continued, with increasing global digitalization.

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

The World Bank ranked Canada as the ninth-largest economy in the world in 2022.

- Real GDP in the forestry and logging subsector fell 7%, driven by ongoing wood supply constraints in British Columbia and the record-setting wildland fire season in 2023.

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 sector compared to other sectors each year.
- Real GDP measures the year-over-year change in the size of the forest sector's economy, after accounting for inflation.

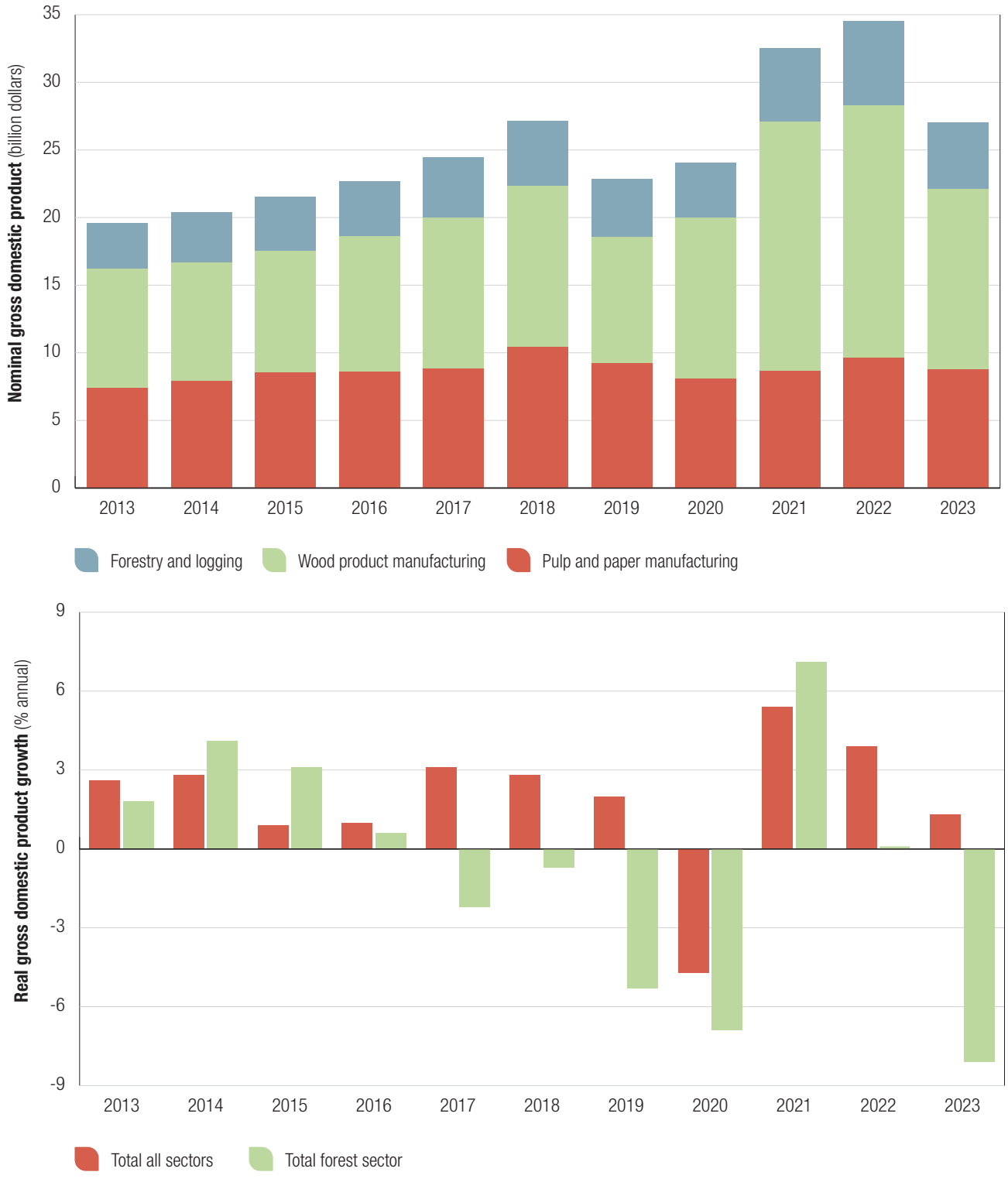
What is the outlook?

- Growth in the wood products subsector is highly linked to housing starts and construction projects. Spending in these segments has been negatively affected by higher mortgage and interest rates. In the long term, the prospects for this subsector are positive and will be supported by strong underlying demand in both the Canadian and United States housing markets.
- Demand for traditional paper products, such as newsprint and printing and writing paper, is expected to continue to decline. Demand for packaging products is expected to grow to keep pace with the demand for online shopping and e-commerce deliveries.

How government initiatives support sustainable forest management

- The federal government's commitment to address housing affordability and increase the construction of new housing, as part of the Canada's National Housing Strategy, is expected to support growth for the wood products sector.

Canadian forest sector's gross domestic product, 2013–2023



See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Production of forest products

Between 2022 and 2023, Canadian production of nearly all forest products decreased. Softwood lumber production decreased by 5.9% and production of structural panels decreased by 5%. Printing and writing paper production decreased by 22.9%. Wood pulp and newsprint decreased by 7.5% and 4% respectively.

- Demand for lumber and structural wood panels continued to decrease in 2023 due to increases in interest rates, which reduced construction activity and housing affordability. This was also the case in the United States, Canada's largest market for softwood lumber.
- Fibre shortages from wildland fire impacts, mountain pine beetle infestations and other factors creating downtime at production facilities contributed to declines in wood product and pulp production.
- Newsprint as well as printing and writing paper production continued its long-term downward trend, reflecting the increasing digitization of media and workflows.

Canada is one of the world's leading producers of newsprint, northern bleached softwood kraft pulp and softwood lumber.

Why is this indicator important?

- Canada is one of the world's top manufacturers and exporters of forest products.
- Production is one of the first forest sector indicators to be affected by economic and market challenges.

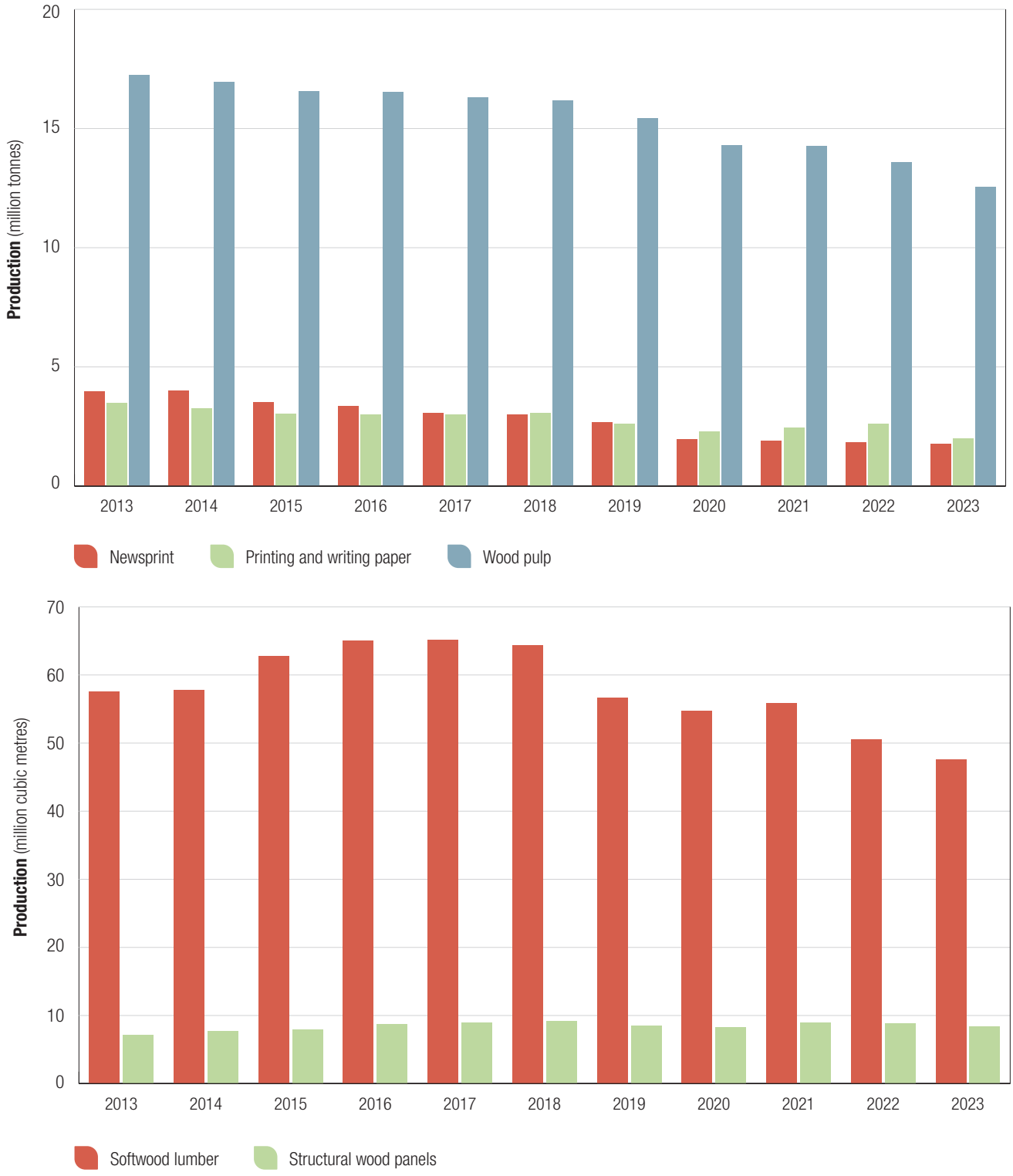
What is the outlook?

- A limited supply of Canadian logs due to rising log costs and a declining supply of fibre is expected to continue in 2024, dampening the production of wood products and pulp. Downtime in production has a trickle-down effect on pulp and paper production due to reducing the quantity of wood chips, which are a key input.
- Over the medium term, a focus on expanding the housing supply in Canada and the United States should encourage the construction activity, in turn supporting long-term demand for wood products.

How government initiatives support sustainable forest management

- The federal government's Forest Innovation Program enables the growth of Canada's bioeconomy by delivering R&D and technology transfer funding to the forest sector. The aim of this program is to improve the sustainability and economic productivity of Canada's forest sector.

Production of Canadian forest products, 2013–2023



See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Exports of forest products

In 2023, the value of Canada's total forest products exports decreased 21% year-over-year to $36.2 billion because of weak forest product prices and subsequent reduced production.

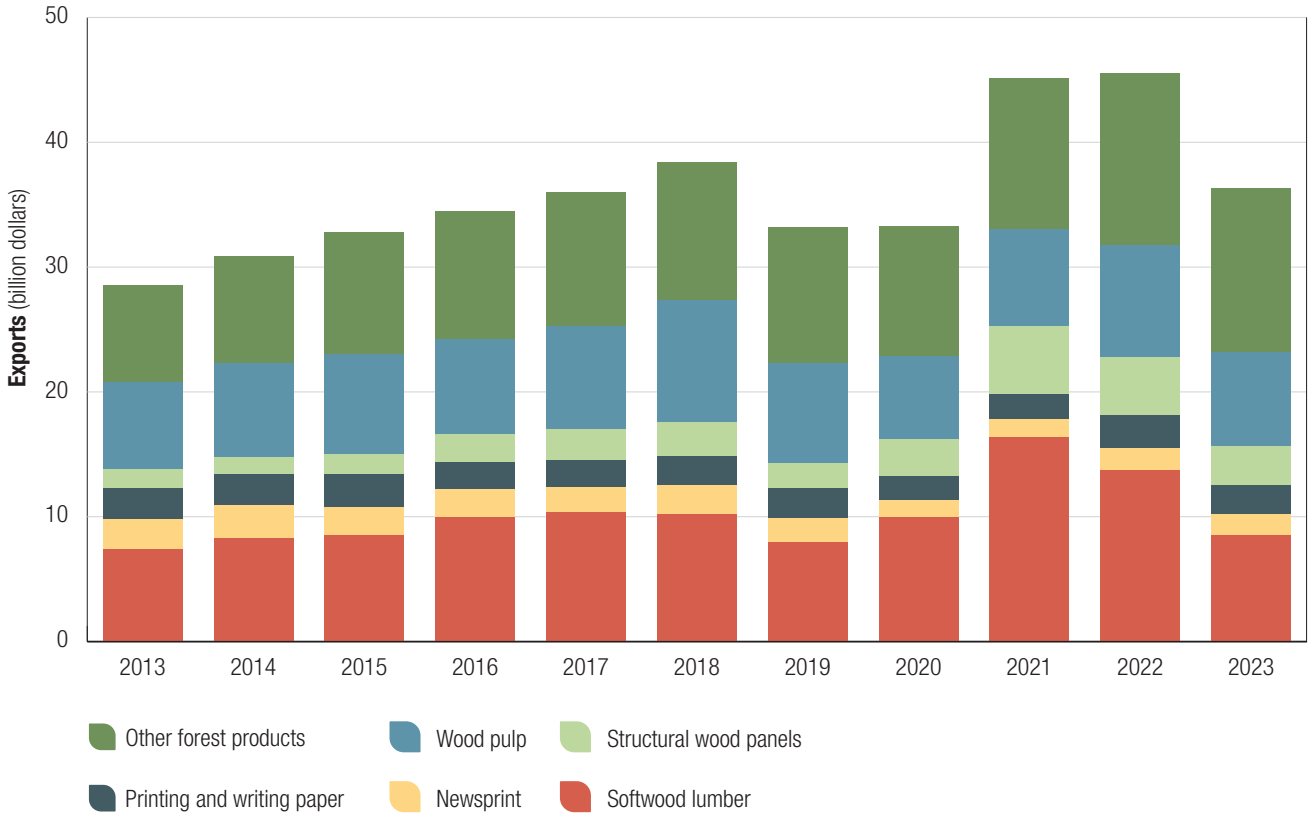
- By value, softwood lumber exports demonstrated the greatest contraction (down $5.2 billion or 38% compared to 2022), resulting from significantly lower average lumber prices and resulting production curtailments in British Columbia and Québec. The value of structural wood panel exports also dropped 33% from the previous year.
- High interest and mortgages rates slowed new housing construction in the United States, lowering demand for Canadian lumber and panels. Furthermore, the continued application of United States import duties on Canadian softwood lumber products made exports of softwood lumber less competitive in the United States market compared to those from other jurisdictions.
- In 2023, wood pulp exports decreased by 16%, printing and writing paper exports fell 13%, and newsprint exports declined 7% (by value). Weak global economic growth from high levels of inflation and elevated interest rates, led to lower demand and weaker prices.

In 2023, Canada was the world's leading exporter of softwood lumber, northern bleached softwood kraft pulp, oriented strand board and newsprint.

Why is this indicator important?

- As one of the world's largest forest product exporters, Canada is a key supplier to countries around the world.
- Canada has an abundant and renewable supply of wood sourced from sustainably managed forests. By exporting forest products, the Canadian forest sector meets the needs of global consumers, which could include helping them toward their climate change mitigation goals, while making a substantial contribution to Canada's economy and balance of trade.

Exports of Canadian forest products, 2013–2023



What is the outlook?

- Demand for softwood lumber and structural wood panels used in home construction has been negatively impacted by rising interest rates. The pace of recovery for Canada's forest product exports will depend on the pace of the housing sector expansion in the United States and Canada.
- Over the medium term, a focus on expanding housing supply in Canada and the United States should help the recovery of the consumption of related wood construction products. Going forward, strong underlying demand in the United States residential construction, which is the main export destination for Canadian panels and softwood lumber, should help to support export growth in these products.
- The consumption, and thus exports, of paper products (e.g. newsprint) are expected to continue to trend downward over the long term, while others are expected to remain flat, such as tissue paper.

How government initiatives support sustainable forest management

- To counter the weaker long-term growth prospects, Canada is seeking to diversify its forest product offerings by adding value through more secondary wood manufacturing and investing in innovative, low-carbon projects.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

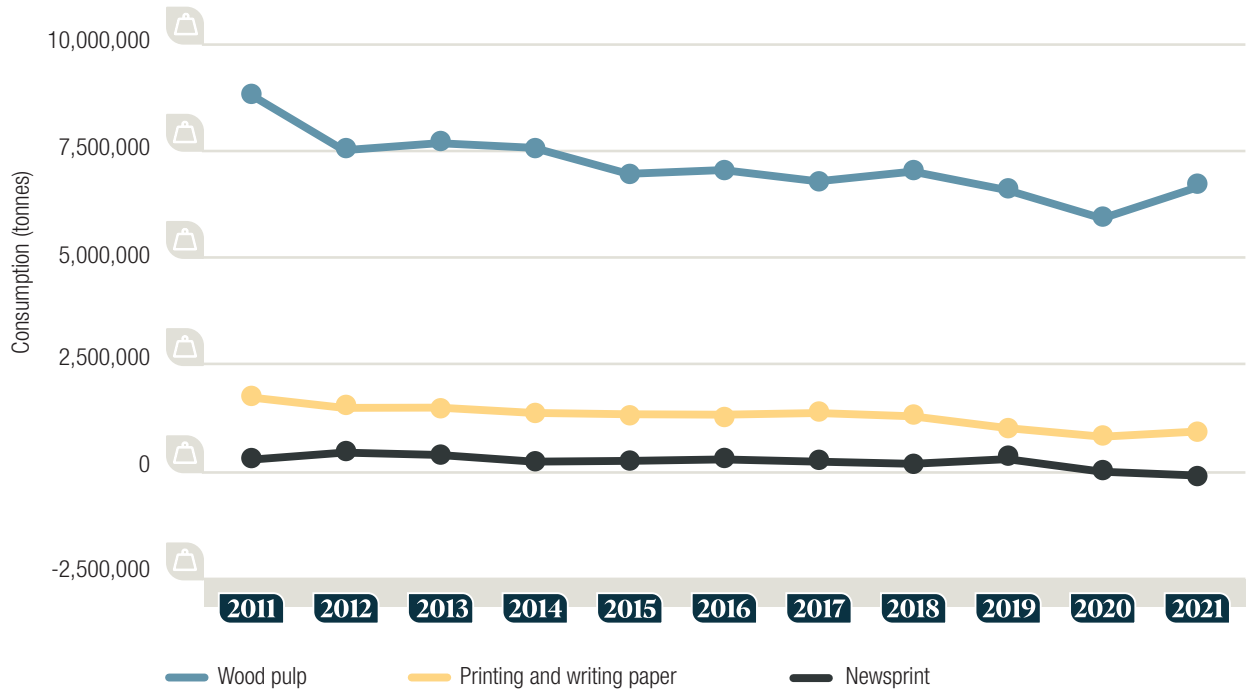
How is the forest sector changing?

Canada's forest sector is experiencing changing market conditions as the preferences of consumers and businesses evolve. For example:

- Demand for sustainable construction materials and methods, in addition to more sophisticated design and production systems, is stimulating the construction market in Canada. Forty-nine mass timber projects began between 2007 and 2009, whereas 170 mass timber projects began between 2019 and 2021.
- Domestic consumption of newsprint, printing and writing paper as well as wood pulp has been decreasing, with the most drastic decline for wood pulp (2011–2021).
- Domestic consumption of softwood lumber has had the highest and most fluctuating domestic consumption compared to hardwood lumber and structural panels. Trendlines for domestic consumption of structural panels and hardwood lumber have been decreasing slightly (2011– 2021).

Consumption of forest products, 2011-2021

Consumption of forest products, 2011-2021



The bioeconomy in other countries

Countries have responded to shifting markets by developing bioeconomy opportunities. The bioeconomy seeks sustainably sourced biomass for bioproducts. Achieving the bioeconomy's environmental, economic and social benefits requires strategies or other policies to set a vision for a sustainable economy over the long term. Sustainable bioeconomy policies need to support goals, such as conservation, climate change mitigation and an inclusive economy.

For example, Finland's bioeconomy strategy highlights the added value of new bio-based products in several industries, such as pharmaceuticals and fashion, which are based on renewable materials produced sustainably. Finland aims to be climate neutral by 2035.

The United States federal government announced key steps in advancing biotechnology and biomanufacturing. In response, several federal departments are collaborating to support the resilience of the United States biomass supply while also advancing food security, environmental sustainability and an inclusive economy. Work is ongoing and moving rapidly.

The global bioeconomy

There are also international developments seeking to guide a sustainable bioeconomy. For example, Brazil's G20 Presidency has led the development of High-Level Principles for the Bioeconomy.

As well, the United Nations Food and Agriculture Organization has recognized the multiple benefits of bioeconomy. It issued a paper entitled Aspirational principles and criteria for a sustainable bioeconomy, an overview of the role that social, economic, environmental and governance dimensions play when considered together for the benefit of communities and the global environment.

Working toward a Canadian forest bioeconomy

Canada's forest sector has a key role to play too. Canada's forest sector is responding to market conditions and global environmental commitments by transitioning to a circular bioeconomy that supports environmental conservation and a sustainable economy. The circular bioeconomy is also a large contributor to the environmental and clean technology products sector.

The Canadian Council of Forest Ministers is working to implement the Renewed Forest Bioeconomy Framework to accelerate the growth of the bioeconomy. In addition, biomass industries in Canada came together to form Bioindustrial Innovation Canada, a partnership that produced Canada's Bioeconomy Strategy. This strategy puts forth recommendations to support a clean economy.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Forest sector financial performance

In 2023, the financial performance in the forest sector was weaker than the pandemic-related surges seen in 2021–2022 when product prices were favourable. Operating profits dropped more than 50% from 2022 to 2023 but were comparable to 2018 levels (the pre pandemic record high), and 180% higher than in 2019. The forest sector is a capital-intensive industry and generated a return on capital employed of 3.0% in 2023, less than half the return in 2022 (6.6%), and nearly four times less than in 2018.

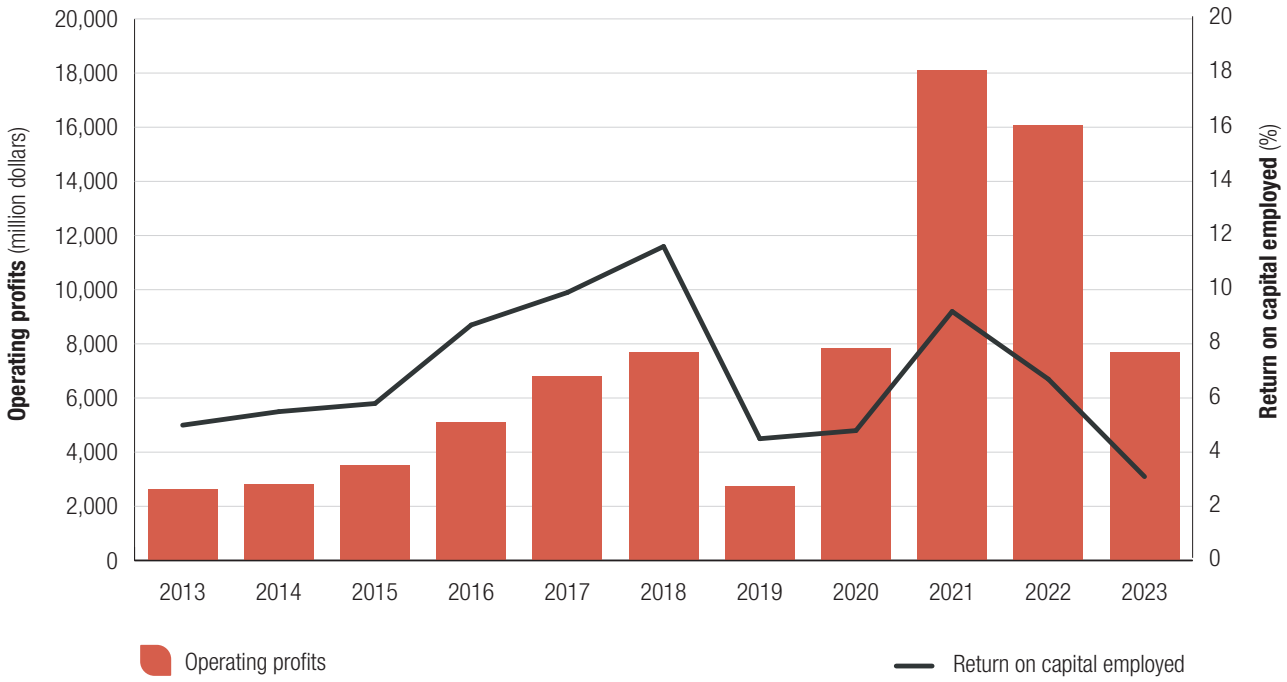
- While commodity pulp prices bounced back at the end of 2023, panel and lumber prices dropped from record highs in 2021 and 2022 to prices below pre-pandemic levels.
- Overall, 2023 price levels were insufficient to offset the rising operating and investment costs resulting from inflation and relatively higher interest rates, as well as labour and high fibre costs—resulting in a drop in the returns on investments.
- Weaker financial performance across the sector has led to a decline in available financial liquidity, forcing many companies to implement cost-cutting measures and to reduce their level of investment.

Why is this indicator important?

- Strong financial performance is essential for the continued economic competitiveness of Canada's forest sector.
- Both operating profits and return on capital employed are indicative of the ability of the forest sector to attract investment and generate economic benefits for Canadians.

Both operating profits and the return on capital employed indicate the economic competitiveness of the forest sector. The operating profit measures the difference between operating revenues and operating expenses. The return on capital employed measures the efficiency of capital in the sector.

Financial performance by Canada's forest sector, 2013–2023



What is the outlook?

- In the short term, the financial performance of the sector will continue to be impacted by high interest rates, which have reduced housing construction activity and, therefore, the demand for lumber and solid wood products.
  - o The housing sector, through residential improvements or new constructions, is a key consumer of forest products (e.g., lumber and solid wood products). This explains the strong link between housing and forest sectors.
- Over the medium term, both Canada and the United States aim to address the housing affordability by increasing wood supply. An increase in housing starts is expected to improve the financial performance and return on investment in this sector.
  - o Financial results in the pulp and paper sector will continue to be negatively impacted by declining sales of traditional paper products, but partially mitigated by increasing revenues in packaging products.
  - o The focus on innovation and on value-added forest products should support the financial outlook of the whole forest sector.

How government initiatives support sustainable forest management

- The federal Investments in Forest Industry Transformation program is one example of how the GOC facilitates the adoption of transformative and innovative technologies and products to support new or diversified revenue streams, such as next generation building products, advanced biomaterials, biochemicals, and biofuels.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Forest sector secondary manufacturing

The secondary wood and paper product manufacturing industries in Canada generated $6.67 billion in real gross domestic product (GDP) in 2023, a decrease of 2.1% from the 2022 level.

- Secondary wood manufacturing real GDP increased 1.9% over 2022 levels, with weak domestic sales offset by stronger net export sales.
- Secondary paper manufacturing real GDP decreased 7.5% below 2022 levels despite a 10% increase in net exports and no significant change in domestic sales, which could be explained via a rise in production costs.

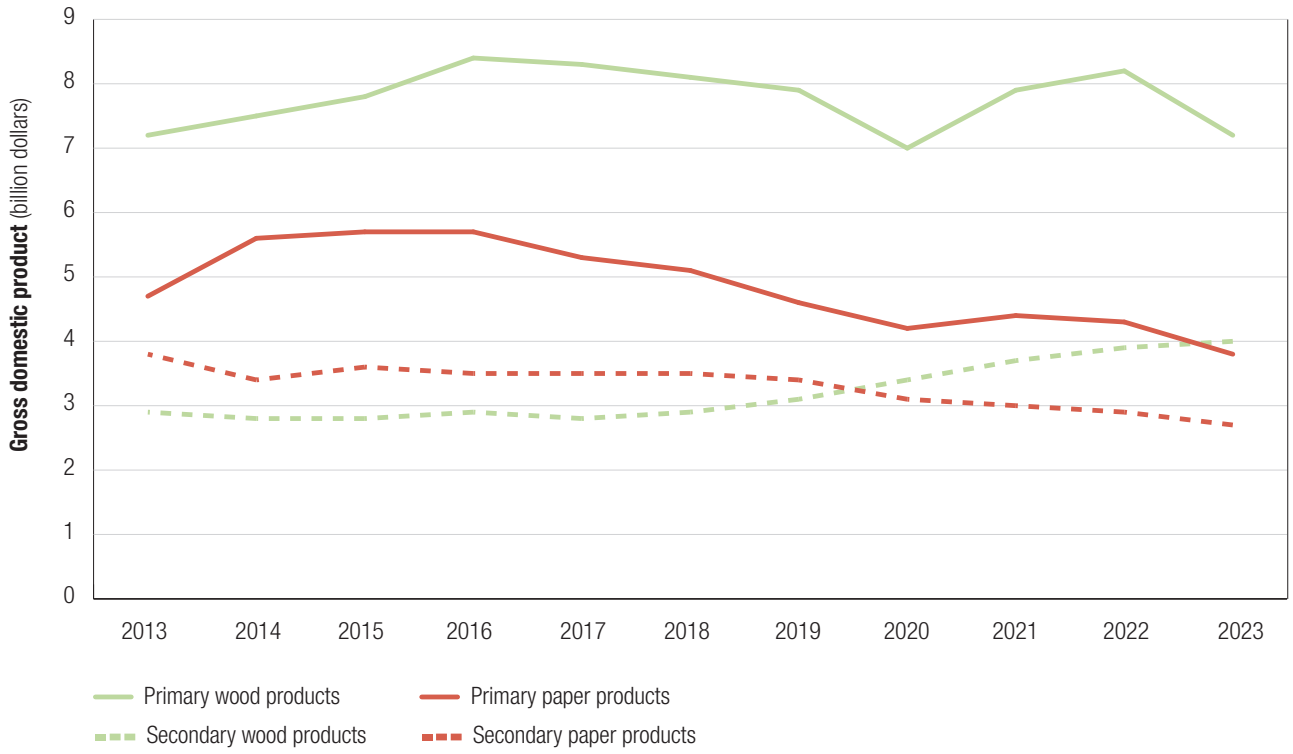
Why is this indicator important?

- The secondary forest product manufacturing sector diversifies economic activities beyond the primary sector. It generates additional employment and revenue while mitigating risks from timber supply decreases to the overall economy and forest-dependent communities.
- Secondary forest product manufacturing is domestic market-focused, which is more stable than the international market where the primary forest products are oriented. This difference mitigates the impacts of price fluctuations of the primary forest products in global markets on the general economy.

Secondary wood and paper product manufacturing is the further processing of lumber and raw paper material into more finished products such as cabinets, wood pellets, stationery products and tissue paper.

The industry GDP shows its contribution to the economy. It is the value added by calculating difference between the value of the industry's output and the value of the intermediate goods and services it purchases from other industries.

Gross domestic product from primary and secondary wood and paper product subsectors, 2013–2023



What is the outlook?

- The current trend is expected to continue, with the secondary wood manufacturing sector expanding at a modest growth rate. The outlook will be influenced by downward trends in housing construction due to higher interest rates in recent years.
- The secondary paper product sector could continue to face challenges, despite the positive trend in online shopping and health and sanitation, to which it is closely linked. Ongoing external competition poses another key risk factor for this sector in addition to the possible increase in production costs.

How government initiatives support sustainable forest management

- The federal Forest Innovation Program provides funding for research and development to improve innovation and productivity in the sector.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Indicator: Forest sector carbon emissions

Following a pronounced reduction between 2005 and 2011, greenhouse gas (GHG) emissions from the use of fossil fuels at forest sector facilities have declined more slowly since 2011. Reductions in GHG emissions followed improvements in energy efficiency, increased use of forest biomass for heat and power generation, and reduced production capacity for certain types of forest products.

- Bioenergy meets 55% of the total annual energy demand of the forest sector and has reduced GHG emissions from fossil fuels (direct and indirect emissions) at forest product facilities by 51% between 2005 and 2021.
- Energy efficiency improvements have helped reduce the total energy demand for the sector by 23% between 2005 and 2021.
- GHG emissions were at an all-time low in 2020, during the peak of the COVID-19 pandemic, but increased slightly in 2021. This rise is due, in part, to the increase in production of construction materials such as oriented strand board (OSB) panels and lumber.

Why is this indicator important?

- Tracking annual emissions from fossil fuels is important for ensuring the forest sector continues to transition to net zero while providing low-carbon forest products to Canada and the world.
- Reliable and accurate data on GHG emissions associated with forest sector facilities and harvesting operations are critical to the evaluation of embodied carbon, such as life cycle GHG emissions of forest products. GHG emissions reported in this report relate to harvest operations and forest product manufacturing. When combined with emissions data from other life cycle stages such as transportation, use and end-of-life, a comprehensive assessment of the overall carbon footprint of forest products is provided and a more accurate comparison with other materials is possible.

Canada's forest sector reduces emissions in other sectors, by utilizing residual forest biomass to produce bioenergy and biomaterials. Biomass is mainly a byproduct of forest product manufacturing (i.e., lumber, pulp and paper, etc.), and increasingly post consumer and demolition waste. In the future, activities such as forest thinning and fire-smarting could become sources of biomass.

Canada continues to address gaps in the estimation of forest biomass availability to improve its effectiveness as a feedstock for several bioproducts, including biofuels.

Fossil fuel greenhouse gas emissions and total energy use in Canada's forest sector 2005-2021

What is the outlook?

- Canada is committed to reducing the embodied carbon of buildings, for example, using mass timber in replacement of more carbon-intensive materials.
- Bioenergy with carbon capture and sequestration technology can support Canada's decarbonization goals and result in net negative emissions energy production. Carbon emission management opportunities also exist for biomass carbon removal and storage. These opportunities cover all technologies and practices that facilitate the removal and storage of biomass CO_2 from the atmosphere, such as applying biochar, a stable form of carbonized biomass, to agricultural land as a soil amendment.

How government initiatives support sustainable forest management

- The development of requirements related to embodied GHG emissions for inclusion in the 2030 National Model Codes and Canada's Buy Clean Strategy, which emphasizes public procurement of low carbon materials, will help reduce embodied carbon of buildings.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

An overview of forest research across Canada

Forest research in Canada is dynamic and carried out from coast to coast to coast. The research is done by and through partnerships within federal, provincial and territorial governments, not-for-profit organizations, and educational institutions like colleges and universities.

Over the past century, research across diverse fields has deepened our understanding and developed tools to enhance sustainable forest management (SFM) and forest conservation. Forest research has also provided crucial insights to help address challenges like climate change.

The following pages highlight a selection of forest research facilities and initiatives which illustrate the diversity of forest research that is conducted throughout Canada. The map shows Natural Resources Canada's (NRCan) research facilities. NRCan conducts forest research in different regions through forestry centres and research forests that are managed by the Canadian Forest Service (CFS). The locations of these facilities are shown on the map, along with short descriptions of their main research areas.

1 Pacific Forestry Centre, Victoria, BC

Priorities:

- Forest entomology and pathology
- Wildfire science and research
- Forest inventory and monitoring
- Climate change
- Economic and market research

2 Northern Forestry Centre, Edmonton, AB

Priorities:

- Boreal ecosystem ecology
- Climate change and forest research
- Land reclamation
- Wildfire science and research

3 Great Lakes Forestry Centre, Sault Ste. Marie, ON

Priorities:

- Forest pests
- Climate change
- Wildfire science and research
- Forest ecosystem research

4

CFS office, National Capital Region

5

Laurentian Forestry Centre, Québec, QC

Priorities:

- Forest pests
- Ecosystem dynamics
- Forest productivity
- Ecogenomics
- Wildfire science and research
- Managing the Valcartier Forestry Research Station

5a Valcartier Forestry Research Station, located 35km north of Québec, QC

Established in 1934, this station has 25 active experimental facilities. The three main research areas include forest genomics, climate change and forest biomass.

6

Atlantic Forestry Centre, Fredericton, NB and Corner Brook, NL

Priorities:

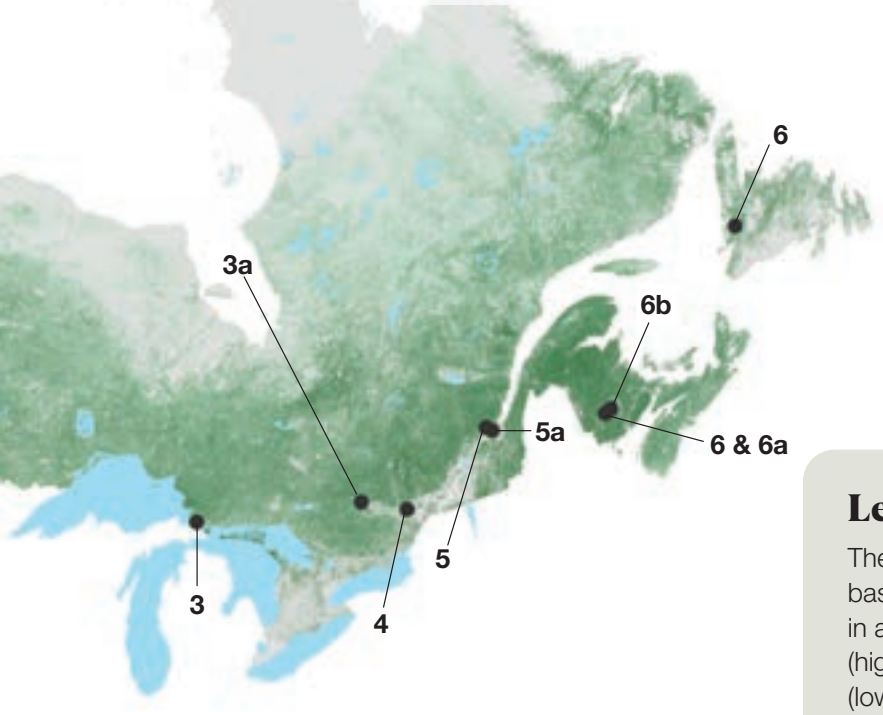
- Native and alien forest pests
- Forest inventory and ecosystem-based management
- Climate change risk and adaptation
- Forest genetic resources and biodiversity
- Wildfire science and research
- Managing the National Tree Seed Centre and the Acadia Research Forest

6a National Tree Seed Centre, located at the Atlantic Forestry Centre

The centre is home to more than 13,000 unique seed collections from 200 tree and shrub species. It is the only national seed bank preserving the genetic diversity of Canada's forests.

6b Acadia Research Forest, located 20 km northeast of Fredericton, NB

Established in 1933, it is one of the oldest and longest-running research forests still operating in Canada. It is a demonstration, training and education facility dedicated to applying SFM principles, managing timber resources, and protecting wildlife habitats and species at risk.



3a Petawawa Research Forest, Chalk River, ON

Established in 1918, this forest is the oldest, continuously operating Canadian research forest.It is home to some of the oldest, permanent sample plots in the country. Its mandate aims to improve SFM practices by facilitating innovative research.

Legend

The background map displays Canada's forest cover basedon the most recent data. Forests are represented in a gradient of green, going from darker for denser forests (high canopy closure) to lighter for more open forests (low canopy closure).

Forest areas

Forest crown closure

High (100%)

Low (10%)

Non-forested areas

CFS research facilities

Spotlight on selected non-federal forest research facilities and initiatives over Canada

Other organizations across the country contribute significantly to forest research and are active in all forested provinces and territories. Below are some examples of facilities and initiatives that help advance the knowledge on forest ecosystems, their dynamics, conservation, sustainable management and much more.

Pan-Canadian

FPInnovations

FPInnovations is a not-for-profit organization with offices in several provinces. Experts carry out research in the areas of forest operations, pulp and paper, wood products and bio-sourced products. They provide solutions and technologies such as:

- Developing technologies to protect wood products against weathering, mould, decay and insects
- Characterizing pulp and paper mill bioproducts and developing applications in various sectors, such as agriculture
- Providing advice on best practices to ensure a high-quality biomass supply
- Developing automated interactive tools for tracking and reporting the status of forest regeneration

British Columbia

Faculty of Forestry, University of British Columbia

Researchers of this faculty develop scientific knowledge that helps improve the conservation of forest ecosystems and forest management practices. Their research focuses on:

- SFM and applied conservation science
- Communities and Indigenous Knowledge
- Ecosystems and climate change
- Urban forestry and green infrastructure
- Wood products, forest bioproducts and the bioeconomy
- Human dimensions of the environment
- Technology and innovation

John Prince Research Forest

This research forest was established in 1999 and results from a collaboration between Tl'azt'en First Nation and the University of Northern British Columbia. Researchers combine First Nations' Traditional Knowledge and western scientific approaches to develop knowledge on:

- The impact of forest management on wildlife
- The habitat, ecology and behaviour of forest-associated wildlife
- Criteria and indicators for SFM
- Co-management practices

Alberta

Ecosystem Management Emulating Natural Disturbance (EMEND) project
The EMEND project is a large-scale variable retention harvest experiment aiming to test the effects of residual forest structure on ecosystem integrity and forest regeneration (e.g. by leaving live single trees and large patches of uncut forests within harvested areas). This project began in 1998 and is planned to run for about 80 to 100 years. It is the result of a collaboration between the University of Alberta, research agencies, provincial and federal governments, as well as northwest Alberta forest companies.

fRI Research
fRI Research, a not-for-profit organization established in 1992, conducts research to improve land and resource management. Researchers study the impact of human and natural disturbances on ecosystems and wildlife (e.g., large mammals, water and fish, landscape change) and share knowledge and tools with governments, industry, academics, non-governmental organizations and communities.

Saskatchewan

Saskatchewan Research Council (SRC), Forestry Services
SRC is a Treasury Board Crown Corporation and was established in 1947. Experts offer forestry services in the following areas:

- Implementation of SFM
- Impact of climate change and adaptation in forest management
- Forest ecosystem monitoring and modelling
- Applied forest ecology and silviculture research
- Forest management planning
- Forest carbon management

Sustainability-Led Integrated Centres of Excellence (SLICE), Saskatchewan Polytechnic
SLICE has four centres of excellence, including one on forestry and environment. This centre partners with industry and communities to improve forestry management by providing forestry research with equipment, such as LiDAR-equipped remotely piloted aircraft systems and augmented and virtual reality.

Manitoba

Manitoba Model Forest (MBMF)
MBMF, established in 1992, encompasses 1 million ha of boreal forest and is adjacent to Lake Winnipeg to the west and the province of Ontario to the east. Activities that take place in MBMF relate to:

- SFM and wildlife, including endangered species such as woodland caribou
- Community development, Indigenous involvement, and youth education and training
- Climate change
- Non-timber forest products

Centre for Forest Interdisciplinary Research (C-FIR)
C-FIR was established in 1998 and is part of the University of Winnipeg. Research conducted in C-FIR seeks to understand forest ecosystem changes and the link between society and forests to promote their sustainable use.

Yukon

Gunnar Nilsson and Mickey Lammers Research Forest
The research forest was established in 1964 and covers about 248 ha. It is located 19 km north of downtown Whitehorse. Research has been carried out since the 1970s on topics such as:

- Trials on forest productivity, thinning, assisted migration adaptation, genetic and provenance. Provenance trials assess the adaptability to environmental conditions of plants from different geographic origins planted in common gardens.
- Community ecosystem project

Northwest Territories

Partnership between the Wilfrid Laurier University and the Government of Northwest Territories
This partnership was established in 2010 and allows researchers to conduct research activities in 400 million ha of boreal forest and tundra. Research activities range from monitoring, modelling, predicting to making policy recommendations in areas such as wildfires, wildlife, Indigenous Knowledge, greenhouse gases, forest dynamics and much more.

Ontario

Centre for Northern Forest Ecosystem Research
This Government of Ontario's centre is located in Thunder Bay. The areas of research are:

- Boreal forest stand ecology (e.g., effects of climate change on black spruce and jack pine forests)
- Boreal silviculture (e.g., ways to monitor forest development with remote sensing)
- Effects of forest management on boreal aquatic systems (e.g., effects on water temperature and brook trout)
- Northern mammal ecology (e.g., effects of human and natural disturbances on woodland caribou)
- Relationship among people, forests and forest management (e.g., assessments of cumulative effects of human and natural disturbances)

Ontario Forest Research Institute
This Government of Ontario's Research Institute is located in Sault Ste. Marie. Experts carry out research in areas such as:

- Forest carbon (e.g. carbon storage in various pools, such as wood products)
- Forest genetic diversity (e.g. adaptation of tree populations under different climatic conditions)
- Forest growth and yield
- Forest health and invasive diseases (e.g. improved survey techniques for forest pests)
- Forest management in boreal mixed woods and in Great-Lakes–St. Lawrence forests
- Wetlands and peatlands (e.g. vulnerability to climate change)
- Terrestrial systems ecology, forest landscapes and disturbance (e.g. shifts in forest composition caused by climate change and forest disturbances)

Nova Scotia

School for Resource and Environmental Studies, Dalhousie University
Researchers at Dalhousie University's School for Resource and Environmental Studies carry out their work in forest-related areas, such as biodiversity conservation and SFM.

Acadia University
Acadia University, located in Wolfville, NS, conducts research on insect chemical ecology to develop and commercialize insect pheromones and semiochemicals to benefit forestry in Canada.

Québec

Government of Québec's Forestry Research Directorate
The Government of Québec, through the work carried out by researchers at the Forestry Research Directorate, acquires and disseminates knowledge on SFM. The areas of research are:

- Forest ecology and genetics
- Ecosystems and environment
- Modelling forest growth and yield
- Production of seeds and plants
- Silviculture and yield of natural forests and plantations
- Forestry work

Different experimental facilities are available to government researchers and their partners, such as:

- 531 experimental forests on public land in deciduous, mixed and boreal forests. These forests are reserved for research and experimentation in forest science.
- 17 teaching and research forests on public land to promote practical teaching and applied research in forestry. These forests are often managed by secondary, college or university establishments.
- An organic and inorganic chemistry lab to support forestry research, which offers soil, plant tissue and water characterization services.

Centre for Forest Research (CFR)
CFR was established in 2006 from the merge of the Centre for Research in Forest Biology and the Inter-University Forest Ecology Research Group. CFR is composed of 75 regular researchers from 11 universities in the province, in addition to associate researchers, graduate and post doctorate students and research professionals. Researchers in CFR aim to understand the functioning and dynamics of forest ecosystems and the interactions between their components. Their work focuses on areas such as:

- Genetics, molecular biology and ecophysiology
- Ecology of populations, communities and conservations biology
- Functioning and dynamics of forest ecosystems
- New silvicultural approaches and strategies for SFM

New Brunswick

Faculty of Forestry and Environmental Management, University of New Brunswick (UNB)

UNB's Department of Forestry has professors, scientists, and undergraduate and graduate students researching:

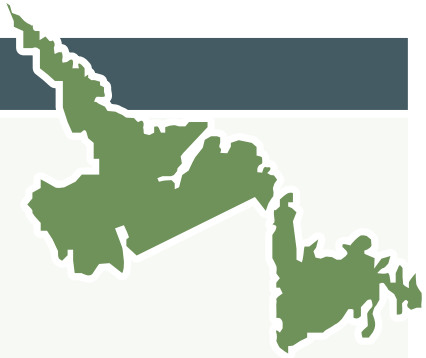
- Forest and wildlife ecology (e.g., genetics, soils, natural disturbances, species at risk, ornithology)
- Environmental social science (e.g., forest governance systems, forest socio-economic values)
- SFM and climate change (e.g., ecosystem services, silviculture, impacts of disturbances)
- Environmental precision technologies (e.g., inventory techniques, geographic information systems, remote sensing)
- Wood science and technology
- Water and watershed management (e.g., ecohydrology, Indigenous Knowledge)

Northern Hardwood Research Institute (NHRI)

A partnership between the forest sector, governments, and academia, the NHRI conducts research to produce knowledge and tools to manage northern hardwood and mixed forests. This includes work on:

- Resource characterization (e.g., improving inventory, predicting volume by species, characterizing tree quality)
- Climate change: using silviculture as a climate change adaptation and mitigation tool
- Efficient forest operations, wood supply and analytics

Newfoundland and Labrador



Centre for Research and Innovation

The Centre for Research and Innovation, located in Corner Brook, NL, is a collaborative effort between Grenfell Campus - Memorial University of Newfoundland, the College of the North Atlantic and Corner Brook Pulp and Paper Limited. The centre aims to support local and regional economic growth through innovation, research, and training.

Prince Edward Island

Provincial forest demonstration woodlots

The Government of Prince Edward Island manages six demonstration woodlots where private woodland owners and people can learn about forest management and silviculture. The sites provide examples of good forest management practices, as well as information on natural history, cultural history, wildlife management and forest ecology.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Key facts and figures

A selection of events that shaped Canada's forests and forest sector over time

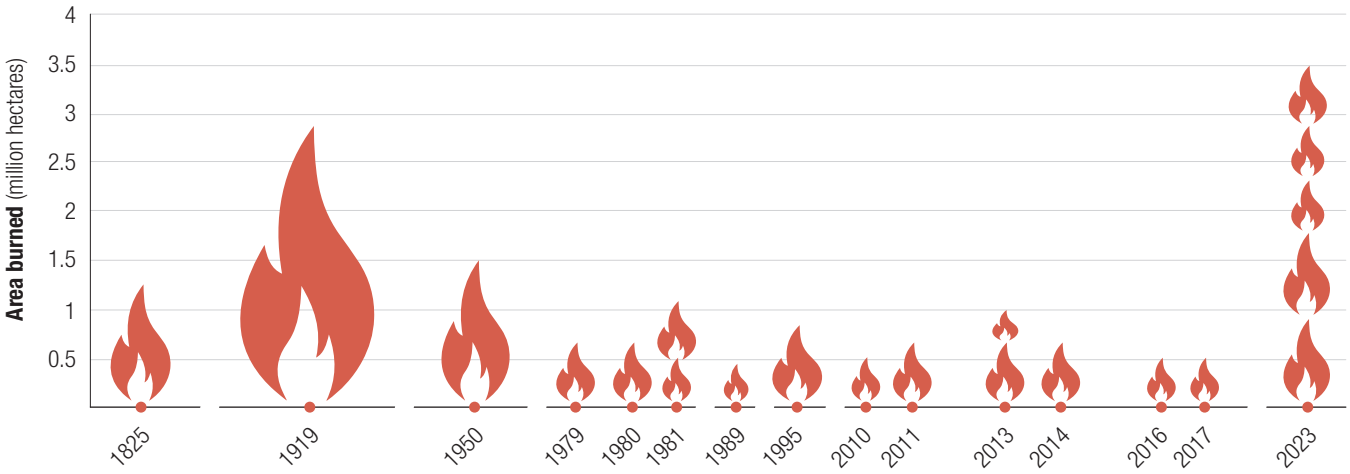
Large wildland fires account for an important part of the forest area burned yearly, in Canada

In Canada, an average of 2.9 million hectares of forest burns each year (average from 1990 to 2023).

Since 1975, wildland fire data in Canada has been collected via satellite imagery. In the pre-satellite era, fire data were collected by provinces and territories, which used diverse methods such as on-the-ground mapping and aerial photo interpretation.

21 largest wildfires recorded in Canada since 1825

Out of the top 21 largest wildfires ever recorded in Canada, 5 of them occurred in 2023 – burning a combined total of more than 3.5 million hectares.



Shifts in forest sector production over time

1600s to 1800s:

Ship construction was the largest economic sector during the colonial period, particularly in the regions that became the Atlantic provinces and Québec. The harvested wood was also used for heating and other purposes (e.g. hemlock tanning bark).

Early 1900s:

Until the mid-1800s, paper was made from cotton or linen. With new techniques for making paper out of wood, the paper sector flourished while, in the early 1900s, the sawmill sector declined until being overtaken by paper and pulp as the forest sector's largest output by the mid-1920s. By the end of World War I (1918), Canada was the largest pulp and paper exporter in the world.

Nowadays:

Solid wood products now predominate Canada's forest sector. For this product category, in 2023, **Canada** was the:

2nd largest exporting country ($18.1 B)

5th largest producing country (486 M m^3)

First reporting of the main invasive insects in Canada

Some invasive insect species have spread in Canada's forests over the years

An invasive alien insect is a species that spreads beyond its usual geographic range, from one ecosystem to another, either by crossing a national border or within the same country.

Canada's academic institutions contribute to the transmission and development of knowledge in forestry

The first three forestry schools were established in the early 1900s in Canada. Their task was to establish a framework of professional foresters in Canada.

1907

Canada's first forestry school opened at the **University of Toronto**

1908

A second forestry school established at the **University of New Brunswick**

1910

A third forestry school opened at **Université Laval**

There are currently eight universities in Canada offering forestry programs accredited by the Canadian Forestry Accreditation Board:

- Université de Moncton (New Brunswick)
- University of New Brunswick
- Université Laval (Québec)
- Lakehead University (Ontario)
- University of Toronto (Ontario)
- University of Alberta
- University of British Columbia
- University of Northern British Columbia

Forestry over time:

Interviews with Canadian Forest Service personnel

Since being established in 1899, the role of the Canadian Forest Service (CFS) has evolved and grown to become the recognized national and international voice of Canada's forest sector. As part of its 125-year anniversary, The State of Canada's Forests report team reached out to several CFS employees whose science, policy and management work aim to improve the well-being of Canadians and Canada's forests. Their reflections link CFS' past, present and future.

Here is what they had to say…

Dr. Sylvie Gauthier

Emeritus Research Scientist, Forest Succession, Laurentian Forestry Centre, Québec City, QC

On the biggest changes over time: I can think of three things which all relate to the diversity of people involved. Firstly, the people working in the forest sector now have multiple backgrounds: forest engineer, biologist, geographer, environmental or social science. Secondly, the number of women working in forestry number is increasing and lastly, and very importantly, First Nations/Indigenous peoples are more involved in forest sector activities.

On the future of forestry: The impact of climate change, notably via disturbances, is one important challenge that I see. With this, I believe that, as a society, we will have to learn to do more and better with less timber, both for us and for the ecosystem itself.

James C.G. Farrell

Forest Project and Program Coordinator, Atlantic Forestry Centre, Fredericton, NB

On the biggest changes over time: The technology. I remember, when I began my education in forestry, we'd have a compass and we'd have a measuring tape for navigation and that was it. Now we have GPS (Global Positioning System), we have GIS (Geographic Information System) for forest planning, as well as remote sensing including LiDAR (light detection and ranging). Now we can get information right down to a fine scale.

I appreciate that sustainable forest management has changed too. It is more balanced, with a greater emphasis on other values, such as the importance of increasing biodiversity, and ecological and cultural values. It's not just about the timber or the economy. Consequently, Canadians are realizing too that forestry is about more than just harvesting trees.

On explaining my research to youth: I work with scientists to try to better understand how different types of trees grow. We study the conditions and areas that make them grow the best and the healthiest. This field of study is called silviculture, it's the art and science of producing and tending trees. To support this work, I undertake projects to measure and identify trees with lasers from airplanes—also known as LiDAR. In this type of remote sensing, you use the scanned ground data and run an algorithm to try to predict what trees are where. This is a type of AI (Artificial Intelligence) called machine learning.

Lucas Brehaut

Research Scientist-Wildfire Resilience, Atlantic Forestry Centre, Corner Brook, NL

On ongoing changes: Wildfires occur at a national level and the presence of research scientists, analysts and prediction modellers studying fire across the country is important. When I was hired as a fire scientist in Newfoundland, the people I talked to were very surprised I was based in Atlantic Canada. This is because they did not picture fires as being a part of their landscape. Within three years, however, from a public's perspective, people have become very aware of the research needs in that field.

On the future of forestry: Public outreach will be very important. I think we are going to be doing a lot more public education work because misinformation is spreading on a number of fire-related topics. As researchers, we've got a lot of information coming to us, and it is our job to digest and understand it, so we are uniquely positioned to do this work. I also believe we'll communicate the forestry-related topics in a more holistic approach. As an example, for fire it is important that we do not only educate on risk associated with it but also highlight the ecological and cultural benefits of fire and the positive impacts to ecosystems and communities.

Ellen Whitman

Forest Fire Research Scientist, Northern Forestry Centre, Edmonton, AB

On a career in forestry research: My key point to everyone is to follow your interests, especially if you're excited about something. I suggest people not to limit themselves.

Even if you don't see a mentor or someone that looks like you in a role, it doesn't mean that you can't do it. If you're excited about that work, and if that's where you want to be, just from the perspective of enjoying your job, and feeling that your job is fulfilling, you are successful.

On how the forest is inspiring: The thing that I really love to think about with relation to forests and fire is the resilience of ecosystems and also the time scales on which they operate because often the fire blasts through, the trees die, and the forest looks so different in a flash. On the time scale of a human life, it can be really challenging to accept these big changes and deal with them. But fires are part of the normal ecosystem process, and in many ways, our forests respond really well to it, in their own time. Personally, the resilience of forests ecosystems is the thing that I find the most exciting and fascinating: how forests successfully recover after disturbances such as fires.

Jacques Régnière

Research Scientist, Insect Population Dynamics, Laurentian Foresty Centre, Québec City, QC

On explaining forestry research to youth: I work in the field of biomathematics, so I try to convey my fascination with just how many insects there are and how they could impact our forests. I explain that we study insects to better understand how they live and to find out what they feed on to survive, which could be leaves or other parts of trees that we want to see survive too. For example, looking at a particular forested area, if we have data on birds that feed on caterpillars that damage trees, we can calculate if, for example, there are enough of these caterpillars for the birds, what happens to the caterpillar population when they are being fed on by these birds, and then how many caterpillars are going to be able to survive and possible impacts.

On the biggest changes over time: In my particular field, at the beginning, we wanted to get rid of bugs. Bugs were bad. Now we're trying to protect the integrity, persistence and longevity of the ecosystems. We realize that insects have a role to play in that, so they're not necessarily bad. Most of the insects that we study are actually beneficial. Sometimes we need to kill bugs, but most of the time we need to understand and accommodate or accept and try to deal with their impact. Before, they were considered in the angle of their influence on our economics, but this changed.

Roxanne Comeau

Science Advisor, Collaborative Research, Science Policy Integration Branch, Ottawa, ON

On the biggest changes over time: In the 1980s, I went to the University of New Brunswick where I was one of, I think seven women, in my class out of a class about 45. But, in a university atmosphere we were all colleagues, so I didn't feel any sort of challenges or things like that until I got to the workplace. That's where I found that there were still barriers for women to enter, or thrive in, certain professions. Field camps, for example, didn't have accommodations for women at the time. Also, when I started working in the private sector, there weren't maternity leave benefits like there is today. So, for my first child, I took four months' leave and for my second child, I took six weeks leave with the agreement that I'd come in to work with her!

On collaborative work: The trade in illegal forest products has been a growing international concern, and though Canada has excellent legal forest practices for their products, we needed to be more aware of the source of forest products that were coming into the country. In collaboration with Global Affairs and Environment and Climate Change Canada, we went to our researchers across the country who are experts in wood identification, and one of the items they developed was a training guide to help the Canada Border Services Agency recognize and identify illegal wood products. We also worked with our expert on the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which lays out which species are on the illegal or endangered list. It was such a nice collaborative piece between the market access, the trade experts and our researchers.

Katalijn MacAfee

Director Forest Ecosystems division, Great Lakes Forestry Centre, Petawawa and Ottawa, ON

On a career in forestry research: What I do tell people often is you need to put yourself first. You have to think about what you want to do and what you want to get out of life. There are a lot of people that will provide advice and have all sorts of ideas, but ultimately you have to choose something that works well for you and not because other people want you to choose something or think you should do something. Ultimately, it's your life and you have to make sure you live your life.

On the future of forestry: Enhanced forest inventory will continue to improve by leaps and bounds. The amount of data we can access now from, for example, LiDAR has provided so much information to us. Also, increased pressures on the forest have forced us to work more closely together to consider different priorities for forests. We used to have a linear vision: harvesting trees, grow trees again, and so on. I feel that now we think more about: What trees do we want to plant? How can we maximize value? Also, how do we maximize biodiversity values? How can we make sure that species at risk are well protected?

A final holistic and humble reflection on nature

From Jacques Régnière: Life in itself is a mysterious thing. It's a fantastic thing to consider and study. What fascinates me most is the complexity of the interplay of ecological relationships in forests, with all of these living beings that coexist in systems that persist over very long periods of time. We come from nature and we're part of it, so I think that we owe our existence to nature. Because we have such power, with our technology, we have a responsibility to those ecosystems that we live in.

125 years of forest history told by a Yukon white spruce

The following pages display a showing of a selection of important events in the history of Canada's forests and the Canadian Forest Service (CFS) over the last 125 years. Events above the bar are mostly related to Canadian laws and events, international agreements, forest products, CFS reorganizations, and world events that had an impact on CFS, its purpose and direction. Events below the bar are related to natural disturbances, forestry, as well as CFS-led silviculture initiatives, science, knowledge, research, technology, tools, inventories and other initiatives.

The dates of the timeline are superimposed on a bar cropped from an image of tree rings from an increment core collected in 2023 from a white spruce (*Picea glauca*) tree in the Dawson Creek area, Yukon. White spruce, the arboreal emblem of Manitoba, is widely distributed and found in all Canadian provinces and territories.

The timeline shows decades on the increment core. The distance between years and decades is not uniform as ring widths vary. Each year is defined by the boundary between dark-coloured late wood formed at the end of summer and light-coloured wood formed in the spring of the next year.

The study of tree rings, dendrochronology, provides a wealth of information about forest change. Tree rings not only tell us when a tree was born but also its age, and how fast it grew throughout its lifetime. Calculations of a **Ring Width Index (RWI)**, which removes the effects of tree age and size on growth, can be examined over time, allowing researchers to accurately attribute annual growth changes to annual environmental changes. By matching temporal patterns of variation in the RWI across many trees, we can learn about forest resilience to disturbances, like fire, insect outbreaks and disease epidemics, and better understand the impacts of climate change on forests. CFS developed a database of tree rings collected from Canadian tree species (called CFS-TRenD). Continued analyses of these data will provide important information to sustainably manage forest resources in a time of rapid environmental change.

Below is the entire white spruce increment core used in the timeline (the section in the red box starting in 1890) and its **derived annual RWI graph**. Solid and dotted lines show the yearly and 20-year mean RWI for our white spruce (blue) and the stand mean (black, 17 trees), as well as the average growth (horizontal black line). This graph tells us that:

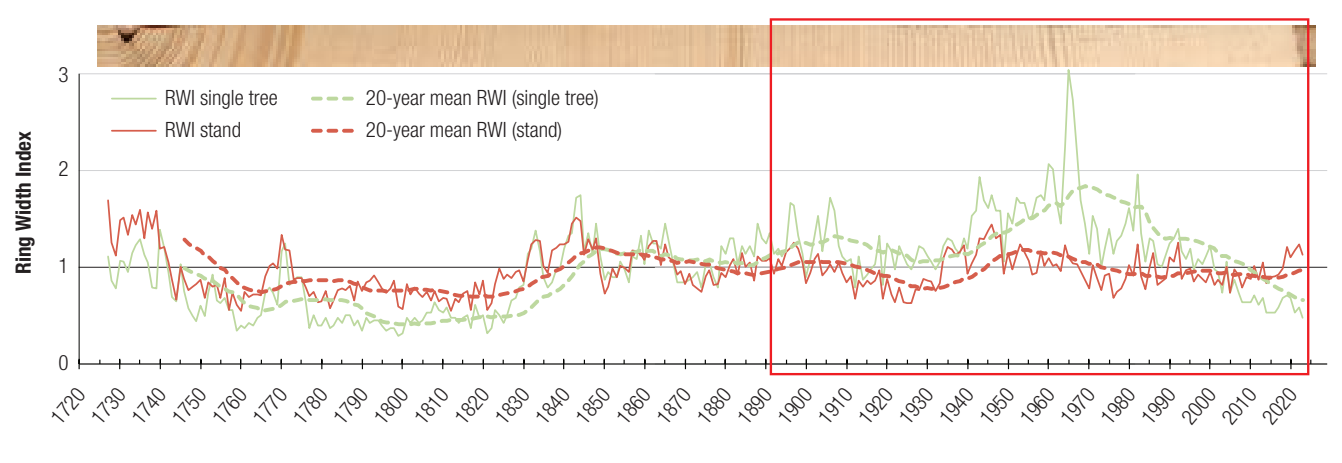
BETWEEN
1750–1820
There was a slow stand growth likely caused by inter-tree competition for limited resources (e.g., light, water).

BETWEEN
1820–1845
There was a rapid stand growth possibly due to growth after an undocumented spruce beetle outbreak.

BETWEEN
1885–1900
There was an above-average stand growth likely due to favourable weather.

BETWEEN
1935–1950
There was a rapid increase in stand growth of surviving trees after a spruce beetle outbreak (1930s) that killed some trees, opening up the forest.

IN
1970
Although our white spruce showed a gradual decline in growth, possibly due to competition or disease, the stand grew normally responding to small interannual weather fluctuations.



As is the case with tree cores, yearly tree rings of disks or "cookies" cut from large trees can also be labelled and associated with important local, national or international events. Such disks have long been used in displays in museums, universities, institutions and CFS forestry offices, as shown in this picture of the Tree Rings and Timelines of šuučabisapuuw display, at the Pacific Forestry Centre. This display shows a tree disk collected in British Columbia linking, on the right, important events with yearly tree rings and, on the left, graphs illustrating tree growth, temperature, and CO_2 concentrations for the 520 years of the tree ring record.

Timeline legend

- Forest, forestry
- Silviculture
- Wildland fire
- Insects
- Diseases
- Seeds
- Inventories, mapping
- Canadian laws and events, and international events and agreements
- Forest products
- CFS story
- Forest, forestry, silviculture and natural disturbances
- Science, knowledge, research and initiatives
- Technology, tools and inventories
- Beginning and end of the 125-year period (1899 to 2024)
- Decades

How sustainable forestry evolved from the early 1900s until now

Forests have played a critical role in shaping Canada's history and economy. The concept of forest management has evolved over the past centuries. What was once as simple as harvesting timber to satisfy economic demand, has expanded to include conservation as well as societal and cultural values. Forest products, as well as forestry principles, practices, methods and technologies have all advanced to ensure the sustainability of our natural resources.

Early practices in Canadian forests (up to the early 1900s)

- Until about 10,000 years ago, nearly all of Canada was covered with glaciers. As the world slowly warmed and the ice receded, human beings began populating the landscape. Following this period, Indigenous Peoples managed forests to meet their needs, for fuel and shelter. For example, large areas of forest were burned to facilitate travel, and to increase grazing lands area for buffalo, deer and elk. With their knowledge of the land, trading networks, and skilled labour, Indigenous Peoples also took active part in the booming fur trade.
- European settlers removed patches of forest in order to build an agricultural economy. During this process, there was no notion of sustainable forestry and trees as a renewable resource, so long-term planning was excluded. Harvesting practices were not regulated because forests were viewed as impeding to the economic priority at that time: agriculture.

Emergence of environmental awareness (early to mid-1900s)

- By the early 1900s, the impacts of overharvesting and deforestation were evident. This led to an important environmental awareness.
- As a result, what is now known as the Canadian Forest service (CFS) was established by the Government of Canada in 1899 with a budget of $1,000. Elihu Stewart, the first employee, focused on protecting forests from fire, planting trees in the Prairies to provide settlers with windbreaks and harvesting timber for fuel and building materials. Forest protection from destructive insects became an important activity shortly thereafter.
- The logging boom of the 1920s and 1930s further emphasized the need to sustain the timber yield.

Shift toward sustainable wood production practices (mid to late 1900s)

Establishment of forest management regulations

- Since the mid-1900s, federal, provincial and territorial governments have implemented a range of regulations and policies aimed at promoting sustainable yield forestry. These regulations required forest managers to provide a sustainable wood supply over the long-term and reforest where natural regeneration was insufficient.
  - Federal examples include the *Canada Forestry Act* (1949) and the *Forestry Act* (1985).
  - Nearly 90% of Canada's forests are publicly owned, being managed by provincial or territorial governments through their laws. Provincial examples include the *Forest Act* of New Brunswick (1980), Québec (recasting of the 1986 Forest Act leading to the 2013 *Sustainable Forest Development Act*) and British Columbia (1996).
- The Canadian Council of Forest Ministers was formed in 1985, providing a framework for cooperation between provincial, territorial and federal governments.
- Since the Rio Summit in 1992, Canada has become a signatory to many international agreements related to sustainable resource use.
- The Montréal Process Working Group was launched in 1994. The group developed a set of international criteria and indicators to report on SFM within its 12-member countries.

Implementation of ecosystem-based management

Forest management in Canada increasingly emphasized ecosystem-based approaches that emulate historical natural disturbances processes. Rather than focusing solely on timber productions, multiple considerations were taken into account, including:

- protected areas
- carbon sequestration
- water quality
- wildlife habitat
- spiritual and cultural values
- recreational opportunities

Adoption of certification systems to promote sustainable forestry practices

Over the past few decades, certification programs have been increasingly used by the forest sector in many provinces and territories. These programs provide third-party verification that forests are being managed in a sustainable manner by meeting environmental, social and economic criteria. Canada's first forest certification occurred in 1995.

Innovation and social forestry (the 2000s)

New tools to assist forest management

Advances in technology greatly improved the ability to monitor and manage forests. Geographic information systems and remote sensing using satellite imagery or light detection and range (LiDAR) enable forest managers to gather detailed data on forest composition, health and productivity, leading to more informed management decisions. Today, most provinces and territories have established inventory programs aimed at collecting LiDAR data across their managed land base.

Investments in research and development for sustainable forestry practices

Ongoing research and innovation have a crucial role in advancing forest management practices. Canadian universities, research institutions, governments and industry partners collaborate on projects to develop adaptive silviculture practices, genetically improved seedlings, forest protection tools and climate change adaptation strategies. This knowledge is transferred to practitioners and helps ensure forest management practices remain adaptive and resilient.

Integration of Indigenous Knowledge and traditional ecological practices

Over 55% (2021) of Indigenous Peoples live in or near forests. For many of these forest-based Indigenous Peoples, their connection to the land and forests is integrated in their cultures, communities and traditions. These vested interests often lead to their active participation in forest management and conservation, collaborative approaches that respect Indigenous rights are increasingly being adopted, leading to more inclusive SFM practices and supporting Indigenous Peoples in regaining sovereignty over their land and resources. NRCan is playing an active role in implementing the *United Nations Declaration on the Rights of Indigenous Peoples Act* through legislation, policy and programs. Implementation of the UN Declaration Act in Canada will empower Indigenous communities to have greater control over their ancestral lands, including forests, ensuring their right to make decisions regarding forestry practices and resource management, and fostering sustainable development in the Indigenous forest sector. The UN Declaration Act also enforces the principle of Free, Prior, and Informed Consent, ensuring that Indigenous communities have a say in decisions related to forestry activities and supporting the preservation of their cultural heritage and traditional knowledge.

Looking ahead

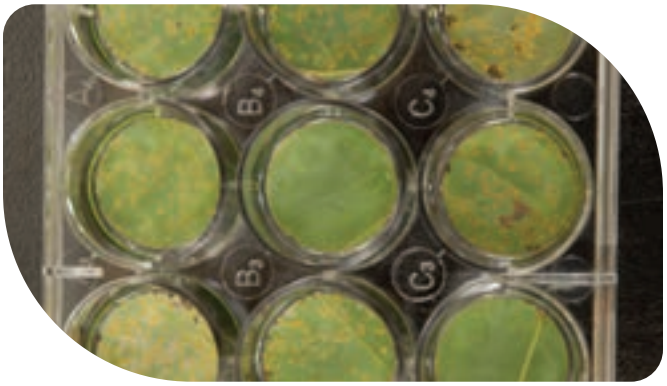
Over the past 125 years, the principles of SFM have evolved to recognize the rights of future generations to enjoy the natural gifts forests provide. SFM continues to evolve by supporting the changing values of society. New tools and management techniques aid this advancement through innovation, including the emergence of artificial intelligence (AI). AI can better characterize forest metrics and recommend actions through decision support platforms. AI can manage large amounts of data and update models in real time.

Canada has made commitments, domestically and internationally, toward SFM and conservation.

In support of sustainability, Canada became one of many signatory countries to the Kunming-Montreal Global Biodiversity Framework (KMGBF) in 2022. The KMGBF makes the halting and reversing of biodiversity loss by 2030, and the restoring of biodiversity levels by 2050, an international effort.

Provinces and territories are shifting their policies, regulations and operational guides toward the overall ecological well-being of the forest, supporting biodiversity and other values.

SFM will continue to evolve in response to environmental, social and economic concerns. As with previous generations, Canada's forest sector is resilient and will respond to any challenge with perseverance, innovation and scientific research.



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The role of forest products in fighting climate change

Forests play a role in mitigating climate change in various ways: trees absorb atmospheric carbon as they grow, help to keep water and soil healthy, and can cool cities in hot summers.

Harvesting trees and ensuring regeneration can also play a role in climate change. Indeed, trees store carbon, and so do the products made from them. That is particularly true for structural lumber like 2x4s and advanced building products like cross-laminated timber.

Like the science of forest management, the science of how to produce forest products has also advanced over the last 125 years. The two main components of harvested wood—lignin and cellulose—can be used in many applications: fuels and bioenergy, pharmaceuticals, cosmetics and textiles, to name a few. Wood and its components can be used and reused: lignin and cellulose can be re-used four or five times before they begin to degrade.

Products that come from the forests, especially wood products, can help us reach our climate change goals by reducing greenhouse gas (GHG) emissions in two main ways:

- **Using long-lived wood products, like building materials, to physically store carbon, expanding carbon storage outside of the forest**
- **Substituting carbon-intensive materials, such as fossil-fuel-based products, with wood products and their byproducts as lower-carbon alternatives.**

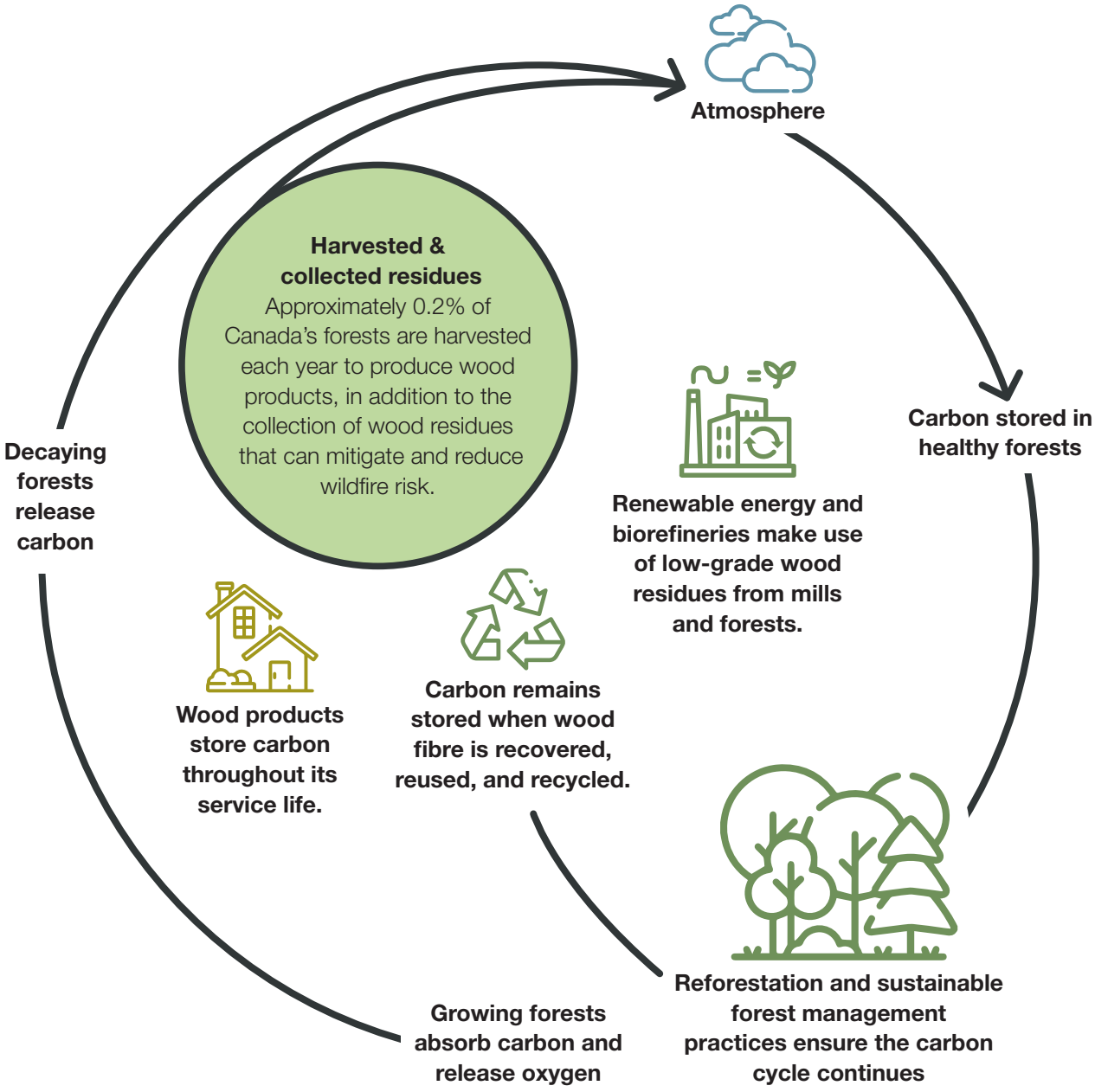
Promoting circularity through the recovering, recycling and reuse of wood products, amplifies the benefits from storage and substitution on climate change.

Canada's sustainably managed forests and integrated value chain mean that forest bioenergy is produced using harvest residues, industrial waste and byproducts from primary manufacturing processes, as well as trees damaged by natural disturbances and material removed to mitigate fire risk. Using biomass energy does not increase harvesting rates. It gives purpose to low-value and undesired feedstock which would have otherwise been left to decay.

Carbon storage in wood products

Forests store more carbon than other land-based ecosystems. Wood-based materials have the unique benefit of being able to store carbon that they absorbed before harvesting. Even though a portion of wood and its stored carbon can be lost during the harvesting and processing of wood products, wood products continue to act as carbon reservoirs, storing the remaining carbon throughout their lifespan, effectively delaying carbon emissions for several decades. The longer a wood product is in use, the longer carbon will remain stored within the wood. Using wood as a construction material is one example of long-term carbon storage, as buildings generally have long lives.

How wood products fit into the natural carbon cycle:



Bioenergy with carbon capture and storage (BECCS) provides opportunities for net-negative emissions and the potential to remove carbon from the atmosphere, which is expected to be needed to offset remaining emissions in other sectors. The CO_2 from bioenergy that is normally released and returned into the natural carbon cycle can be captured and stored, permanently removing carbon from the cycle.

Using wood products as substitutes for fossil-based products

The forest sector prioritizes the use of the whole tree in order to maximize economic value. Higher value products like mass timber and lumber can be used as an alternative to more carbon-intensive building materials, for example in the construction of multi-residential buildings. Lower-value wood residues can be turned into renewable energy, lessening demand for fossil fuels. Residues can even be broken down further into its components (e.g. cellulose, hemicellulose and lignin) to produce chemicals and other materials.

Using wood products in buildings

The manufacturing, transportation and installation of wood-based materials use less energy and emit fewer GHGs and pollutants over their life cycle compared to other construction materials.

- For example, 2,325 m^3 of Canadian timber was used to construct the Science Collaboration Centre and Support Facility in the Canadian Nuclear Laboratories in Chalk River, Ontario, reducing GHG Emissions by approximately 1,580 tonnes of carbon dioxide equivalent (CO_2e), with 971 tonnes of CO_2e sequestered and stored in the timber and 609 tonnes of **CO_2e avoided** by substituting traditional construction materials with wood-based low-carbon materials.

Using wood products in innovative biomaterials

- Biomaterials made with wood fibre can include plastics, textiles, pharmaceuticals, lubricants and adhesives, which traditionally use fossil-based inputs.
- Lignin, an organic chemical that binds fibre together in plants and trees, can be used to replace bitumen in asphalt to reduce its carbon intensity and as an electrical conductor for use in electrical vehicle batteries.

Using wood products in bioenergy

- Residues and lower-value forest biomass have traditionally been used to manufacture solid biofuels (e.g. wood pellets used to produce energy) but are also increasingly being used for advanced liquid biofuels (e.g. biocrude, sustainable aviation fuel) and gaseous biofuels (e.g. synthetic gas, hydrogen). Biofuels can replace fossil fuels and thus reduce net carbon emissions.
- Bioenergy is used in wood product facilities, reducing industrial emissions by displacing fossil energy, but can also be used to provide readily available clean electricity and heat to communities which can in turn improve local energy security, reduce fossil fuel consumption and reduce the risk of pollution from fuel spill contamination.

Climate change presents forest management with new challenges but also new opportunities to increase the positive impact of forest products. While climate change increases the risk of forest fires, pests and disease in Canada's forests, some landscape management activities, such as forest thinning for forest fire mitigation, improve community resilience and create wood residue which can be developed into marketable wood products with economic value. However, further efforts are required to overcome obstacles including the costs of transporting wood residue to facilities. Sustainable forest management practices will continue to be an important aspect of mitigating the impacts of climate change on Canada's forests, while also ensuring that the forest sector stays a relevant player in Canada's path to net-zero emissions.

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

How Natural Resources Canada supports sustainable forest management

Forests in Canada are managed for diverse values through the principles of sustainable forest management (SFM). The federal government, in partnership with academia, industry, non-governmental organizations, Indigenous communities and all orders of government, supports the continuous improvement of SFM through investments in forest data, research and programs. Natural Resources Canada (NRCan) has a number of national research programs, and several targeted initiatives led by the Canadian Forest Service (CFS). New knowledge, tools and partnerships are being developed to ensure Canada's forests remain healthy and sustainable for present and future generations. Collaboration is key, as provinces, territories, industry and communities rely on alliances to carry out SFM practices. Collaboration with Indigenous Peoples, who have acted as stewards of the land and forests since time immemorial, utilizing Indigenous Knowledge and practices to maintain ecological balance and sustainability, is particularly important. The unique features and Indigenous perspectives within this stewardship approach can complement modern forest management strategies.

The selected programs and actions presented in the table below are a first step in reporting on the capacity of the federal government to support the environmental, economic, social and cultural aspects of SFM. Information about the legal and regulatory framework that governs and guides SFM in Canada will be provided in future State of Canada's Forests reports.

NRCan—CFS programming supporting SFM. Note: Not all programming contribute directly to sustainability indicators and reporting through the State of Canada's Forests annual report. Some federal programs and research develop new knowledge, tools and innovative practices to support SFM.

Program name and brief description	Selected federal actions	Associated indicator theme in the State of Canada's Forests report
Enhancing SFM Practices • National data, reporting and forest ecosystem research to better understand forest ecosystems and inform SFM policies and practices.	• Managing forests for sustainability requires increased understanding of Canada's forests and how they are changing. Research on forest biodiversity and forest management is assessing the effectiveness of forest management practices for biodiversity outcomes, such as habitat for birds or species at risk. This knowledge is informing provincial and federal policies, and forest management practices to ensure sustainability. • Federal investments are enhancing wildfire resilience by improving forest fuel mapping across northern Canada for more accurate hazard and risk assessment.	How much forest does Canada have? How are Canada's forests harvested sustainably?
Enhancing Forest Climate Change Adaptation and Mitigation Strategies • Research and actions to support climate change adaptation in Canada's forests and forest sector, as well as the contribution of forests to mitigating climate change.	• The 2 Billion Trees program supports the Government of Canada's commitment to planting two billion additional trees over 10 years. The program funds organizations to plant trees, offering a nature-based solution for climate change mitigation and adaptation, while also enhancing biodiversity and benefiting the well-being of Canadians. • Carbon modelling under the National Forest Carbon Monitoring, Accounting and Reporting System is advancing our understanding of forest carbon dynamics to meet greenhouse gas emission reduction targets and inform sustainable forest carbon management. • In support of Canada's National Adaptation Strategy, research is evaluating forest practices and scenarios to advance forest adaptation, support management of multiple forest values, including carbon, and ensure forests remain resilient to a changing climate. Assessing the impacts of climate change and how forests are changing provides a basis for future forest policy and management.	How does disturbance shape Canada's forests?

Program name and brief description	Selected federal actions	Associated indicator theme in the State of Canada's Forests report
Enhancing Forest Pest Risk Management • Research on insects and diseases affecting Canada's forests to manage risks to forest health and resilience.	• Federal investments in science are helping forest management decision-makers understand, monitor, slow the spread and mitigate the negative impacts of native and invasive insects and diseases in Canada's forests. NRCan provides continued scientific leadership to understand and mitigate the risks of forest pests to economic and ecological forest values. Federal science also contributes to phytosanitary standards and guidance to stop the global spread of forest diseases and pests. • The Spruce Budworm Early Intervention Strategy initiative (2022-2026) helps keep spruce budworm populations below an outbreak threshold and minimize tree damage and timber losses in Atlantic Canada's spruce and fir forests.	How does disturbance shape Canada's forests?
Wildfire Risk Management • Fundamental and applied science to help governments, industries, communities and citizens adapt and live with wildfire impacts.	• As part of the priorities identified by the National Adaptation Strategy, the Government of Canada launched the Wildfire Resilient Futures Initiative in 2023-24, investing $285M over five years. This initiative is designed to mobilize and bring together all orders of government, Indigenous Peoples, public and private sectors, academia and individuals to participate and coordinate efforts to effectively live safely within wildland fire prone areas. These federal investments are helping transform how Canada manages wildland fire and inform SFM, recognizing that we need to take proactive steps to prepare for wildland fires and to reduce risks before they occur. Given that more than 70% of Indigenous communities are located on or near forested lands, this initiative advances reconciliation by creating resilient communities through FireSmart practices. Further, the initiative aims to build and mobilize fire knowledge, including Indigenous fire knowledge, contributing to NRCan's commitment to building nation-to-nation relationships.	How does disturbance shape Canada's forests?

Program name and brief description	Selected federal actions	Associated indicator theme in the State of Canada's Forests report
Addressing Cumulative Effects of Natural Resource Development • Research to improve the environmental performance of Canada's renewable and non-renewable natural resource sectors by developing knowledge, data, tools and capacity to manage the combined effects of natural processes (such as wildland fires) and resource development activities occurring in Canada's forests over the long-term.	• Federal research is developing knowledge, data and tools regarding cumulative effects to support implementation of the *Impact Assessment Act* (2019). Better understanding of cumulative effects in Canada's forests enables better land management for multiple values and products, such as biodiversity and natural resource products (e.g., timber, oil and gas). NRCan's research is showcased in this Cumulative Effects Research Story Map. • This program continues to develop science and expertise for woodland caribou habitat protection and conservation. Work includes developing tools to better assess, adapt and mitigate the impacts of cumulative effects on forest habitat for caribou while supporting and complementing Environment and Climate Change Canada's wildlife programming. Habitat restoration tools can help optimize habitat recovery and resiliency. Caribou research outcomes are available on the Canadian Conservation and Land Management Portal page—a forum for sharing information and lessons learned about conservation, wetland best practices, land restoration and land reclamation.	
Developing Sustainable Fibre Solutions • Research reduces the risk to the forest fibre supply in Canada and increases the resiliency of our forests to the impacts of climate change.	• As part of the international research program Adaptive Silviculture for Climate Change, researchers at the Petawawa Research Forest are evaluating forest management options that will enable forests to thrive in the future, by determining the most effective silvicultural treatments to increase tree diversity and improve regeneration in a changing climate. • Securing our wood fibre supply also includes digitizing the forest value chain and developing innovative tools and technologies, including the use of "big data" and artificial intelligence. This work provides an increasingly accurate and comprehensive inventory of our forest resources by gathering, sending and sharing information digitally and filling information gaps.	How are Canada's forests harvested sustainably?

Program name and brief description	Selected federal actions	Associated indicator theme in the State of Canada's Forests report
Strengthening Forest Sector Competitiveness • Based on economic research, analysis and advice, this program advances policies and programs that support the development of new forest products, foster a culture of innovation and leverage Canada's international leadership to facilitate the transformation of Canada's forest sector.	• The Indigenous Forestry Initiative (IFI) advances reconciliation by supporting Indigenous-identified and Indigenous-led priorities to accelerate Indigenous awareness, influence, inclusion and leadership. The IFI continues to evolve to better align with Indigenous priorities. The program's new grants stream has the potential to directly increase Indigenous participation and influence in forest management planning and SFM policy discussions. • The Forest Innovation program supports research and development, provides technology transfer funding for the forest sector and aims to improve its sustainability and economic productivity. • The Investments in Forest Industry Transformation program is an example of how the Government of Canada facilitates the adoption of transformative and innovative technologies and products, such as next generation building products, advanced biomaterials, biochemicals and biofuels. • The Green Construction through Wood program encourages the use of innovative wood-based building technologies in construction projects to decarbonize the built environment. This includes mass timber, modular and pre-fabrication techniques and approaches, to enable lower carbon, faster and more versatile construction. This program advances reconciliation by creating increased market opportunities, job opportunities and more affordable housing for Indigenous communities.	How do forests benefit Canadians? How does the forest sector contribute to Canada's economy? How is the forest sector changing?

See *Sources and information* for more detail and references and visit us online at cfs.nrcan.gc.ca/stateoftheforests.

Sources and information

The State of Canada's Forests Annual Report 2024: An overview

Canadian Council of Forest Ministers. The Canadian Council of Forest Ministers' framework of criteria and indicators of sustainable forest management in Canada. https://www.ccfm.org/releases/framework-of-criteria-and-indicators-of-sustainable-forest-management-in-canada/

Drushka, K. and Burt, B. 2001. The Canadian Forest Service: Catalyst for the forest sector. *Forest History Today* Spring/Fall, 19–28. https://foresthistory.org/wp-content/uploads/2016/12/drushka_canadian-forest-service.pdf

Food and Agriculture Organization of the United Nations. 2020. Global Forest Resources Assessment 2020: Main report. Rome, Italy. https://doi.org/10.4060/ca9825en

Montréal Process Working Group. https://montreal-process.org/

United Nations. 2019. Global Forest Goals and Targets. https://www.un.org/esa/forests/wp-content/uploads/2019/04/Global-Forest-Goals-booklet-Apr-2019.pdf

Forest statistical data

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 January 24, 2024).

Forest inventory

Forest area by classification:
Food and Agricultural Organization of the United Nations. 2020. Global forest resources assessment 2020: Country report: Canada. Rome, Italy. https://doi.org/10.4060/ca9825en

National Forest Inventory. Standard reports, Version 3.0, Table 12.0, Area (1000 ha) of forest land by ownership in Canada. https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t12_forown_area_en.html (accessed May 23, 2024).

- Remeasurement (2017) estimate of Canada's forest area by ownership type.
- 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 ha where the tree canopy covers more than 10% of the total land area and the trees can grow to a height of more than five 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 five 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% to 10% of the total area and the trees, when mature, can grow to a height above five 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. 2023. National Inventory Report 1990–2021: Greenhouse gas sources and sinks in Canada. https://unfccc.int/documents/627833

Environment and Climate Change Canada's National Inventory Report 1990–2021: Greenhouse gas sources and sinks in Canada is based on data and analysis from Natural Resources Canada, Canadian Forest Service's National Forest Carbon Monitoring, Accounting and Reporting System.

Forest type:
National Forest Inventory. Standard reports, Table 5.0, Version 3. Area (1000 ha) of forest land by forest type and age class in Canada. https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t5_forage20_area_en.html (accessed May 23, 2024).

Forest ownership:
National Forest Inventory. Standard reports, Table 12.0, Version 3. Area (1000 ha) of forest land by ownership in Canada. https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t12_forown_area_en.html (accessed May 23, 2024).

Growing stock:
National Forest Inventory. Standard reports, Table 15.0, Version 3. Total tree volume (million m^3) on forest land by forest type and age class in Canada. https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t15_forage20_vol_en.html (accessed May 23, 2024).

National Forest Inventory. Standard reports, Table 16.0, Version 3. Total tree volume (million m^3) by species group and age class in Canada. https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t16_lsage20_vol_en.html (accessed May 23, 2024).

Disturbance
Forest insects:
National Forestry Database. Forest insects, Table 4, Area of moderate to severe defoliation (including beetle-killed trees) by insects. http://nfdp.ccfm.org/en/data/insects.php (accessed April 19, 2024).

- Forest area disturbed by defoliators (e.g., budworms, spongy moth) includes only areas with tree mortality or moderate to severe defoliation. Defoliation does not always result in mortality. Several factors, including defoliation severity, duration and frequency, or presence of other stressors (e.g., drought), can affect the level of mortality.
- Forest area disturbed by bark beetles (e.g., mountain pine beetle, spruce beetle) is derived from aerial surveys that map trees that are dead or dying from successful beetle attack.
- Summing the areas affected by more than one insect to create a grand total can result in an overestimate if more than one insect species occurs in the same stand in the same year. For example, in a mixed wood forest, spruce budworm may defoliate balsam fir in the same stand where forest tent caterpillar is defoliating the aspen trees.

Note: "Spongy moth" was adopted by the Entomological Society of Canada and the Entomological Society of America in March 2022 as the new official common name for *Lymantria dispar*. The species was formerly known as "gypsy moth" and as "LDD moth" in some reports.

Forest fires:
National Forestry Database. Forest fires, Table 3.1.1, Number of fires by cause class. http://nfdp.ccfm.org/en/data/fires.php (accessed August 23, 2024).

National Forestry Database. Forest fires, Table 3.2.1, Area burned by cause class. http://nfdp.ccfm.org/en/data/fires.php (accessed March 21, 2024).

- The National Forestry Database sources the latest year's fire data from the Canadian Interagency Forest Fire Centre, and all years prior to the Canadian Wildland Fire Information System.

Forest management
Forest harvesting:
National Forestry Database. Harvest, Table 5.1, Net merchantable volume of roundwood harvested by ownership, category and species group. http://nfdp.ccfm.org/en/data/harvest.php (accessed May 7, 2024).

National Forestry Database. Harvest, Table 5.2, Area harvested by ownership, management and harvesting method. http://nfdp.ccfm.org/en/data/harvest.php (accessed April 7, 2024).

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

Forest regeneration:
National Forestry Database. Regeneration, Table 6.3, Area of direct seeding by ownership and application method. http://nfdp.ccfm.org/en/data/regeneration.php (accessed April 11, 2024).

National Forestry Database. Regeneration, Table 6.5, Area planted by ownership and species group. http://nfdp.ccfm.org/en/data/regeneration.php (accessed April 7, 2024).

Third-party certification:
Certification Canada. Canadian statistics. 2022 year-end statistics. http://certificationcanada.org/en/statistics/canadian-statistics (accessed March 22, 2024).

- 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:
IUCN: International Union for Conservation of Nature (http://www.iucn.org).

- Data obtained from the Canadian Protected and Conserved Areas Database (CPCAD) (https://www.canada.ca/en/environment-climate-change/services/national-wildlife-areas/protected-conserved-areas-database.html).

Greenhouse gas inventory
Environment and Climate Change Canada. 2023. National Inventory Report 1990–2021: Greenhouse gas sources and sinks in Canada. https://unfccc.int/documents/627833

- Environment and Climate Change *Canada's National Inventory Report 1990–2021: 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 removal 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 removal include ongoing removal by all areas afforested over the past 20 years.
- See the sources and information for the sustainability indicator Forest carbon emissions and removal for more detail.

Domestic economic impact
Canadian housing starts:
Statistics Canada. Table 34-10-0126-01 (formerly CANSIM 0277-0009): Canada Mortgage and Housing Corporation, housing starts, under construction and completions, all areas, annual. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3410012601 (accessed: June 4, 2024).

Forest sector contribution to nominal GDP:
Statistics Canada. Table 36-10-0434-04: Gross domestic product (GDP) at basic prices, by industry, monthly (x 1,000,000). https://doi.org/10.25318/3610043401-eng (accessed April 11, 2024).

Statistics Canada. Table 18-10-0267-01: Industrial product price index, by industry, monthly. https://doi.org/10.25318/1810026701-eng (accessed April 11, 2024).

Statistics Canada. Table 18-10-0268-01: Raw materials price index, monthly. https://doi.org/10.25318/1810026801-eng (accessed April 11, 2024).

Statistics Canada. Table 18-10-0265-01: Industrial product price index, by major product groups, monthly. https://doi.org/10.25318/1810026501-eng (accessed April 11, 2024).

- Natural Resources Canada, Canadian Forest Service's calculations for the latest year's nominal GDP are based on Statistics Canada's tables 36-10-0434-04, 18-10-0267-01, 18-10-0268-01 and 18-10-0265-01: GDP in 2012 constant prices and on estimated industry price deflators indexed to 2012.

Forest sector 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, industry detail (x 1,000,000). https://doi.org/10.25318/3610043401-eng (accessed April 11, 2024).

- Real GDP in 2012 constant prices.
- Nominal and real GDP vary in that real values are adjusted for inflation whereas nominal values are not. Therefore, real GDP is used to account for differences between periods.

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 March 12, 2024).

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 March 12, 2024).

- 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 sector 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 March 28, 2024).

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&request_locale=en (accessed May 28, 2024).

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 March 26, 2024).

- Employment includes jobs held by people employed directly in the following subsectors: 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 Survey of Employment, Payrolls and Hours (SEPH) and the Natural Resources Satellite Account (NRSA).
  - SEPH data focus on industry and can be used for comparing direct company employment in forestry with that in other sectors.
  - Data from Statistics Canada's NRSA are a key source of information on the economic contribution of the forest sector in Canada. The NRSA is able to capture economic activity in forest industry segments that have traditionally been difficult to measure, such as wood furniture manufacturing.
- Natural Resources Canada—Canadian Forest Service calculated indirect employment using Statistics Canada's National Symmetric Input-Output Tables (15-207-XCB) and National Multipliers (15F0046XDB).
  - The calculations for indirect employment were changed in 2019 to better account for employment in the forest sector. Retroactive changes to data from previous years 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 March 12, 2024).

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 March 12, 2024).

- 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, February 8, 2024).

- 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 of forest products:
APA—The Engineered Wood Association. Quarterly production reports.

- For production data of structural panels (plywood and oriented strand board).

Pulp and Paper Products Council (personal communication, data provided by email).

- For production data of newsprint, printing and writing paper and wood pulp.

Statistics Canada. Table 16-10-0017-01: Lumber production, shipments and stocks by species, monthly (x 1,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1610001701 (accessed March 5, 2024).

- For production data of lumber, which includes total softwood production for Canada.
- In January 2019, Statistics Canada noted that they made changes to the sampling and estimation methods for the monthly Sawmills survey, which is the source of the softwood lumber production data for this indicator. As a result of these changes, Statistics Canada replaced Table 16-10-0017-01 with Table 16-10-0045-01 as of January 2019. See https://www150.statcan.gc.ca/n1/daily-quotidien/200302/dq200302a-eng.htm for more information.
- Because of changes in sampling and estimation methods in the Sawmills survey, readers should exercise caution in comparing data from different sources directly.

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 5, 2024).

- 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 on 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, Canadian Forest Service

- 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.

Indicators

How much forest does Canada have?

Dyk, A., Leckie, D., et al. 2015. Canada's national deforestation monitoring system: System description. (Information Report BC-X-439). 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 Canada's National Deforestation Monitoring System: System description. Annual deforestation data provided by Canada's National Deforestation Monitoring System, special tabulation, to the NFI on May 8, 2024.

Food and Agriculture Organization of the United Nations. 2023. Global forest resources assessment (FRA) 2025: Terms and definitions. Rome, Italy. https://www.fao.org/3/cc4691en/cc4691en.pdf

- This document provides definitions of forest, afforestation and other key terms. Note that Canada uses this definition of forest for most, but not all purposes. National greenhouse gas inventory and forest carbon accounting uses a slightly different definition of forest and deforestation.

Gillis, M. D. 1988. Estimating change from successive static forest inventories. *The Forestry Chronicle* (August 1988: 352-354). Metadata - Estimating change from successive static forest inventories (canada.ca).

- This paper describes the practice of using multiple measurements of a static forest inventory (specific points in time) to measure forest attribute change through time. It discusses how the change observed while doing so can be "real" or "artificial," and that caution must be taken to understand what is causing the change before reporting on it.

National Forest Inventory. 2004. Canada's National Forest Inventory Estimation Procedures (Version 1.13). Victoria, BC: Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://nfi.nfis.org/resources/estimation/Estimation_procedures_v1.13.pdf

- This document describes NFI estimation procedures.

National Forest Inventory. 2004. Canada's National Forest Inventory National Standards for Photo Plots Compilation Procedures (Version 1.4). Victoria, BC: Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://nfi.nfis.org/resources/photoplot/Pp_compilation_v1.4.pdf

- This document describes NFI photo plot compilation procedures.

National Forest Inventory. 2021. Canada's National Forest Inventory business process, Version 8.0. Victoria, BC: National Forest Inventory (NFI) Project Office. https://nfi.nfis.org/resources/general/NFI-Business-Process-Version-8.0.pdf

- Description of the procedure and means by which the NFI collects, validates, stores, uses and disseminates national forest inventory data.

National Forest Inventory. *History: Forest Inventory in Canada*. https://nfi.nfis.org/en/history

- This page provides a brief history on the programs that preceded the NFI, explains why the NFI was created, and displays images of other nations NFIs as well as the time periods of Canada's NFI.

National Forest Inventory. Standard reports – T1 version 3.0, Table 4.0, Area (1000 ha) of forest and non-forest land in Canada.

- Point estimate: https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t4_for_area_en.html
- Change estimate: https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t4_for_area_change_en.html
- Remeasurement (2017) estimate of Canada's forest area. This is the source data which was used to derive a forest area value of 369 million ha.

Indicator: Forest area

Information:

Forest area trend reporting method

Now that the NFI has gathered enough data through time to estimate forest changes (see more in the section **How much forest does Canada have?**), we can more accurately estimate forest area in Canada. In the past, the NFI had a forest area point estimate for 2006 only. Trend reporting was done by adding known afforestation and removing deforestation from this value for each year in the time series. The afforestation and deforestation values were from programs that were not specifically designed for NFI use.

Today, the NFI calculates forest area using a hybrid method. The NFI now has point value for 2017 and it has average annual change values covering the period 2000 to 2017. For more information, see the Gillis (1988) paper below. The point values are used for 2006 and 2017 and the annual change estimate is used to calculate the values for the years from 2000 to 2017. The change values are not meant to predict forest area values outside the measurement period, so from 1990 to 1999 and 2018 onwards, known afforestation and deforestation are added and removed from the 2000 and 2017 values, respectively.

- (Equation 1) F2020 = F2017 - D(2017,2018,2019) + A(2017,2018,2019)
- (Equation 2) F1990 = F2000 + D(1999, 1998, 1997, 1996, 1995, 1994, 1993, 1992, 1991, 1990) - A(1999, 1998, 1997, 1996, 1995, 1994, 1993, 1992, 1991, 1990)
  F = forest area; D = deforestation; A = afforestation

The NFI can say with statistical confidence that Canada's forest area has increased from 2000 to 2017. From 2018 onwards, the deforestation and afforestation approach show minor decreases in forest area with 369 million ha reported for 2023. Once the second remeasurement period is complete in 2027, the NFI will have a third forest area point value and will be able to calculate statistical change estimates for 2018 to 2027.

Sources:

Dyk, A., Leckie, D., et al. 2015. Canada's national deforestation monitoring system: System description. (Information Report BC-X-439). 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 Canada's National Deforestation Monitoring System: System description. Annual deforestation data provided by Canada's National Deforestation Monitoring System, special tabulation, to the National Forest Inventory on May 8, 2024.

Hermosilla, T., M.A. Wulder, J.C. White, N.C. Coops, C.W. Bater, G.W. Hobart. (In review) Characterizing long-term tree species dynamics in Canada's forested ecosystems using annual time series remote sensing data. *Remote Sensing of Environment* (RSE-D-24-00311; submitted January 31, 2024)

- The CFS research findings published in the scientific literature is also reporting increases in tree cover.
- Research published by others in the scientific literature also found increasing tree cover, but some findings suggest that the changes may not be occurring exactly as originally theorized. Continued monitoring and research by governments and academia are needed to understand all the dynamics we are observing and inform efforts to forecast future changes.

Food and Agriculture Organization of the United Nations. 2023. Global forest resources assessment (FRA) 2025: Terms and definitions. Rome, Italy. https://www.fao.org/3/cc4691en/cc4691en.pdf

- This document provides definitions of forest, afforestation and other key terms. Note that Canada uses this definition of forest for most, but not all purposes. National greenhouse gas inventory and forest carbon accounting uses a slightly different definition of forest and deforestation.

Gillis, M.D. 1988. Estimating change from successive static forest inventories. *The Forestry Chronicle* (August 1988: 352-354). Metadata - Estimating change from successive static forest inventories (canada.ca).

- This paper describes the practice of using multiple measurements of a static forest inventory (specific points in time) to measure the forest attribute change through time. It discusses how the change observed while doing so can be "real" or "artificial," and that caution must be taken to understand what is causing the change before reporting on it.

National Forest Inventory. 2004. Canada's National Forest Inventory Estimation Procedures (Version 1.13). Victoria, BC: Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://nfi.nfis.org/resources/estimation/Estimation_procedures_v1.13.pdf

- This document describes NFI estimation procedures.

National Forest Inventory. 2004. Canada's National Forest Inventory National Standards for Photo Plots Compilation Procedures (Version 1.4). Victoria, BC: Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://nfi.nfis.org/resources/photoplot/Pp_compilation_v1.4.pdf

- This document describes NFI photo plot compilation procedures.

National Forest Inventory. 2021. Canada's National Forest Inventory business process, Version 8.0. National Forest Inventory (NFI) Project Office. https://nfi.nfis.org/resources/general/NFI-Business-Process-Version-8.0.pdf

- Description of the procedure and means by which the NFI collects, validates, stores, uses and disseminates national forest inventory data.

National Forest Inventory. Standard reports – T1 version 3.0, Table 4.0, Area (1000 ha) of forest and non-forest land in Canada.

- Point estimate: https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t4_for_area_en.html
- Change estimate: https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t4_for_area_change_en.html
- Remeasurement (2017) estimate of Canada's forest area. This is the source data which was used to derive a forest area value of 369 million ha.

Indicator: Deforestation and afforestation

Dyk, A., Leckie, D., et al. 2015. Canada's national deforestation monitoring system: System description. (Information Report BC-X-439). Victoria, BC: Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://ostrnrcan-dostrncan.canada.ca/handle/1845/244040

- National deforestation estimates are calculated on a periodic basis using the method described in Canada's National Deforestation Monitoring System: System description. Figure data provided by Canada's National Deforestation Monitoring System, special tabulation, April 25, 2024.

Environment and Climate Change Canada. 2024. National Inventory Report 1990–2022: Greenhouse gas sources and sinks in Canada. https://publications.gc.ca/collections/collection_2024/eccc/En81-4-2022-1-eng.pdf.

- Environment and Climate Change Canada's National Inventory Report 1990–2022: Greenhouse gas sources and sinks in Canada includes reporting on greenhouse gas sources caused by deforestation based on data and analysis from Natural Resources Canada—Canadian Forest Service's National Forest Carbon Monitoring, Accounting and Reporting System using data provided by Canada's National Deforestation Monitoring System.

United Nations Framework Convention on Climate Change. Report on the conference of the parties on its seventh session, held at Marrakesh from October 29 to November 10, 2001; Addendum, part 2: Action taken by the conference of the parties. FCCC/CP/2001/13/Add.1. Bonn, Germany. 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 a minimum land area of 1 ha with tree crown cover of more than 25%, and with trees having the potential to reach a minimum height of 5 m 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 slightly different from the Food and Agriculture Organization of the United Nations' definition used elsewhere in this report.
- Deforestation is the conversion of forest to non-forest land uses. Consistent with international definitions, deforestation does not include harvest followed by forest regrowth.
- Data have been updated with new mapping of hydroelectric reservoirs.
- Deforestation by the forestry sector includes the creation of new permanent forestry access roads and landings.
- 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.
- Afforestation is the conversion of non-forest land to forest through the planting or seeding of trees.

Additional information:
Canadian Forest Service. *Canada's Deforestation Monitoring Story Map*. https://ca.nfis.org/ndms/ndms_overview_eng.html (Accessed April 26, 2024).

Indicator: Wood volume

Information:

Wood volume trend reporting method

Now that the NFI has gathered enough data through time to estimate forest changes (see more in the section **How much forest does Canada have?**), we can more accurately estimate wood volume trends in Canada. In the past, the NFI had a wood volume point estimate for 2006 only. Trend reporting was done by adding and subtracting the National Forest Carbon Monitoring Accounting and Reporting System (NFCMARS) change in above-ground biomass stock estimate between 2006 and the year of interest.

Today the NFI calculates wood volume using a hybrid method. The NFI now has point value for 2017 and it has average annual change values covering the period 2000 to 2017. For more information, see the Gillis (1988) paper below. The point values are used for 2006 and 2017 and the annual change estimate is used to calculate the values for the years from 2000 to 2017.

The change values are not meant to predict wood volume values outside the measurement period, so from 1990 to 1999 and 2018 onwards, the NFCMARS above ground biomass stock estimate is still used to derive trends. From 1990 to 1999 and from 2018 onwards, the formulas used are:

- Wood volume in [year] = (*wood volume in 2000*) x (*aboveground biomass in [year]/above-ground biomass in 2000*)
- Wood volume in [year] = (*wood volume in 2017*) x (*aboveground biomass in [year]/above-ground biomass in 2017*)

The NFI can say with statistical confidence that Canada's wood volume has increased from 2000 to 2017. From 1990 to 1999 and from 2018 onwards, wood volume shows slight decreases using the NFCMARS method. Once the second remeasurement period is complete in 2027, the NFI will have a third wood volume point value and will be able to calculate statistical change estimates for 2018 to 2027.

NFCMARS assumptions:

- Changes in wood volume should be closely related to changes in above-ground forest biomass and above-ground forest biomass carbon.
- Wood volume data is typically used to derive above-ground biomass and carbon data, but the opposite was done here to utilize NFCMARS annual time series data.
- 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. However, all this 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, W., 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).

Sources:

Environment and Climate Change Canada. 2024. National Inventory Report 1990–2022: Greenhouse gas sources and sinks in Canada https://publications.gc.ca/collections/collection_2024/eccc/En81-4-2022-1-eng.pdf

- Environment and Climate Change Canada's National Inventory Report 1990–2022: 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.

Gillis, M.D. 1988. Estimating change from successive static forest inventories. *The Forestry Chronicle* (August 1988: 352-354). Metadata - Estimating change from successive static forest inventories (canada.ca)

- This paper describes the practice of using multiple measurements of a static forest inventory (specific points in time) to measure forest attribute change through time. It discusses how the change observed while doing so can be "real" or "artificial," and that caution must be taken to understand what is causing the change before reporting on it.

National Forest Inventory. 2004. Canada's National Forest Inventory Estimation Procedures (Version 1.13). Victoria, BC: Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://nfi.nfis.org/resources/estimation/Estimation_procedures_v1.13.pdf

- This document describes NFI estimation procedures.

National Forest Inventory. 2004. Canada's National Forest Inventory National Standards for Photo Plots Compilation Procedures (Version 1.4). Victoria, BC: Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://nfi.nfis.org/resources/photoplot/Pp_compilation_v1.4.pdf

- This document describes NFI photo plot compilation procedures.

National Forest Inventory. 2021. Canada's National Forest Inventory business process, Version 8.0. National Forest Inventory (NFI) Project Office. https://nfi.nfis.org/resources/general/NFI-Business-Process-Version-8.0.pdf

- Description of the procedure and means by which the NFI collects, validates, stores, uses and disseminates National Forest Inventory data.

National Forest Inventory. Standard reports - T1 version 3.0, Table 15.0, Total tree volume (million m^3) on forest land by forest type and age class in Canada.

- Point estimate: https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t15x_forage20_vol_en.html
- Change estimate: https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t15_forage20_vol_change_en.html
- This is the source for the 50.4 billion cubic metres (m^3) of wood in Canada's forest ecosystems. It is also the source for the forest type by wood volume summary provided in the text.

National Forest Inventory. Standard reports -T1 version 3.0, Table 16.0, Total tree volume (million m^3) by species group and age class in Canada.

- Point estimate: https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t16_lsage20_vol_en.html
- Change estimate: https://nfi.nfis.org/resources/general/summaries/t1/en/CA/html/ca_t16_lsage20_vol_change_en.html
- This is the source for the age class summary and species group graphic.

How are Canada's forests harvested sustainably

British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development. 2017. Provincial timber management goals, objectives and targets. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/silviculture/timbergoalsobjectives2017apr05_revised.pdf

LégisQuébec. 2010. Sustainable Forest Development Act. Publication A-18.1. https://www.legisquebec.gouv.qc.ca/en/tdm/cs/A-18.1 (accessed May 15, 2024).

Nova Scotia Legislature. 1989. Forests Act: An act respecting forests. https://nslegislature.ca/sites/default/files/legc/statutes/forests.pdf

Additional information can be found at:

Gauthier, S., Kuuluvainen, T., Macdonald, S. E. et al. 2023. Ecosystem management of the boreal forest in the era of global change. In M.M. Girona, H. Morin, S. Gauthier and Y. Bergeron (eds.), Boreal forests in the face of climate change. Advances in global change research, vol 74, 3–49. Springer Nature. https://doi.org/10.1007/978-3-031-15988-6_1

Thiffault, N., Coll, L. and Jacobs, D. F. 2015. Natural regeneration after harvesting. In K.S.-H. Peh, R.T. Corlett and Y. Bergeron (eds.), Routledge handbook of forest ecology, 371–384. Oxford, United Kingdom: Routledge.

Thiffault, N., Fera, J., Hoepting, M. K. et al. 2024. Adaptive silviculture for climate change in the Great Lakes-St. Lawrence Forest Region of Canada: Background and design of a long-term experiment. *The Forestry Chronicle* 100(2), 155-164. https://doi.org/10.5558/tfc2024-016

Thiffault, N., Lenz, P. R. N. and Hjelm, K. 2023. Plantation forestry, tree breeding, and novel tools to support the sustainable management of boreal forests. In M.M. Girona, H. Morin, S. Gauthier and Y. Bergeron (eds.), Boreal forests in the face of climate change. Advances in global change research, vol 74, 383–401. Springer Nature. https://doi.org/10.1007/978-3-031-15988-6_14

Indicator: Forest area harvested

National Forestry Database. Harvest, Table 5.2, Area harvested by ownership, management and harvesting method. http://nfdp.ccfm.org/en/data/harvest.php (accessed April 7, 2024).

- 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: Forest regeneration

Government of British Columbia. A billion trees planted will benefit B.C. for generations. https://news.gov.bc.ca/releases/2021FLNRO0091-002141

Government of British Columbia. Trends in timber harvest in B.C. http://www.env.gov.bc.ca/soe/indicators/land/timber-harvest.html (accessed May 15, 2024).

Government of Canada. 2 Billion Trees Program. https://www.canada.ca/en/campaign/2-billion-trees/2-billion-trees-program.html

National Forestry Database. Regeneration, Table 6.3, Area of direct seeding by ownership and application method. http://nfdp.ccfm.org/en/data/regeneration.php (accessed April 11, 2024).

National Forestry Database. Regeneration, Table 6.4, Number of seedlings planted by ownership and species group. http://nfdp.ccfm.org/en/data/regeneration.php (accessed April 11, 2024).

National Forestry Database. Regeneration, Table 6.5, Area planted by ownership and species group. http://nfdp.ccfm.org/en/data/regeneration.php (accessed April 11, 2024).

Notes:

- 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 SFM objectives.

Indicator: Volume harvested relative to the sustainable wood supply

National Forestry Database. Wood supply, Table 2, Wood supply estimates by ownership and species group. http://nfdp.ccfm.org/en/data/woodsupply.php (accessed May 6, 2024).

- 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" and "hardwood."

National Forestry Database. Harvest, Table 5.1, Net merchantable volume of roundwood harvested by ownership, category and species group. http://nfdp.ccfm.org/en/data/harvest.php (accessed May 6, 2024).

- Harvests include total industrial roundwood 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 mixed wood 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 NFD.

How does disturbance shape Canada's forests?

Information

The picture of the mountain pine beetle attacked canopy in the red stage seen from top of the Kennedy Siding Flux Tower in Interior British Columbia was taken by Matthew Brown, UBC, and was not modified. https://commons.wikimedia.org/wiki/File:Mountain_Pine_Beetle_attacked_forest_(28371273132).jpg

The map of the historic range and expanded range of the mountain pine beetle in Canada comes from Natural Resources Canada. https://natural-resources.canada.ca/our-natural-resources/forests/insects-disturbances/top-forest-insects-and-diseases-canada/mountain-pine-beetle/13381

Sources

Bush E, Lemmen DS, Eds. (2019). Canada's Changing Climate Report; Government of Canada, Ottawa, ON. 444 p. https://changingclimate.ca/CCCR2019/

Gauthier S, Bernier P, Burton PJ, Edwards J, Isaac K, Isabel N, Jayen K, Le Goff H, Nelson EA (2014). Climate change vulnerability and adaptation in the managed Canadian boreal forest. *Environmental Reviews*. 22(3): 256-285. https://doi.org/10.1139/er-2013-0064

Kurz, W.A., Dymond, C.C., et al. 2008. Mountain pine beetle and forest carbon feedback to climate change. *Nature* 452, 987–990. https://doi.org/10.1038/nature06777

Lemprière, T.C., Bernier, P.Y., et al. 2008. The importance of forest sector adaptation to climate change. (Information Report NOR-X-416E). Edmonton, AB. Northern Forestry Centre, Canadian Forest Service, Natural Resources Canada. https://cfs.nrcan.gc.ca/pubwarehouse/pdfs/29154.pdf

Mikkelson, K.M., Maxwell, R.M., et al. 2013. Mountain pine beetle infestation impacts: modeling water and energy budgets at the hill-slope scale. *Ecohydrology* 6, 64–72. https://doi.org/10.1002/eco.278

Price, D.T., Alfaro, R.I., et al. 2013. Anticipating the consequences of climate change for Canada's boreal forest ecosystems. *Environmental Reviews* 21(4), 322–365. https://doi.org/10.1139/er-2013-0042

Seebens, H., T. M. Blackburn, E. E. Dyer, P. Genovesi, P. E. Hulme, J. M. Jeschke, S. Pagad, P. Pyšek, M. Winter, M. Arianoutsou, et al. 2017. No saturation in the accumulation of alien species worldwide. *Nature Communications* 8, 14435. https://doi.org/10.1038/ncomms14435

Seidl, R., Thom, D., et al. 2017. Forest disturbances under climate change. *Nature Climate Change* 7, 395–402. https://doi.org/10.1038/nclimate3303

Vore ME, Déry SJ, Hou Y, Wei X (2020). Climatic influences on forest fire and mountain pine beetle outbreaks and resulting runoff effects in large watersheds in British Columbia, Canada. *Hydrological Processes* 34, 4560-4575. https://doi.org/10.1002/hyp.13908

Warren, F.J., and Lemmen, D.S. (eds.). 2014. Canada in a changing climate: Sector perspectives on impacts and adaptation. Ottawa, ON: Government of Canada, 286 pages. https://natural-resources.canada.ca/maps-tools-and-publications/publications/climate-change-publications/canada-changing-climate-sector-perspectives-on-impacts-and-adaptation/16309

White JC, Wulder MA, Hermosilla T, Coops NC, Hobart GW (2017). A nationwide annual characterization of 25 years of forest disturbance and recovery for Canada using Landsat time series. *Remote Sensing of Environment* 194, 303-21. https://doi.org/10.1016/j.rse.2017.03.035

Indicator: Forest insects

Langor DW. 2019. The diversity of terrestrial arthropods in Canada. In: Langor DW, Sheffield CS (Eds) The Biota of Canada – A Biodiversity Assessment. Part 1: The Terrestrial Arthropods. *Zookeys* 819, 9–40. https://doi.org/10.3897/zookeys.819.31947

National Forestry Database. Forest insects, Table 4, Area of moderate to severe defoliation (including beetle-killed trees) by insects. http://nfdp.ccfm.org/en/data/insects.php (accessed April 19, 2024).

- Forest area disturbed by defoliators (e.g., budworms, spongy moth) includes only areas with tree mortality or moderate to severe defoliation. Defoliation does not always result in mortality. Several factors, including defoliation severity, duration and frequency, or presence of other stressors (e.g., drought), can affect the level of mortality.
- Forest area disturbed by bark beetles (e.g., mountain pine beetle, spruce beetle) is derived from aerial surveys that map trees are dead or dying from successful beetle attack.
- Summing the areas affected by more than one insect to create a grand total can result in an overestimate if more than one insect species occurs in the same stand in the same year. For example, in a mixed wood forest, spruce budworm may defoliate balsam fir in the same stand where forest tent caterpillar is defoliating the aspen trees.

Note: The name "Spongy moth" was adopted by the Entomological Society of Canada and the Entomological Society of America in March 2022 as the new official common name for *Lymantria dispar*. The species was formerly known as gypsy moth and as "LDD moth" in some reports. https://esc-sec.ca/2022/03/02/new-common-name-for-lymantria-dispar/

Additional information can be found at:
Bleiker, K.P., Ethier, C.A. and Van Hezewijk, B.H., 2023. Suitability of a historical, novel, and occasional host for mountain pine beetle (*Coleoptera: Curculionidae*). *Forests* 14(5), 989. https://doi.org/10.3390/f14050989

Bowden, J.J., van der Meer, B., Moise, E.R., Johns, R.C. and Williams, M., 2023. Not just for the birds: Spiders as natural enemies of spruce budworm *(Choristoneura fumiferana*, Clem.). *Journal of Applied Entomology* 147(2), 176-180. https://doi.org/10.1111/jen.13096

Lee, S.-I.; Langor, D.W.; Spence, J.R.; Pinzon, J.; Pohl, G.R.; Hartley, D.J.; Work, T.T.; Wu, L. 2023. Rapid recovery of boreal rove beetle (Staphylinidae) assemblages 16 years after variable retention harvest. *Ecography* 2023: e06347. https://doi.org/10.1111/ecog.06347

Turgeon, J.J., Smith, M.T., Pedlar, J.H., Fournier, R.E., Orr, M. and Gasman, B., 2022. Tree selection and use by the polyphagous xylophage *Anoplophora glabripennis* (Coleoptera: Cerambycidae) in Canada. *Canadian Journal of Forest Research* 52(4), 622-643. https://doi.org/10.1139/cjfr-2021-0244

Indicator: Forest diseases

Canadian Food Inspection Agency. Oak wilt. https://inspection.canada.ca/plant-health/invasive-species/plant-diseases/oak-wilt/eng/1325624048625/1325624535106

Capron, A., Herath, P., et al. 2023. SODplex, a series of hierarchical multiplexed real-time PCR assays for the detection and lineage identification of *Phytophthora ramorum*, the causal agent of sudden oak death and sudden larch death. *PhytoFrontiers*™ 3(1), 173–185. https://doi.org/10.1094/PHYTOFR-09-22-0095-FI

Daigneault, B.C. 2024. Fungal forensics: *Neodothiora populina* found in Yukon, Canada, with insights into its global biogeographic distribution (Unpublished honours thesis). Department of Biology, University of Western Ontario, London, ON.

Joshi, V., Burlakoti, P., and Babu, B. 2023. Diseases/symptoms diagnosed on commercial crop samples submitted to the British Columbia Ministry of Agriculture and Food (BCMAF), Plant Health Laboratory in 2022. In: Elmhirst J (editor). Canadian Plant Disease Survey 2023 Volume 103: Disease Highlights 2022, Canadian Journal of Plant Pathology 45(sup 1): 7–12. https://doi.org/10.1080/07060661.2023.2222486

Natural Resources Canada. Sooty bark disease. https://natural-resources.canada.ca/our-natural-resources/forests/insects-disturbances/top-forest-insects-and-diseases-canada/sooty-bark-disease/25599

Ramsfield, T.D., Feau, N., et al., 2023. First report of *Melampsora epitea* causing stem cankers on *Salix pentandra* in Alberta, Canada. *Frontiers in Forests and Global Change* 6, 1172889. https://doi.org/10.3389/ffgc.2023.1172889

Tanney, J. B., Feau, N. et al. 2024. Cryptostroma corticale (Ellis & Everh.) P. H. Greg. & S. Waller causing sooty bark disease in British Columbia, Canada. *Canadian Journal of Plant Pathology* 1–15. https://doi.org/10.1080/07060661.2024.2369324

Winton, L.M., Adams, G.C. and Ruess, R.W., 2022. Determining the novel pathogen *Neodothiora populina* as the causal agent of the aspen running canker disease in Alaska. *Canadian Journal of Plant Pathology* 44(1), 103–114. https://doi.org/10.1080/07060661.2021.1952487

Indicator: Forest fires

British Columbia Wildfire Service. Wildfire Season Summary. https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary (accessed May 17, 2024).

Business in Vancouver. Estimated 400 buildings destroyed this summer by BC wildfires. https://www.biv.com/news/economy-law-politics/estimated-400-buildings-destroyed-summer-bc-wildfires-8273271

Canadian Interagency Forest Fire Centre. Canada report. https://www.ciffc.ca/publications/canada-reports

Canadian Wildland Fire Information System. CWFIS datamart. https://cwfis.cfs.nrcan.gc.ca/datamart (accessed March 23, 2024).

Firefighting in Canada. Canada on fire. https://www.firefightingincanada.com/canada-on-fire/

Insurance Bureau of Canada. Okanagan and Shuswap area wildfires cause over $720 million in insured damage. https://www.ibc.ca/news-insights/news/okanagan-and-shuswap-area-wildfires-cause-over-720-million-in-in-sured-damage

Insurance Bureau of Canada provides Jasper wildfire recovery update https://www.ibc.ca/news-insights/news/insurance-bureau-of-canada-provides-jasper-wildfire-recovery-update

Jain, P., Barber, Q., Taylor, S., Whitman, E., Castellanos Acuna, D., Boulanger, Y., Chavardès, R.D., Chen, J., Englefield, P., Flannigan, M., Girardin, M.P., Hanes, C.C., Little, J., Morrison, K., Skakun, R.S., Thompson, D.K., Wang, X., Parisien, M.A. 2024. Canada under fire – Drivers and impacts of the record-breaking 2023 wildfire season. ESS Open Archive. https://doi.org/10.22541/essoar.170914412.27504349/v1

National Forestry Database. Forest fires, Table 3.1.1, Number of fires by cause class. http://nfdp.ccfm.org/en/data/fires.php (accessed March 21, 2024).

National Forestry Database. Forest fires, Table 3.2.1, Area burned by cause class. http://nfdp.ccfm.org/en/data/fires.php (accessed March 21, 2024).

Natural Resources Canada. Cost of wildland fire protection. https://natural-resources.canada.ca/climate-change/climate-change-impacts-forests/forest-change-indicators/cost-fire-protection/17783

Skakun, R., Castilla, G., Metsaranta, J., Whitman, E., Rodrigue, S., Little, J., Groenewegen, K., Coyle, M. 2022. Extending the National Burned Area Composite Time Series of Wildfires in Canada. *Remote Sensing* 14, 3050. https://doi.org/10.3390/rs14133050

The Conversation. Québec's summer 2023 wildfires were the most devastating in 50 years. Is the worst yet to come? https://theconversation.com/quebecs-summer-2023-wildfires-were-the-most-devastating-in-50-years-is-the-worst-yet-to-come-216933

The Office of the Prime Minister of Canada. (2024, May 10). Keeping Canadians safe from wildfires [press release] Archived. https://www.pm.gc.ca/en/news/news-releases/2024/05/10/keeping-canadians-safe-wildfires

Indicator: Forest carbon emissions and removals

Environment and Climate Change Canada. 2024. National Inventory Report 1990–2022: Greenhouse gas sources and sinks in Canada. https://publications.gc.ca/collections/collection_2024/eccc/En81-4-2022-1-eng.pdf (accessed May 3, 2024).

- 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 (carbon monoxide, methane and nitrous oxide) 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, including carbon storage and emissions resulting from these products regardless of where in the world these emissions occur.
- "Managed land" includes all lands managed for production of 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 all areas of one hectare or more having the potential to develop forest cover, with a minimum crown closure of 25% and a minimum tree height of five metres at maturity in situ.
- Managed forest land is further divided into an anthropogenic partition (those lands predominantly influenced by human activities) and a natural partition (those lands predominantly influenced by large-scale natural disturbances). When stands are affected by stand-replacing wildfires, the emissions and subsequent removal during post-fire regrowth are reported in the "natural partition." After regrowing stands reach commercial maturity (45 to 100 years), the emissions and removal are reported in the "anthropogenic partition." Stands affected by partial disturbances that cause more than 20% mortality are reported in the natural partition until the biomass reaches pre-disturbance levels.
- The first figure includes the entire managed forest, while the second figure includes only the anthropogenic partition (areas impacted by management and by insect disturbances causing 20% or less tree mortality). The third figure includes only the natural partition (areas impacted by stand-replacing wildfires or insect disturbances causing greater than 20% tree mortality). The sum of figures 2 and 3 is reported in figure 1.

- Harvested wood product emissions are estimated using the "simple decay" approach of the IPCC and include annual end-of-life emissions from all wood harvested in Canada since 1900 and used to produce products or energy anywhere in the world. In contrast, the emissions from other Canadian natural resources (e.g., oil and gas) are reported by the country in which they are consumed. Transfers of wood and paper products to landfills are assumed to instantly oxidize as CO_2.
- 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.
- Emissions bear a positive sign and removal bear a negative sign, in accordance with international reporting standards.
- The State of Canada's Forests report describes GHG emissions from Canada's managed forest as a whole. This means the GHG emissions estimates differ from values presented in Canada's National Inventory Report which addresses international requirements to report on emissions/removals from human activities in the managed forest. Differences in the reported estimates between the two reports are driven primarily by four differences in reporting methods:
  1. The State of Canada's Forests report includes natural disturbance emissions in the total GHG emissions estimate.
  2. GHG emissions totals presented in the State of Canada's Forests report includes CO emissions which is presented as a separate line item in Canada's NIR.
  3. Emissions from bioenergy sourced from croplands and urban lands are excluded from the State of Canada's Forests report but included in the NIR.
  4. CH_4 and N_2O emissions from bioenergy are included in the totals in the State of Canada's Forests report but are reported by the energy sector in the NIR.

Note:
A review of historic harvesting activity (1890 to 1989) in Canada has recently been completed and was implemented in NIR2024. This data improvement affected the disaggregation and reporting of the emissions in the anthropogenic and natural components.

In accordance with international rules, Canada categorizes its emissions and removals from the managed forest into two categories: human-caused (anthropogenic) and natural disturbances. This year, Canada used updated data from the provinces about the area harvested prior to 1990 to make a significant improvement to the area contributing to the anthropogenic and natural disturbance categories. The new data tells us that historically Canada harvested a smaller area than previously assumed. This means that more area is now reported as natural disturbance origin and less is reported as anthropogenic origin at the beginning of the time series. Less area reported in the anthropogenic category means that there is also less carbon sequestration during regrowth happening in the anthropogenic category. This results in higher net emissions from the anthropogenic category than previously estimated, but it does not mean that overall emissions to the atmosphere have increased because the regrowth is still occurring in the natural disturbance category.

Additional information can be found at:
Kurz, W., Shaw, C., et al. 2013. Carbon in Canada's boreal forest: A synthesis. *Environmental Reviews* 21(4), 260–292. https://cdnsciencepub.com/doi/full/10.1139/er-2013-0041

Kurz, W., Hayne, S., et al. 2018. Quantifying the impacts of human activities on reported greenhouse gas emissions and removal in Canada's managed forest: Conceptual framework and implementation. *Canadian Journal of Forest Research* 48(10), 1227–1240. https://cdnsciencepub.com/doi/full/10.1139/cjfr-2018-0176

Lemprière, T., Kurz, W., et al. 2013. Canadian boreal forests and climate change mitigation. *Environmental Reviews* 21(4), 293–321. https://cdnsciencepub.com/doi/10.1139/er-2013-0039

Metsaranta, J., Shaw, C., 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(8), 1082–1094. https://cdnsciencepub.com/doi/full/10.1139/cjfr-2017-0088

Natural Resources Canada, Canadian Forest Service. Carbon budget model. https://natural-resources.canada.ca/climate-change/climate-change-impacts-forests/carbon-budget-model

Natural Resources Canada, Canadian Forest Service. Inventory and land-use change, Forest Inventory. https://natural-resources.canada.ca/climate-change/forest-carbon/inventory-land-use-change

Ogle, S., Domke, G., et al. 2018. Delineating managed land for reporting national greenhouse gas emissions and removal to the United Nations Framework Convention on Climate Change. *Carbon Balance Management* 13(9). https://cbmjournal.biomedcentral.com/articles/10.1186/s13021-018-0095-3

Stinson, G., Kurz, W., et al. 2011. An inventory-based analysis of Canada's managed forest carbon dynamics, 1990 to 2008. *Global Change Biology* 17(6), 2227–2244. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3597256/

How do forests benefit Canadians?

Canadian Council of Forest Ministers. Forests: An integral part of our communities. https://www.ccfm.org/canadians-and-communities/forests-an-integral-part-of-our-communities/#:~:text=Forests%20benefit%20Canadians%20environmentally%20with,water%2C%20acting%20as%20natural%20cleansers

Government of Canada. Budget 2024. https://budget.canada.ca/2024/report-rapport/budget-2024.pdf

Miller, D., de Graaf, M. et al. 2021. Forests & floods: Natural infrastructure for a green recovery. Sackville, NB: Community Forests International. https://forestsinternational.org/wp-content/uploads/2021/06/Community-Forests-International-Report_Forests-and-Flooding.pdf

Natural Resources Canada. Bioeconomic models. https://natural-resources.canada.ca/our-natural-resources/forests/industry-and-trade/forest-bioeconomy-bioenergy-bioproducts/bioeconomic-models/13327

Natural Resources Canada. Forest bioeconomy, bioenergy and bioproducts. https://natural-resources.canada.ca/forest-forestry/forest-industry-trade/forest-bioeconomy

Natural Resources Canada. Forest Carbon. https://natural-resources.canada.ca/climate-change/climate-change-impacts-forests/forest-carbon/13085

Natural Resources Canada. 2009. Climate change and Canada's forests: From impacts to adaptation. Edmonton, AB: Canadian Forest Service and Sustainable Forest Management Network. https://cfs.nrcan.gc.ca/pubwarehouse/pdfs/29616.pdf

Profor. How Forests Enhance Resilience to Climate Change. https://www.profor.info/knowledge/how-forests-enhance-resilience-climate-change

Statistics Canada. Census Profile, 2021 Census of Population. https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/download-telecharger.cfm?Lang=E

Statistics Canada. Indigenous Population Profile, 2021 Census of Population. https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/ipp-ppa/index.cfm?Lang=E

Indicator: Forest sector employment

Total employment:

Statistics Canada. 2021 census of population. https://www12.statcan.gc.ca/census-recensement/index-eng.cfm?DGUID=2021A000011124 (special extraction, May 6, 2024).

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 28, 2024).

- Data include NAICS 113, 1153, 321 and 322.
- 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.
- NRCan, CFS prefers to use employment data from Statistics Canada's SNA because these data are linked to the underlying framework used to compile the Canadian System of National Accounts.
- Data is based on the 2024 spring SNA annual data release. SNA employment estimates are often revised in future releases. Year-over-year comparisons are calculated with the most recent estimates available.

Indigenous employment in the forest sector:
Statistics Canada. 2021 census of population. https://www12.statcan.gc.ca/census-recensement/index-eng.cfm?DGUID=2021A000011124 (special extraction, May 6, 2024).

- Natural Resources Canada, Canadian Forest Service calculations for Indigenous employment are based on Statistics Canada's 2021 census of population.
- These values refer to the number of people in the labour force, which includes those unemployed.
- "Indigenous" refers to people who are First Nations (North American Indian), Inuk (Inuit), or Métis. Indigenous also refers to people who are Registered or Treaty Indians (i.e., registered under the *Indian Act*) and/or those who have membership in a First Nation or Indian band.

Skilled trades data:
Statistics Canada. Registered apprenticeship training programs, 2022. https://www150.statcan.gc.ca/n1/daily-quotidien/231205/dq231205c-eng.htm (accessed May 6, 2024).

Indicator: Forest sector average earnings

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 March 28, 2024).

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 March 28, 2024).

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 January 24, 2024).

Notes:
- The data exclude overtime.
- Starting in 2023, the average earnings were calculated using the Consumer Price Index re-based to 2017 values, compared to 2012 dollars in previous years.
- Issues of *The State of Canada's Forests: Annual Report* prior to 2018 calculated real average earnings using GDP at market prices as the measure of inflation. More recent issues of *The State of Canada's Forests: Annual Report* uses the Consumer Price Index (including volatile commodities) because it is a better indicator of the spending power of Canadians.

Additional information can be found at:
Random Lengths. Random Lengths weekly report. https://www.fastmarkets.com/forest-products/random-lengths-weekly-report/

- Various weekly reports on North American forest products markets.

ResourceWise. ResourceWise's 2024 forest products industry predictions. https://www.resourcewise.com/forest-products-blog/resourcewises-2024-forest-products-industry-predictions (accessed August 15, 2024).

Natural Resources Canada. Overview of Canada's forest industry. https://natural-resources.canada.ca/our-natural-resources/forests/industry-and-trade/overview-canadas-forest-industry/13311

Indicator: Forest communities

Forest-reliant communities:
Natural Resources Canada, Canadian Forest Service. Calculations based on Statistics Canada's 2021 census of population.

Statistics Canada. 2021 Census of Population. https://www12.statcan.gc.ca/census-recensement/index-eng.cfm (special extraction, March 24, 2023).

- The Forest community 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. In 2021, Canada was divided into 5,161 census subdivisions.
- In 2019, the CFS 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, CFS used the SDI to establish whether the forest sector provides a high number of jobs relative to the average Canadian community. The calculations also determine if there are many other sectors that are also an important source of jobs for residents.
- In 2018, The State of Canada's Forests: Annual Report noted that the forest sector was a major source of income for 105 census subdivisions in Canada. In 2019, following the new method, it reported that 300 Canadian communities rely on the forest sector for a significant share of economic activity.
- Employment data from Statistics Canada's 2021 census of population refers to the number of people employed, as opposed to the size of the labour force (which also includes unemployed individuals).

Number of Indigenous people and Canadians that live in or near forests:

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

Natural Resources Canada, Canadian Forest Service. Calculations based on Statistics Canada's 2021 census of population and Natural Resources Canada, Canadian Forest Service's National Forest Inventory's forested land cover.

Statistics Canada. 2021 census of population. (special extraction, March 24, 2023).

- Spatial (geographic information system) analysis used the two previous sources to calculate the percentage of forest cover by census subdivision (CSD). To be considered forested, a CSD needed to contain >=25% of forested land cover. Populations residing within those forested CSDs are considered living in or near forests.

Statistics Canada. Table 14-10-0326-01 (formerly CANSIM 285-0002): Archived – Job vacancies, payroll employees, job vacancy rate, and average offered hourly wage by industry sector, quarterly, unadjusted for seasonality (inactive). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410032601 (accessed May 1, 2024).

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

National Forestry Database. Download, Table 7, Statement of revenues from the sale of timber from provincial Crown land. http://nfdp.ccfm.org/en/download.php (accessed May 2, 2024).

Statistics Canada. 2021 Census of Population (special extraction, May 3, 2024). https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/index-eng.cfm

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://doi.org/10.25318/3610048901-eng (accessed June 18, 2024).

Environmental and Clean Technology Products:
Estimates are from the Environmental and Clean Technology Products Economic Account (ECTPEA). ECTPEA GDP estimates are in nominal terms. Estimates for 2021 and 2022 are preliminary. Environmental and clean technology products are defined as any process, product or service that reduces environmental impacts through any of the following three strategies:

- Environmental protection activities that prevent, reduce or eliminate pollution of any other degradation of the environment;
- Resource management activities that result in the more efficient use of natural resources, thus safeguarding against their depletion; and
- The use of goods that have been adapted to be significantly less energy or resources intensive than the industry standard.

Estimates presented in this report are special extractions that relate to the tables below:
Statistics Canada. Table 36-10-0632-01: Environmental and Clean Technology Products Economic Account, employment (special extraction). https://doi.org/10.25318/3610063201-eng (accessed May 3, 2024).

Statistics Canada. Table 36-10-0645-01: Environmental and Clean Technology Products Economic Account, output, gross domestic product, and compensation of employees per industry (special extraction). https://doi.org/10.25318/3610064501-eng (accessed May 9, 2024).

Nominal GDP:
Natural Resources Canada, Canadian Forest Service's calculations for nominal GDP are based on Statistics Canada's tables 36-10-0434-04, 18-10-0267-01, 18-10-0268-01 and 18-10-0265-01.

- GDP in 2017 constant prices and estimated industry price deflators indexed to 2017.

Statistics Canada. Table 36-10-0434-04: Gross domestic product (GDP) at basic prices, by industry, monthly, industry detail (x 1,000,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610043404 (accessed May 9, 2024).

Statistics Canada. Table 36-10-0401-01 (formerly CANSIM 379-0029): Gross domestic product (GDP) at basic prices by industry (x 1,000,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040101 (accessed May 3, 2024).

- For nominal GDP up to (and including) 2017

Statistics Canada. Table 18-10-0267-01 Industrial product price index, by industry, monthly. https://doi.org/10.25318/1810026701-eng (accessed May 3, 2024).

Statistics Canada. Table 18-10-0268-01 Raw materials price index, monthly. https://doi.org/10.25318/1810026801-eng (accessed May 3, 2024).

Statistics Canada. Table 18-10-0265-01 Industrial product price index, by major product group, monthly. https://doi.org/10.25318/1810026501-eng (accessed May 3, 2024).

IHS Connect. Global Trade Atlas (accessed April 29, 2024).

- Forest products include HS Codes 44, 47 and 48.
- Softwood lumber includes only HS Codes 440710, 440711, 440712, 440713, 440714 and 440719.
- Global value comparisons are on a United States dollar basis.

Indicator: Forest sector gross domestic product

The World Bank. *Databank: World Development Indicators*. https://databank.worldbank.org/reports.aspx?source=world-development-indicators (accessed April 29, 2024).

Nominal GDP:
Statistics Canada. Table 18-10-0265-01: Industrial product price index, by major product group, monthly. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810026501 (accessed April 30, 2024).

Statistics Canada. Table 18-10-0267-01: Industrial product price index, by industry, monthly. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810026701 (accessed April 30, 2024).

Statistics Canada. Table 18-10-0268-01: Raw materials price index, monthly. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810026801 (accessed April 30, 2024).

Gross domestic product (GDP) at basic prices, by industry, monthly, industry detail (x 1,000,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610043404 (accessed April 30, 2024).

Statistics Canada. Table 36-10-0401-01 (formerly CANSIM 379-0029): Gross domestic product (GDP) at basic prices by industry (x 1,000,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040101 (accessed April 30, 2024).

Notes:
- For nominal GDP up to (and including) 2017.
- Natural Resources Canada, Canadian Forest Service's calculations of nominal GDP for 2020 to the latest year are based on Statistics Canada's tables 36-10-0434-04, 18-10-0267-01, 18-10-0268-01 and 18-10-0265-01: GDP in 2017 constant prices and estimated industry price deflators indexed to 2017.

Real GDP:
Statistics Canada. Table 36-10-0434-04: Gross domestic product (GDP) at basic prices, by industry, monthly (x 1,000,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610043404 (accessed April 30, 2024).

Notes:
- Real GDP in 2017 constant prices.
- Nominal and real GDP vary in that real values are adjusted for inflation whereas nominal values are not. Therefore, real GDP is used to account for differences between time periods (e.g., comparing previous two years' GDP).
- Data from Statistics Canada's Natural Resources Satellite Account (NRSA) are a key source of information on the economic contribution of the forest sector in Canada. 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 $32.1 billion to Canada's nominal GDP (1.1% of total GDP) in 2023.

Indicator: Production of forest products

APA–The Engineered Wood Association. Quarterly production reports.

- For production data of structural panels (plywood and oriented strand board).

Pulp and Paper Products Council (personal communication, data provided by email).

- For production data of newsprint, printing and writing paper, and wood pulp.

Statistics Canada. Table 16-10-0017-01: Lumber production, shipments, and stocks by species, monthly (x 1,000). Archived. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1610001701 (accessed March 5, 2024).

Statistics Canada. Table 16-10-0045-01: Lumber, production, shipments and stocks, monthly (x 1,000). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1610004501 (accessed April 8, 2021) Archived.

Notes:
- Statistics Canada sources are for production data of lumber, which include total softwood production for Canada.
- In January 2019, Statistics Canada noted that they made changes to the sampling and estimation methods for the monthly Sawmills survey, which is the source of the softwood lumber production data for this indicator. As a result of these changes, Statistics Canada replaced Table 16-10-0017-01 with Table 16-10-0045-01 as of January 2019. Archived. See https://www150.statcan.gc.ca/n1/daily-quotidien/200302/dq200302a-eng.htm for more information.
- Lumber production data for years 2010 to 2013 (inclusive) comes from the older Table 16 10 0045 01.
- Lumber production data for years 2014 to 2023 (inclusive) comes from the newer Table 06 10 0017-01.
- Because of changes in sampling and estimation methods in the Sawmills survey, readers should exercise caution in directly comparing data from different sources.

Indicator: Exports of forest products

IHS Connect. Global Trade Atlas (special extraction April 29, 2024)

- Forest Products include only HS codes 44, 47 and 48.
- Softwood Lumber includes only HS codes 440710, 440711, 440712, 440713, 440714 and 440719.
- Global value comparisons are on a United States dollar basis.

Statistics Canada. Merchandise trade data (special extraction, April 30, 2024).

- Each product in this dataset represents the total for a custom grouping of HS codes.

How is the forest sector changing?

Bioindustrial Innovation Canada. 2019. Canada's Bioeconomy Strategy. https://www.biotech.ca/wp-content/uploads/2022/01/National_Bioeconomy_Strategy_EN-compressed.pdf

Canadian Council of Forest Ministers. 2022. Renewed Forest Bioeconomy Framework. https://www.ccfm.org/wp-content/uploads/2022/11/40829.pdf

Finnish Government. *Bioeconomy Strategy* 2022–2035, 2022. https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/163969/VN_2022_5.pdf?sequence=4&isAllowed=y

Food and Agriculture Organization of the United Nations. *Aspirational Principles and Criteria for a Sustainable Bioeconomy*, 2021. https://www.fao.org/3/cb3706en/cb3706en.pdf

Haudenosaunee Confederacy. *Values*. Accessed 22 May 2024. https://www.haudenosauneeconfederacy.com/values/

Natural Resources Canada. *Mass timber construction in Canada*, 2024. https://natural-resources.canada.ca/our-natural-resources/forests/industry-and-trade/forest-products-applications/mass-timber-construction-canada/23428

Natural Resources Canada. *State of Mass Timber Interactive Map*, 2024. https://experience.arcgis.com/experience/58e313c4ac0247138ba5057d655ed1d4

Natural Resources Canada. Statistical data, *Domestic Consumption (Canada)*, 2022. https://cfs.cloud.nrcan.gc.ca/statsprofile/consumption/domestic-consumption.html

United States Department of Agriculture. *Biotechnology: Bioeconomy*. https://www.usda.gov/topics/biotechnology/bioeconomy

Indicator: Forest sector financial performance

Fastmarkets (Random Length). Weekly lumber prices and panel prices reports. https://www.fastmarkets.com/forest-products/random-lengths-is-part-of-fastmarkets

Government of Canada. Current lumber, pulp and panel prices.: https://natural-resources.canada.ca/our-natural-resources/domestic-and-international-markets/current-lumber-pulp-panel-prices/13309 (accessed May 1, 2024).

Madison's Lumber Reporter. Weekly lumber and panel prices.

Statistics Canada. Quarterly balance sheet and income statement, by North American Industry Classification System (NAICS) (special extraction, March 10, 2020).

- For data before and including 2019, as Statistics Canada discontinued the use and update of this source (to be replaced with Table 33-10-0225-01).

Statistics Canada. Table 33-10-0225-01: Quarterly balance sheet, income statement and selected financial ratios, by non-financial industries, non-seasonally adjusted (x 1,000,000) https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3310022501 (accessed March 5, 2024).

- For data including and beyond 2020.

Trade Tree Online and Brian McClay & Associates (TTO BMA). Market Pulp Monthly Reports.

Indicator: Forest sector secondary manufacturing

Statistics Canada. Table: 12-10-0136-01: Canadian international merchandise trade by industry for all countries. Archived. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1210013601 (accessed February 15, 2024).

Statistics Canada. Table 16-10-0047-01 (formerly CANSIM 304-0014): Manufacturers' sales, inventories, orders and inventory to sales ratios, by industry (dollars unless otherwise noted) https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1610004701 (accessed February 19, 2024).

Statistics Canada. Table 36-10-0434-04: Gross domestic product (GDP) at basic prices, by industry, monthly, industry detail. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610043404 (accessed March 5, 2024).

Notes:

- Real GDP is in 2017 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.

Additional information on the regional secondary wood manufacturing industries can be found within these six publications:

Bogdanski, B.E.C., Sun, L., et al. 2020. Secondary manufacturing of solid wood products in Ontario 2017: Structure and economic contribution (Information report BC-X-451). Victoria, BC. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://publications.gc.ca/site/archivee-archived.html?url=https://publications.gc.ca/collections/collection_2020/rncan-nrcan/Fo143-2-451-eng.pdf

Bogdanski, B.E.C., Wong, L., et al. 2020. Secondary manufacturing of solid wood products in Québec 2017: Structure and economic contribution (Information report BC-X-453). Victoria, BC. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://publications.gc.ca/site/archivee-archived.html?url=https://publications.gc.ca/collections/collection_2020/rncan-nrcan/Fo143-2-453-eng.pdf

Sun, L., and Bogdanski, B.E.C. 2019. Secondary manufacturing of solid wood products in Alberta 2017: Structure and economic contribution (Information report BC-X-448). Victoria, BC. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://publications.gc.ca/site/archivee-archived.html?url=https://publications.gc.ca/collections/collection_2019/rncan-nrcan/Fo143-2-448-eng.pdf

Sun, L., Bogdanski, B.E.C., et al. 2019. Secondary manufacturing of solid wood products in Saskatchewan and Manitoba 2017: Structure and economic contribution (Information report BC-X-449). Victoria, BC. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://publications.gc.ca/site/fra/9.874229/publication.html

Wong, L., Stennes, B., et al. 2019. Secondary manufacturing of solid wood products in British Columbia 2016: Structure, economic contribution and changes since 1990 (Information Report BC-X-447). Victoria, BC. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://publications.gc.ca/site/eng/9.867130/publication.html

Wong, L., and Bogdanski, B.E.C. 2019. Secondary manufacturing of solid wood products in New Brunswick and Nova Scotia 2017: Structure and economic contribution (Information Report BC-X-452). Victoria, BC. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. https://publications.gc.ca/site/eng/9.877927/publication.html

Indicator: Forest sector carbon emissions

Natural Resources Canada. Comprehensive Energy Use Database. https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm (accessed May 22, 2024).

- National Resources Canada's Comprehensive Energy Use Database is compiled using the following sources:
  - The Canadian Energy and Emissions Data Centre (CEEDC), Simon Fraser University. 2023
  - Statistics Canada. 2023. Report on Energy Supply and Demand in Canada 2000–2021
  - Natural Resources Canada. 2023 Industrial End-Use Model
  - Environment and Climate Change Canada. 2023. National Inventory Report 1990–2021: Greenhouse Gas Sources and Sinks in Canada

Notes:

- The Office of Energy Efficiency at NRCan has changed the base year related to its National Energy Use Database (NEUD) from 1990 to 2000, beginning with the release of 2018 data. This change in methodology has resulted in minor changes in the energy use and GHG emissions data back to 2000. This rebasing is to ensure that NEUD reflects developments in trends and structures of Canada's energy end use and efficiency across sectors. It also synchronizes Canada's energy use data reporting with changes recently made by the International Energy Agency. While new estimates are no longer made available for years prior to 2000, data with the new base year are expected to better service the development, implementation and monitoring of government policies, programs and projects; evidence-based decision-making; industrial and market analysis and projection; and energy use literacy, education and stakeholder engagement.
- Direct emissions come from sources that are owned or controlled by the reporting entity. Indirect emissions are emissions that are a consequence of the activities of the reporting entity but that occur at sources owned or controlled by another entity. For this indicator, indirect emissions reported only include emissions from electricity generation.

Map: An overview of forest research across Canada

Background forest cover map

Guindon, L., Manka, F., Correia, D. L. P., et al. 2024. A new approach for spatializing the Canadian National Forest Inventory (SCANFI) using Landsat dense time series. *Canadian Journal of Forest Research* 54(7), 793–815. https://doi.org/10.1139/cjfr-2023-0118

Federal research facilities

Natural Resources Canada. Atlantic Forestry Centre. https://natural-resources.canada.ca/science-data/science-research/research-centres/atlantic-forestry-centre

Natural Resources Canada. Great Lakes Forestry Centre. https://natural-resources.canada.ca/great-lakes-forestry-centre/13459

Natural Resources Canada. Laurentian Forestry Centre. https://natural-resources.canada.ca/science-data/science-research/research-centres/laurentian-forestry-centre

Natural Resources Canada. National research forests. https://natural-resources.canada.ca/forest-forestry/sustainable-forest-management/national-research-forests

- Provides information on Acadia and Petawawa Research Forests, and Valcartier Forestry Research Station.

Natural Resources Canada. National Tree Seed Centre. https://natural-resources.canada.ca/science-data/science-research/research-centres/national-tree-seed-centre

Natural Resources Canada. Northern Forestry Centre. https://natural-resources.canada.ca/science-and-data/research-centres-and-labs/forestry-research-centres/northern-forestry-centre/13485

Natural Resources Canada. Pacific Forestry Centre. https://natural-resources.canada.ca/science-data/science-research/research-centres/pacific-forestry-centre

Other non-federal forest research facilities and initiatives

Pan-Canadian

FPInnovations. Home. https://web.fpinnovations.ca/

British Columbia

John Prince Research Forest. Home. http://jprf.ca/home

The University of British Columbia. UBC Faculty of Forestry. Research areas. https://forestry.ubc.ca/research/areas/

Alberta

Ecosystem Management Emulating Natural Disturbance. Home. https://emend.ualberta.ca/

fRI Research. About. https://friresearch.ca/about/

Saskatchewan
Saskatchewan Polytechnic. Sustainability-Led Integrated Centres of Excellence (SLICE). https://saskpolytech.ca/about/applied-research-and-innovation/SLICE/

Saskatchewan Research Council. Forestry Services. https://www.src.sk.ca/services/forestry-services

Manitoba
Canadian model forest network. Manitoba Model Forest. https://www.modelforest.net/index_option_com_k2_view_item_layout_item_id_36_Itemid_37_lang_en.html

The University of Winnipeg. Centre for Forest Interdisciplinary Research. https://www.uwinnipeg.ca/cfir/index.html

Woodlot association of Manitoba. Death knell sounded for Canada's model forest network. https://woodlotmanitoba.com/news/2017/05/death-knell-sounded-for-canadas-model-forest-network/

Yukon
Government of Yukon. Visit the research forest. https://yukon.ca/en/outdoor-recreation-and-wildlife/trails-tours-and-activities/visit-research-forest

Northwest Territories
Wilfrid Laurier University. GNWT-Laurier partnership. https://www.wlu.ca/academics/research/partnerships/gnwt/index.html

Ontario
Government of Ontario. Forest research. https://www.ontario.ca/page/forest-research

- Information on the Centre for Northern Forest Ecosystem Research and the Ontario Forest Research Institute.

Québec
Centre for Forest Research. Home. https://www.cef-cfr.ca/pmwiki.php?n=Actualit%c3%a9.Accueil?userlang=en

Gouvernement du Québec. Recherche forestière gouvernementale. https://www.quebec.ca/agriculture-environnement-et-ressources-naturelles/forets/recherche-connaissances/recherche-forestiere-gouvernementale

New Brunswick
Northern Hardwoods Research Institute. Home. https://hardwoodsnb.ca/

University of New Brunswick. Forestry and Environmental Management. https://www.unb.ca/fredericton/forestry/about/index.html

Nova Scotia
Dalhousie University. School for Resource and Environmental Studies. Research strengths. https://www.dal.ca/faculty/science/sres/research/research-strengths.html

Hillier Lab 2024. Welcome to the Hillier Lab 2024! https://www.acadiau.ca/~khillier/index.html

Newfoundland and Labrador
Memorial University. Centre for Research and Innovation. https://mun.ca/grenfellcampus/research/centre-for-research-and-innovation/

Prince Edward Island
Government of Prince Edward Island. Provincial forests. https://www.princeedwardisland.ca/en/information/environment-energy-and-climate-action/provincial-forests

Town of Kensington. Demonstration Woodlots. https://kensington.ca/wp-content/themes/ktown/island/demonstrationwoodlots.htm

Infographic: Key facts and figures: A selection of events that shaped Canada's forests and the forest sector over time

Large wildland fires account for an important part of the forest area burned yearly, in Canada
Canadian Forest Service. Canadian National Fire Database – Agency Fire Data. Edmonton, AB: Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre. https://cwfis.cfs.nrcan.gc.ca/downloads/nfdb/ (accessed July 5, 2024).

- The area burned comes from the Canadian National Fire Database, except for the Great Fires in AB and SK (1919) and the Miramichi fire (1825). These two wildland fires are a recognized part of Canadian fire history, although their areas are estimates made at the time using methods less rigorous than today's method.

- The provincial and territorial fire management agencies can designate groups of fires as complexes depending on how they are managed. If several fires are burning at the same time in the same area, they may be assigned to a single fire management team, regardless of whether they are joined together. However, many of the largest fires are only monitored, rather than actively managed, because they are burning out in the wilderness, are not threatening any values and are recognized as a natural process. When these fires burn together forming a continuous burned area, they may be reported as a single or complex fire, depending on the procedures followed by the relevant agency.

Canadian Geographic. Mapping 100 years of forest fires in Canada. https://canadiangeographic.ca/articles/mapping-100-years-of-forest-fires-in-canada/

21 largest wildfires recorded in Canada since 1825

Year	Fire name	Area burned (hectares)	Location
1825	Miramichi	1.200.000	(Central and northern NB)
1919	Great Fires	2,800,000	(Central AB and SK)
1950	Chinchaga/ Wisp	1,462,449	(Northern AB and BC)
1979	SM-002/ DA3021/ Andrew	579,656	(On the border of NT, AB, and SK)
1980	DA3002/ Alta-563	573,565	(Northern AB and SK)
1981	DA2066/ |October	490,575	(Northern AB and SK)
1981	HY-049	552,539	(On the NT-AB border)
1989	6-6-29 Ashern	449,694	(South-central MB / Interlake region of MB)
1995	HY-010 Horn Plateau	828,532	(Northwest of Great Slave Lake, NT)
2010	10SR-Pasfield	469,631	(Northern SK)
2011	MWF007 Richardson	576,195	(Northeastern AB)
2013	286 Côte-Nord	427,768	(Northeastern QC)
2013	235 Eastmain	560,228	(Northwestern QC)
2014	ZF-020	596,459	(Northwest of Great Slave Lake, NT)
2016	MWF009 Horse River (Fort McMurray)	496,219	(Northeastern AB)
2017	C10784 Plateau	520,885	(Central BC / BC Interior / Cariboo Region of BC)
2023	23LX-Smith	543,976	(Northern SK)
2023	G80280 Donnie Creek	619,073	(Northeastern BC)
2023	SS-022	641,421	(Southern NT / North of Fort Smith, NT / North of Wood Buffalo National Park)
2023	FS-001/ G90288 Hossitl Creek	831,839	(On the border of NT, BC, and AB)
2023	218 Lac Casterne 1	885,388	(Northwestern QC)

Shifts in the forest sector production over time

Canadian Council of Forest Ministers. 2017. A forest bioeconomy framework for Canada. Ottawa, ON. https://ostrnrcan-dostrncan.canada.ca/entities/publication/1de31e8b-32e0-4a3f-9716-8ceba9260bf3?fromSearchPage=true

Centre d'enseignement et de recherche en foresterie de Sainte-Foy (CERFO). 2010. Portrait de la forêt préindustrielle de la région de Portneuf. Rapport final 09-0489-EB-05/02/2010. Programme de mise en valeur des ressources du milieu forestier – volet 2. https://cerfo.qc.ca/portrait-de-la-foret-preindustrielle-de-la-region-de-portneuf-cerfo-et-shfq-rapport-2009-27-100-p-6-annexes/

Food and Agriculture Organization (FAO) of the United Nations. FAO STAT. Forestry production and trade. https://www.fao.org/faostat/en/#data/FO (accessed July 17, 2024).

- Note that the solid wood volume presented does not include wood pellets, but does include wood chips

IHS Connect. Global Trade Atlas (accessed July 17, 2024).

- Solid wood products (HS Code 44).
- Note that this database no longer reports Russia's exports. The last available data point from Russia is 2021 (as a result of the war with Ukraine).

Some invasive insect species have spread in Canada's forests over the years

Griffiths, K. J., 1959. Observations on the European Pine Sawfly, *Neodiprion sertifer* (Geoff.), and its parasites in southern Ontario. The Canadian Entomologist 91(8), 501–512. https://doi.org/10.4039/Ent91501-8

Haack, R. A., Jendak, E., Liu, H., et al. 2002. The emerald ash borer: a new exotic pest in North America. *Newsletter of the Michigan Entomological Society* 47(3-4), 1–5. https://research.fs.usda.gov/treesearch/11858

Natural Resources Canada. Balsam woolly adelgid. https://tidcf.nrcan.gc.ca/en/insects/factsheet/5314

North American Plant Protection Organization. Report of carnation tortrix (*Cacoecimorpha pronubana*) in British Columbia, Canada (2022) / Rapport sur la présence de la tordeuse méditerranéenne de l'oeillet (*Cacoecimorpha pronubana*) en Colombie-Britannique, Canada (2022). https://www.pestalerts.org/nappo/official-pest-reports/1032/

Natural Resource Canada. Forest pest management. https://natural-resources.canada.ca/our-natural-resources/forests/insects-disturbances/forest-pest-management/13361

North American Plant Protection Organization. Update on the Brown Spruce Longhorn Beetle (BSLB), *Tetropium fuscum* (Fabricius), in Nova Scotia, Canada. https://www.pestalerts.org/nappo/official-pest-reports/320/

Canada's academic institutions contribute to the transmission and development of knowledge in forestry

Drushka, K. and Burt, B. 2001. The Canadian Forest Service: Catalyst for the forest sector. *Forest History Today* Spring/Fall, 19–28. https://foresthistory.org/wp-content/uploads/2016/12/drushka_canadian-forest-service.pdf

Infographic: 125 years of forest history told by a Yukon white spruce

Introduction

Campbell, E. M., Antos, J. A. and vanAkker, L. 2019. Resilience of southern Yukon boreal forests to spruce beetle outbreaks. *Forest Ecology and Management* 433, 52–63. https://doi.org/10.1016/j.foreco.2018.10.037

Girardin, M. P., Guo, X. J., Metsaranta, J. et al. 2021. A national tree-ring data repository for Canadian forests (CFS-TRenD): structure, synthesis, and applications. *Environmental Reviews* 29(2), 225–241. https://doi.org/10.1139/er-2020-0099

Ha-Shilth-Sa. Old growth tree slice reinterpreted through a Nuu-chah-nulth perspective. https://hashilthsa.com/news/2019-11-05/old-growth-tree-slice-reinterpreted-through-nuu-chah-nulth-perspective

Mainly Malaspina newsletter. May 2003. Malaspina gets enormous tree cookie. https://www.viurrspace.ca/server/api/core/bitstreams/e1a413cb-6ab4-408b-b121-ef2370810c46/content

Morton, J. 1977. The enterprising Mr. Moody, the bumptious Captain Stamp: The lives and colourful times of Vancouver's lumber pioneers. J. J. Douglas Limited. North Vancouver, BC.

Natural Resources Canada. 2024. Tree rings database. National Tree-ring Data Repository for Canadian Forests (CFS-TRenD). https://treesource.rncan.gc.ca/en/treerings

Natural Resources Canada. White spruce. https://tidcf.nrcan.gc.ca/en/trees/factsheet/38

Royal Ontario Museum. Conservator in the house – In-situ conservation of the “tree cookie”. https://www.rom.on.ca/en/blog/conservator-in-the-house-in-situ-conservation-of-the-tree-cookie

Tree Canada. Canada’s arboreal emblems. https://tree-canada.ca/resources/canadas-arboreal-emblems/

Trofymow, J. A. 2024. Tree Rings and Timelines of šuučabisapuuw – A companion report to the display. Natural Resources Canada. 24. https://ostrnrcan-dostrncan.canada.ca/handle/1845/276144

Timeline

Active History. Learning from past pandemics: Resources on the 1918–1919 influenza epidemic in Canada. http://activehistory.ca/2020/04/learning-from-a-past-pandemic-resources-on-the-1918-1919-influenza-epidemic-in-canada/

Black, K. 2017. An archive of settler belonging: Local feeling, land, and the forest resource on Vancouver Island (Doctoral thesis). Carleton University, Ottawa, ON. https://repository.library.carleton.ca/concern/etds/1v53jx906

Canada’s National Forest Inventory. Home. https://nfi.nfis.org/en/faq

Canadian Council of Forest Ministers. National Forest Information System. https://ca.nfis.org/index_eng.html

Canadian Forest Service. Canadian National Fire Database – Agency Fire Data. Edmonton, AB: Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre. https://cwfis.cfs.nrcan.gc.ca/downloads/nfdb/ (accessed July 5, 2024).

Canadian Interagency Forest Fire Centre. About CIFFC. https://www.ciffc.ca/about/about-ciffc

Canadian Museum of History. The Great Depression. https://www.historymuseum.ca/history-hall/great-depression/

Canadian National Vegetation Classification. Home. http://cnvc-cnvc.ca/index.cfm

Christianson, A. C., Sutherland, C. R., Moola, F. et al. 2022. Centering Indigenous voices: The role of fire in the boreal forest of North America. *Current Forestry Reports* 8, 257–276. https://doi.org/10.1007/s40725-022-00168-9

Clayoquot Sound Scientific Panel. 1995. First Nations’ perspectives relating to forest practices standards in Clayoquot Sound. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwja3b6UyqiMAxVqvokEHVnnCaoQFnoECCEQAQ&url=https%3A%2F%2Fblogs.ubc.ca%2Fapfnet01%2Ffiles%2F2015%2F08%2FClayoquot_Science_Panel_Report-3-First_Nations_Perspectives.pdf&usg=AOvVaw3Tj_4UM0CjVE5kiY5Gu9yl&opi=89978449

CTV News. List: Canada’s most destructive wildfires. Archived. https://www.ctvnews.ca/list-canada-s-most-destructive-wildfires-1.644736

D’Eon, S. and MacAfee, K. 2016. Knowledge exchange in the Canadian Wood Fibre Centre: National scope with regional delivery. *The Forestry Chronicle* 92(4), 441–446. https://doi.org/10.5558/tfc2016-079

Daigle, B. 2012. One hundred years of federal forestry presence in New Brunswick. *The Forestry Chronicle* 88(3), 233–235. https://doi.org/10.5558/tfc2012-046

Drushka, K. and Burt, B. 2001. The Canadian Forest Service: Catalyst for the forest sector. *Forest History Today* Spring/Fall, 19–28. https://foresthistory.org/wp-content/uploads/2016/12/drushka_canadian-forest-service.pdf

Government of British Columbia. How cultural burning enhances landscapes and lives. https://blog.gov.bc.ca/bcwildfire/how-cultural-burning-enhances-landscapes-and-lives/#:~:text=B.C.%20was%20the%20first%20province,and%20landscape%20we%20see%20today

Government of Canada. 2016. Indigenous Peoples and forestry in Canada. Natural Resources Canada. https://publications.gc.ca/collections/collection_2016/rncan-nrcan/Fo4-58-2016-eng.pdf

Government of Canada. First World War 1914–1918. https://www.veterans.gc.ca/eng/remembrance/history/first-world-war

Government of Canada. WildFireSat: Enhancing Canadas's ability to manage wildfires. https://www.asc-csa.gc.ca/eng/satellites/wildfiresat/

Hirsch, K. G. 1996. Canadian Forest Fire Behaviour Prediction (FBP) system: User's guide (Special Report 7). Edmonton, AB: Northern Forestry Centre, Canadian Forest Service, Natural Resources Canada.

Honer, T.G. and Johnstone, K. 1984. Elihu Stewart and the beginnings of Dominion forestry. *The Forestry Chronicle* 60(4), 225–230. https://pubs.cif-ifc.org/doi/pdf/10.5558/tfc60225-4

Indigenous Foundation. Constitution Act, 1982 Section 35. https://indigenousfoundations.arts.ubc.ca/constitution_act_1982_section_35/

Johnstone, K. 1991. Timber and Trauma: 75 years with the Federal Forestry Service 1899–1974. Ottawa, ON: Minister of Supply and Services Canada. https://cfs.nrcan.gc.ca/pubwarehouse/pdfs/10035.pdf

Keith, C. 1990. Canadian accomplishments in forest products research. *The Forestry Chronicle* 66(2), 148–155. https://doi.org/10.5558/tfc66148-2

MacKay, D. 1982. Empire of wood: The MacMillan bloedel story. University of Washington Press, Vancouver, BC.

McAlpine, R. S., Stocks, B.J., Van Wagner, C. E., et al. 1990. Forest fire behavior research in Canada. *Proceedings of the International Conference on Forest Fire Research*, A02. https://scf.rncan.gc.ca/pubwarehouse/pdfs/19175.pdf

National Centre for Truth and Reconciliation. Reports. http://nctr.ca/reports.php

National Forestry Database. Forest fires, Table 3.2.1, Area burned by cause class. http://nfdp.ccfm.org/en/data/fires.php (accessed March 21, 2024).

Natural Resources Canada. 1999. Canadian Forest Service 1899–1999. Victoria, BC: Information Forestry, Pacific Forestry Centre, Canadian Forest Service. https://publications.gc.ca/collections/collection_2015/rncan-nrcan/Fo12-12-1999-2-eng.pdf

Natural Resources Canada. 2007. The First Nations Forestry Program: An overview. BC: The Bridge Newsletter #16, Pacific Forestry Centre, Canadian Forest Service. https://publications.gc.ca/collections/collection_2007/nrcan-rncan/Fo12-36-16-2007E.pdf

Natural Resources Canada. 2012. White pine blister rust: Knowledge, control and innovation. Québec, QC: Branching Out, Laurentian Forestry Centre. https://publications.gc.ca/site/eng/423099/publication.html?wbdisable=true

Natural Resources Canada. Boreal forest research. https://natural-resources.canada.ca/our-natural-resources/forests/sustainable-forest-management/boreal-forest/boreal-forest-research/17398

Natural Resources Canada. Canadian Wildland Fire Information System. https://cwfis.cfs.nrcan.gc.ca/home

Natural Resources Canada. Canadian Wildland Fire Information System. Background information. https://cwfis.cfs.nrcan.gc.ca/background/summary/fbp

Natural Resources Canada. Carbon Budget Model. https://natural-resources.canada.ca/climate-change/climate-change-impacts-forests/carbon-accounting/carbon-budget-model/13107

Natural Resources Canada. Eat, prey, love – stopping the spruce budworm. https://natural-resources.canada.ca/simply-science/eat-prey-love-stopping-the-spruce-budworm/20681

Natural Resources Canada. Emerald ash borer. https://natural-resources.canada.ca/our-natural-resources/forests/insects-disturbances/top-forest-insects-and-diseases-canada/emerald-ash-borer/13377

Natural Resources Canada. Indigenous Forestry Initiative. https://natural-resources.canada.ca/forest-forestry/forest-programs/indigenous-forestry-initiative

Natural Resources Canada. Mountain pine beetle. https://natural-resources.canada.ca/forest-forestry/insects-disturbances/mountain-pine-beetle

Natural Resources Canada. National Tree Seed Centre. https://natural-resources.canada.ca/science-and-data/research-centres-and-labs/forestry-research-centres/atlantic-forestry-centre/national-tree-seed-centre/13449

Natural Resources Canada. Plant hardiness of Canada. http://planthardiness.gc.ca/

Natural Resources Canada. White pine blister rust. https://tidcf.nrcan.gc.ca/en/diseases/factsheet/24

Natural Resources Canada. Wildfire Resilient Futures Initiative. https://natural-resources.canada.ca/our-natural-resources/forests/wildland-fires-insects-disturbances/wildfire-resilient-futures-initiative/25593

Rajala, R. A. 2005. Feds, forests and fire: A century of Canadian forestry innovation. Ottawa, ON: Canada Science and Technology Museum. https://publications.gc.ca/collections/collection_2018/mstc-cstm/NM97-2-13-eng.pdf

Schroeder, W. R. 2023. Trees against the wind: The birth of the Prairie shelterbelts. Nature Saskatchewan, Regina, SK. https://www.naturesask.ca/store/en/publications/trees-against-the-wind-the-birth-of-prairie-shelterbelts

The Canadian Encyclopedia. Pandemics in Canada. https://www.thecanadianencyclopedia.ca/en/article/pandemic

The Montréal Process. Home. https://montreal-process.org/index.shtml

Thompson, D. G. 2013. TreeAzin – a natural systemic insecticide for use against the emerald ash borer in Canada (Technical Note 113). Sault Ste. Marie, ON: Frontline, forestry research applications, Great Lakes Forestry Centre, Canadian Forest Service, Natural Resources Canada. https://publications.gc.ca/site/eng/9.576880/publication.html

Whitford, H. N. and Craig, R. D. 1918. Forests of British Columbia. Commission of Conservation. Ottawa, ON.

Wikipedia. Canadian Forest Service. https://en.wikipedia.org/wiki/Canadian_Forest_Service

Wikipedia. Enterprise Building 1. https://unbhistory.lib.unb.ca/Enterprise_Building_1

Wikipedia. Geographic information system. https://en.wikipedia.org/wiki/Geographic_information_system

Wikipedia. Matheson fire. https://en.wikipedia.org/wiki/Matheson_Fire

Woods, M., Pitt, D., Penner, M., et al. 2011. Operational implementation of a LiDAR inventory in Boreal Ontario. *The Forestry Chronicle* 87(4), 512–528. https://doi.org/10.5558/tfc2011-050

World Health Organization. WHO COVID-19 dashboard. https://data.who.int/dashboards/covid19/cases

Wyatt, W. 2008. First Nations, forest lands, and "aboriginal forestry" in Canada: from exclusion to comanagement and beyond. Canadian Journal of Forest Research 38(2), 171–180. https://doi.org/10.1139/X07-214

Notes:

Burned area mapping

During the fire season, the area burned is estimated from fire perimeter maps made using a variety of methods, ranging from detailed (airborne infrared) to approximate (satellite hotspots). Using these methods, the total area burned in 2023 was 17.2 million ha. However, many of these perimeters include "islands" of unburned forest, water bodies and barren land. Higher-resolution mapping using Sentinel and Landsat imagery indicates that the total burned area for 2023 was 15.0 million ha. Either way, this area is:

- larger than the island of Newfoundland
- almost twice the size of Lake Superior
- more than 7 times the 20-year average
- double the previous record set in 1989
- more than 4% of Canada's total forest area

Article: How sustainable forestry evolved from the early 1900s until now

Daigle B. 2012. One hundred years of federal forestry presence in New Brunswick. *The Forestry Chronicle* 88(3), 233–235. https://doi.org/10.5558/tfc2012-046

Drushka, K. and Burt, B. 2001. The Canadian Forest Service: Catalyst for the forest sector. *Forest History Today* Spring/Fall, 19–28. https://foresthistory.org/wp-content/uploads/2016/12/drushka_canadian-forest-service.pdf

MacDonald, H., DeBoer, K., and McKenney, D. W. 2023. Collaboration results in higher impact research: Case study of the Canadian Forest Service. *The Forestry Chronicle* 99(1),25–33. https://doi.org/10.5558/tfc2023-005

Natural Resources Canada. Canada's forest laws. https://natural-resources.canada.ca/our-natural-resources/forests/sustainable-forest-management/canadas-forest-laws/17497

The Montréal Process. Criteria and indicators. https://montreal-process.org/The_Montreal_Process/Criteria_and_Indicators/index.shtml

Article: The role of forest products in fighting climate change

Canada Energy Regulator. (2023). Canada's energy future 2023. https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2023/

Food and Agriculture Organization of the United Nations. Climate change mitigation and harvested wood products: Lessons learned from three case studies in Asia and the Pacific. Bangkok, Thailand. https://www.fao.org/3/cb8810en/cb8810en.pdf

United Nations Economic Commission for Europe. Carbon storage in harvested wood products (HWP). https://unece.org/forests/carbon-storage-harvested-wood-products-hwp#:~:text=Harvested%20Wood%20Products%20(HWPs)%20are,like%20products%2C%20or%20for%20energy

Article: How Natural Resources Canada supports sustainable forest management

Adaptive Silviculture for Climate Change. Petawawa Research Forest. https://adaptivesilviculture.org/petawawa-research-forest/

Canadian Conservation and Land Management. Boreal caribou. https://www.cclmportal.ca/portal/boreal-caribou

Environment and Climate Change Canada. Canada's National Adaptation Strategy: Building resilient communities and a strong economy. Gatineau, QC. https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/national-adaptation-strategy/full-strategy.html

Government of Canada. 2 Billion Trees commitment. https://www.canada.ca/en/campaign/2-billion-trees.html

Government of Canada. Budget 2021. https://www.budget.canada.ca/2021/home-accueil-en.html

Government of Canada. Budget 2022. https://www.budget.canada.ca/2022/home-accueil-en.html

Government of Canada. Budget 2023. https://www.budget.canada.ca/2023/home-accueil-en.html

Government of Canada. Budget 2024. https://www.budget.canada.ca/2024/home-accueil-en.html

Government of Canada. Impact Assessment Act (S.C. 2019, c. 28, s. 1). https://laws-lois.justice.gc.ca/eng/acts/i-2.75/

Natural Resources Canada. 2020. Forest pest risk management: National research agenda (2019–2029). Ottawa, ON: Canadian Forest Service. https://ostrnrcan-dostrncan.canada.ca/entities/publication/f9372ee6-02b0-408d-b182-2c211525865a

Natural Resources Canada. Addressing cumulative effects of natural resource development in Canada's forests: National research agenda (2019-2029). Ottawa, ON: Canadian Forest Service. https://ostrnrcan-dostrncan.canada.ca/entities/publication/f0147b74-444b-4a41-ad70-dfd72c2b1dd3

Natural Resources Canada. Canada's forest carbon reporting system. https://natural-resources.canada.ca/climate-change/climate-change-impacts-forests/carbon-accounting/13087

Natural Resources Canada. Enhancing forest climate change mitigation and adaptation in Canada: A collaborative research agenda. Ottawa, ON: Canadian Forest Service. https://publications.gc.ca/collections/collection_2021/rncan-nrcan/Fo4-141-2019-eng.pdf

Natural Resources Canada. Enhancing sustainable forest management practices in Canada: National research agenda (2019–2029). Ottawa, ON: Canadian Forest Service. https://publications.gc.ca/site/archivee-archived.html?url=https://publications.gc.ca/collections/collection_2021/rncan-nrcan/Fo4-142-2019-eng.pdf

Natural Resources Canada. Forest innovation program. https://natural-resources.canada.ca/forest-forestry/forest-programs/forest-innovation-program

Natural Resources Canada. Government of Canada extends funding for spruce budworm research to protect forests in Atlantic Canada. https://www.canada.ca/en/natural-resources-canada/news/2022/12/government-of-canada-extends-funding-for-spruce-budworm-research-to-protect-forests-in-atlantic-canada.html

Natural Resources Canada. Green construction through wood (GCWood) program. https://natural-resources.canada.ca/funding-partnerships/green-construction-through-wood-gcwood-program

Natural Resources Canada. Indigenous forestry initiative. https://natural-resources.canada.ca/forest-forestry/forest-programs/indigenous-forestry-initiative

Natural Resources Canada. Investments in forest industry transformation. https://natural-resources.canada.ca/science-and-data/funding-partnerships/opportunities/forest-sector/investments-forest-industry-transformation/13139

Natural Resources Canada. Overview of cumulative effects research at NRCan 2018–2023. https://maps.canada.ca/stories/storymap-en.html?lang=en&appid=77e97ee6eb944a62811153c47924627c&appidalt=a70494d1d332466f9344b591cc5c6c4f

Natural Resources Canada. Wildfire resilient futures initiative. https://natural-resources.canada.ca/our-natural-resources/forests/wildland-fires-insects-disturbances/wildfire-resilient-futures-initiative/25593