An Overview of Sustainable Forestry in Canada for Architecture and Engineering Students

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Conseil canadien du bois

Canada: A Forest Country

With 362 million hectares of forest, Canada is the third-most forested country in the world.

Canada has **9%** of the world's forests.

About **270 million hectares**, or 78%, of Canada's forests are located in the boreal zone.

Forests cover **38%** of Canada's land area.

Canada's forests are important to Canadians, the economy and the environment.

In 2018, the forest sector directly employed **204,555 people**.

In 2019, Canada's forest sector contributed **$23.7 billion** to Canada's nominal GDP.

According to the last census (2016), over **70%** of Indigenous people in Canada live in or near forests.

Canada's boreal wetlands represent nearly **20%** of the world's wetlands.

Data Source: Natural Resources Canada, 2020. *The State of Canada's Forests: Annual Report 2020, 8*. https://d1ied5g1xfgpx8.cloudfront.net/pdfs/40219.pdf

Please note!

Each PPT slide is accompanied by notes and links.

The Learning Module document (PDF) compiles all notes, and links, and includes a **Glossary of Terms**, sample questions, and CACB learning objectives.

Which Trees are in Canada's Forests?

There are approximately 180 tree species in Canada's forests.

35 tree species today are used for forest products.

- None of which are species at risk.

75% of Canada's forests are in the boreal zone.

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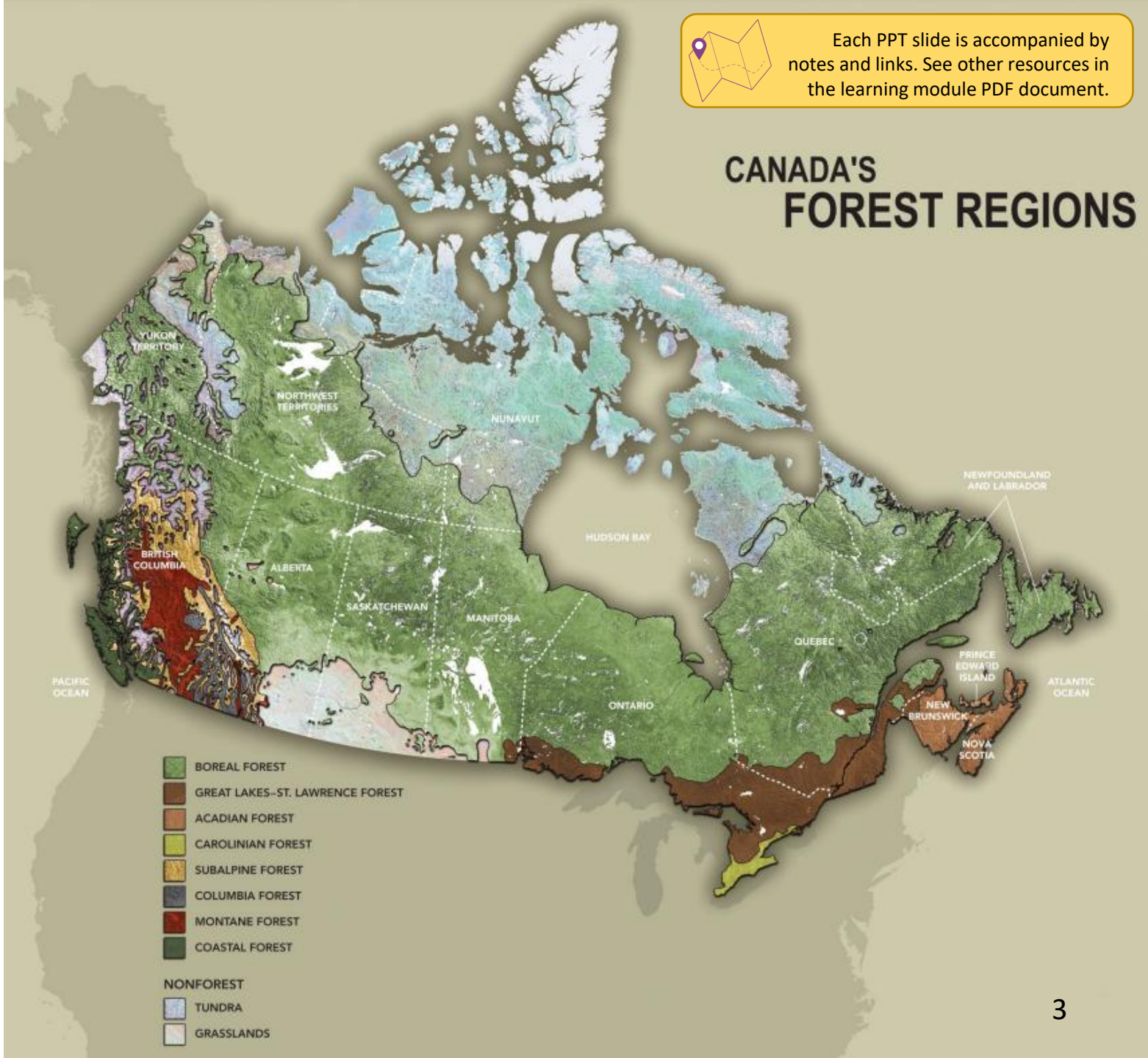

Image Credit: Natural Resources Canada. (2021). *Forest Maps*. Natural Resources Canada. https://www.nrcan.gc.ca/maps-tools-and-publications/maps/forest-maps/16874.

Canada's Forest Products

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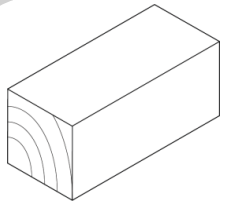
FOR MASS TIMBER

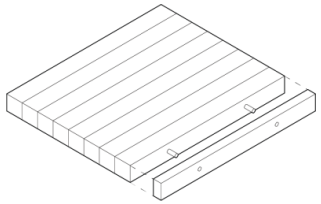


Softwood lumber

#2 GLOBAL PRODUCER (2016) AND #1 EXPORTER (2017)

Conifer timber sawed into dimensional lumber and other products

Biggest market is US housing construction



Structural wood panels

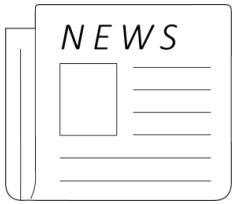
#3 GLOBAL PRODUCER (2016) AND #2 EXPORTER (2017)

For walls, floors, roofs, and furniture

Wood pulp

#3 GLOBAL PRODUCER (2016) AND #2 EXPORTER (2017)

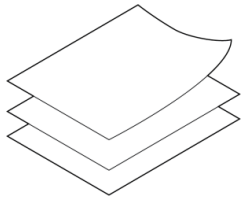
For paper products, food additives, and many other products



Newsprint

#1 GLOBAL PRODUCER (2016) AND EXPORTER (2017)

For newspapers and magazines



Printing and writing paper

#8 GLOBAL PRODUCER (2016) AND EXPORTER (2017)

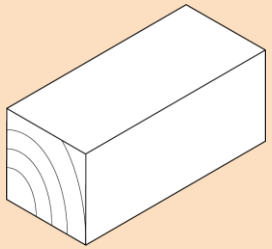
For higher quality, heavier paper for printers, envelopes, and forms

Image Credit: Sanjana Patel
Data Source: Natural Resources Canada, 2021. *The State of Canada's Forests: Annual Report 2021*, 52.
https://www.nrcan.gc.ca/sites/nrcan/files/forest/sof2021/6317_NRCan_SoF_AR_2021_EN_P7B_web_accessible.pdf

Canada's Forest Products

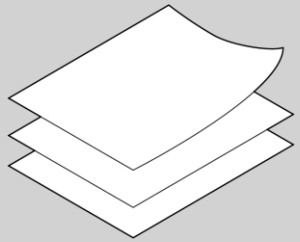
Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

Exports of Canadian forest products, 2020

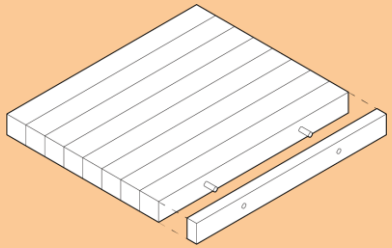


30%
Softwood lumber
$10 billion

4%
Newsprint
$1.3 billion



6%
Printing and writing paper
$2 billion



9%
Structural wood panels
$2.9 billion

20%
Wood pulp
$6.7 billion

31%
Other forest products
$10.4 billion

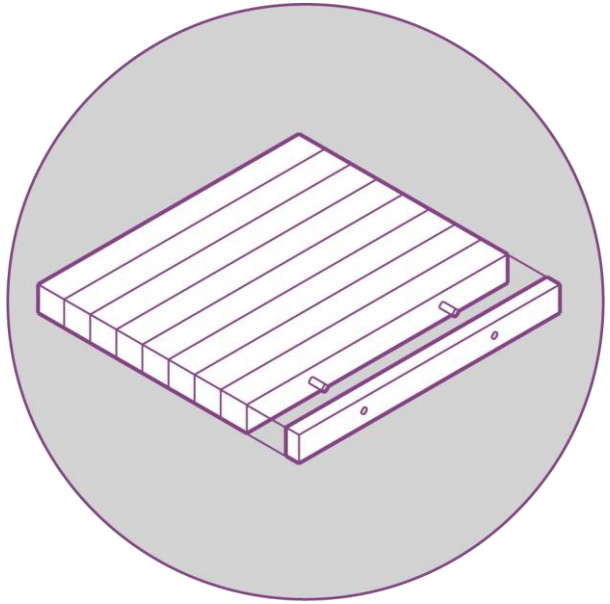
Image Credit: Sanjana Patel
Data Source: Natural Resources Canada, 2021. *The State of Canada's Forests: Annual Report 2021*, 53.
https://www.nrcan.gc.ca/sites/nrcan/files/forest/sof2021/6317_NRCan_SoF_AR_2021_EN_P7B_web_accessible.pdf

Canada's Forest Sector is Important for the Economy

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

184,510 people (2020) are employed by the forest sector in Canada.
This includes 12,000 Indigenous people (6.5% of Canada's forestry workforce).

In 2018, the forest sector generated *$1.9 billion in revenue* for provincial and territorial governments.
In 2020, the forest sector contributed *$25.2 billion (1.2%) to Canada's nominal GDP.*

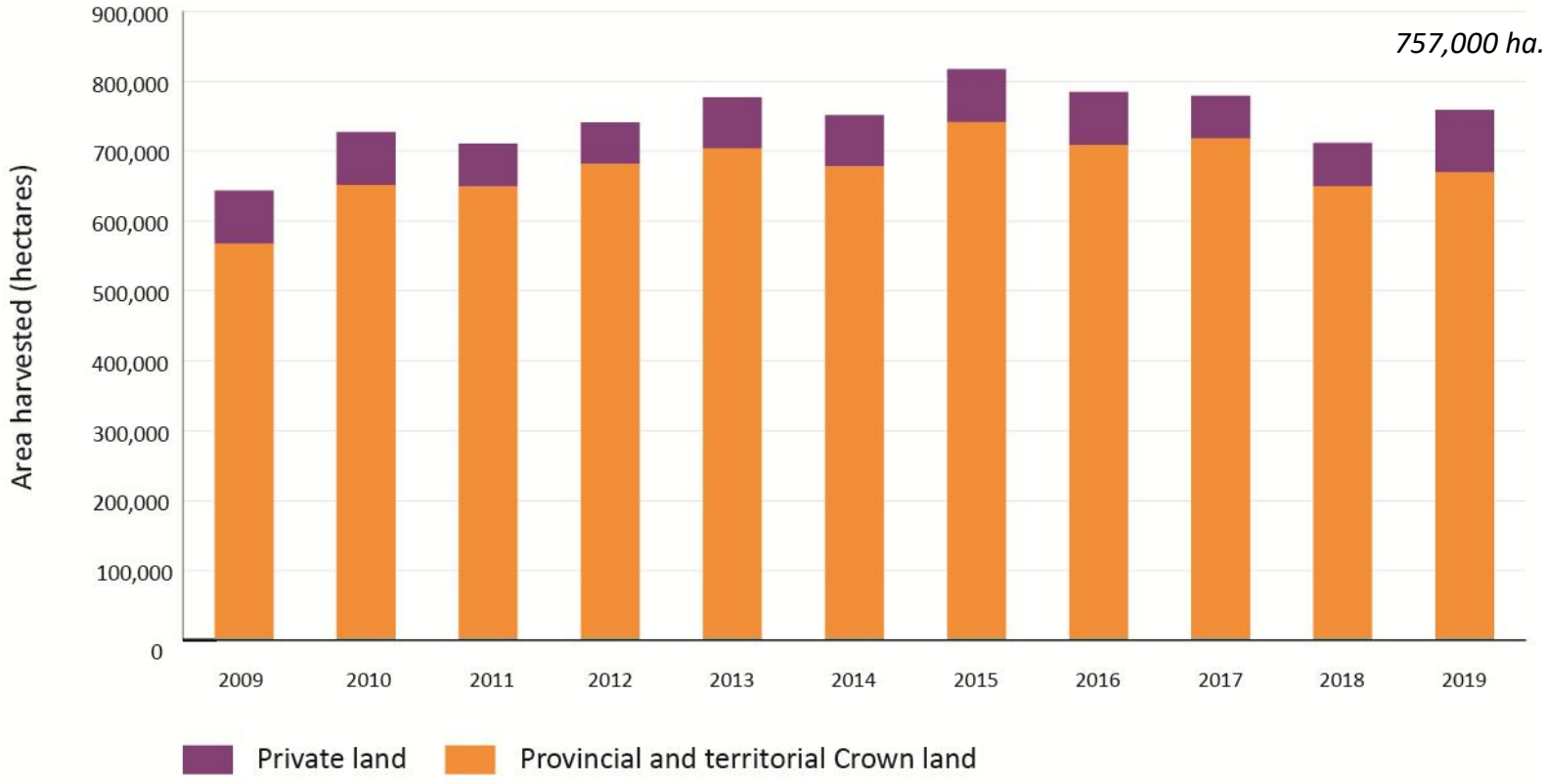


In 2019, Canada's *forest product exports were valued at $33 billion* ($4^{th}$ largest in the world behind China, the US, and Germany).

Image Credit: Sanjana Patel
Data Source: Natural Resources Canada, 2021. *The State of Canada's Forests: Annual Report 2021*, 51.
https://www.nrcan.gc.ca/sites/nrcan/files/forest/sof2021/6317_NRCan_SoF_AR_2021_EN_P7B_web_accessible.pdf

Forest Harvesting

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.



In 2019, approximately *757,000 hectares* of forest were harvested - this is *less than 0.5%* of Canada's forests annually.

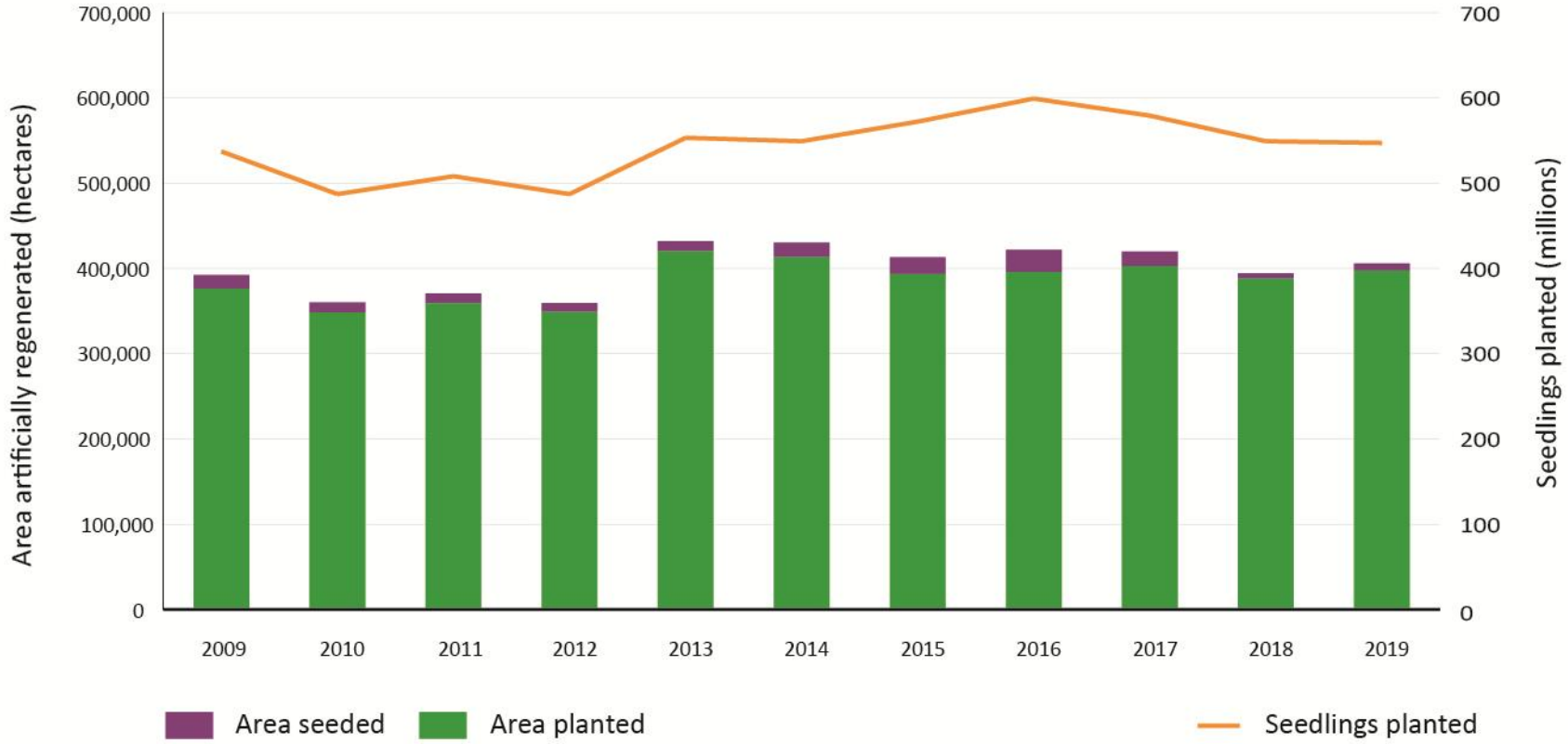
Harvesting of crown forests is regulated to ensure a sustainable supply of timber.

Data Source: Natural Resources Canada, 2021. *The State of Canada's Forests: Annual Report 2021*, 24.
https://www.nrcan.gc.ca/sites/nrcan/files/forest/sof2021/6317_NRCan_SoF_AR_2021_EN_P7B_web_accessible.pdf

No Forest Harvesting is Allowed Without Regeneration

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

Regeneration



In 2019, more than:

547 million seedlings were planted on 375,000 hectares of forest land in Canada

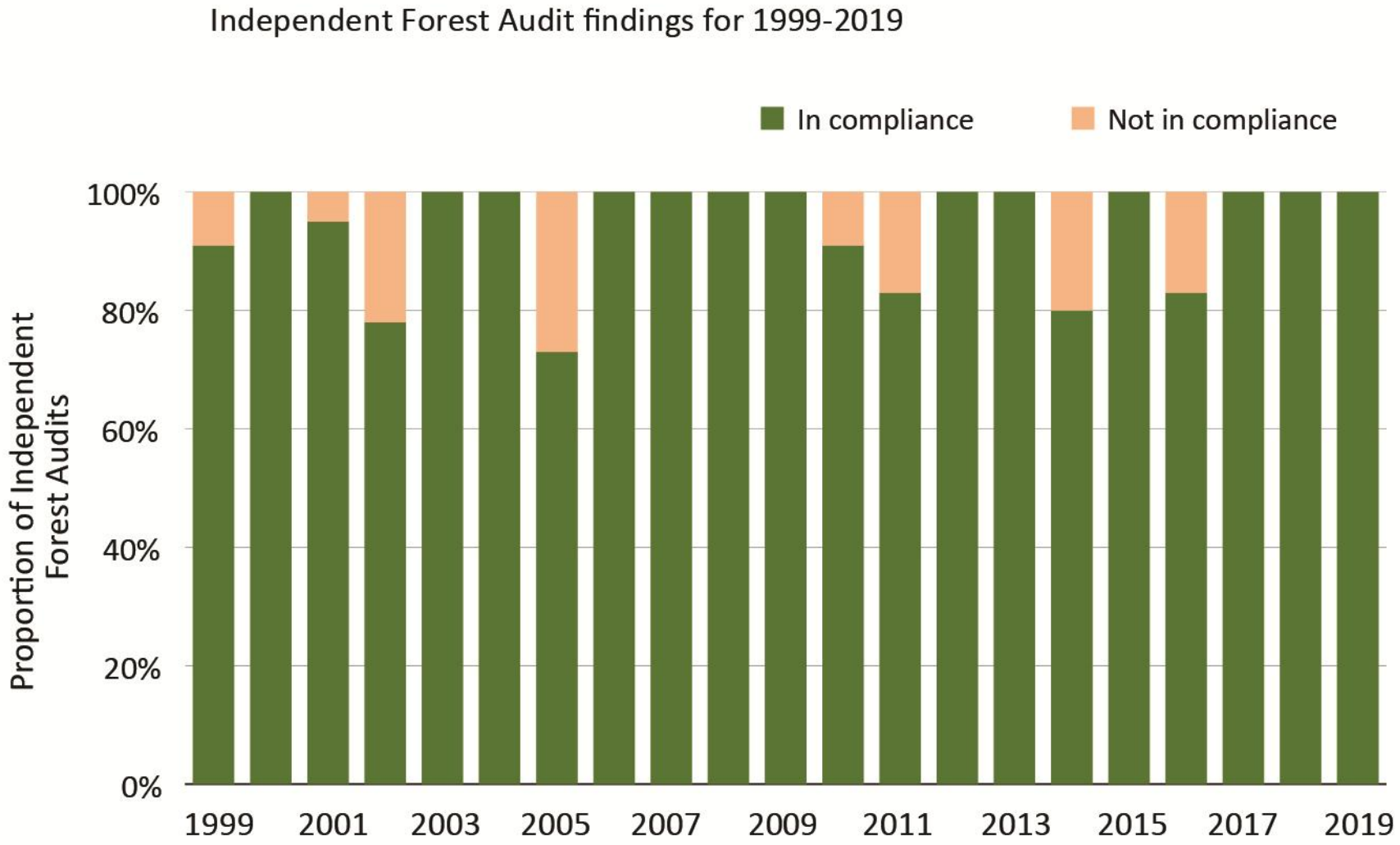
8,600 hectares of forest were established by seeding

Data Source: Natural Resources Canada, 2021. *The State of Canada's Forests: Annual Report 2021, 25*. https://www.nrcan.gc.ca/sites/nrcan/files/forest/sof2021/6317_NRCan_SoF_AR_2021_EN_P7B_web_accessible.pdf

Is Forest Regeneration Successful?

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

- For example, Independent Forest Audits occur every 10-12 years in Ontario.
    - They assess sustainable forest management, which includes forest regeneration.
- From 1999 to 2013, the average compliance rate was 94%.
- It can take 15 or more years for harvested areas to be successfully regenerating, i.e. “established” in Ontario’s definition (see Glossary).



Data Source: Ministry of Northern Development, Mines, Natural Resources and Forestry. (2022). *Independent forest audits*. Government of Ontario. https://www.ontario.ca/page/independent-forest-audits.

Ownership of Canada's Forests

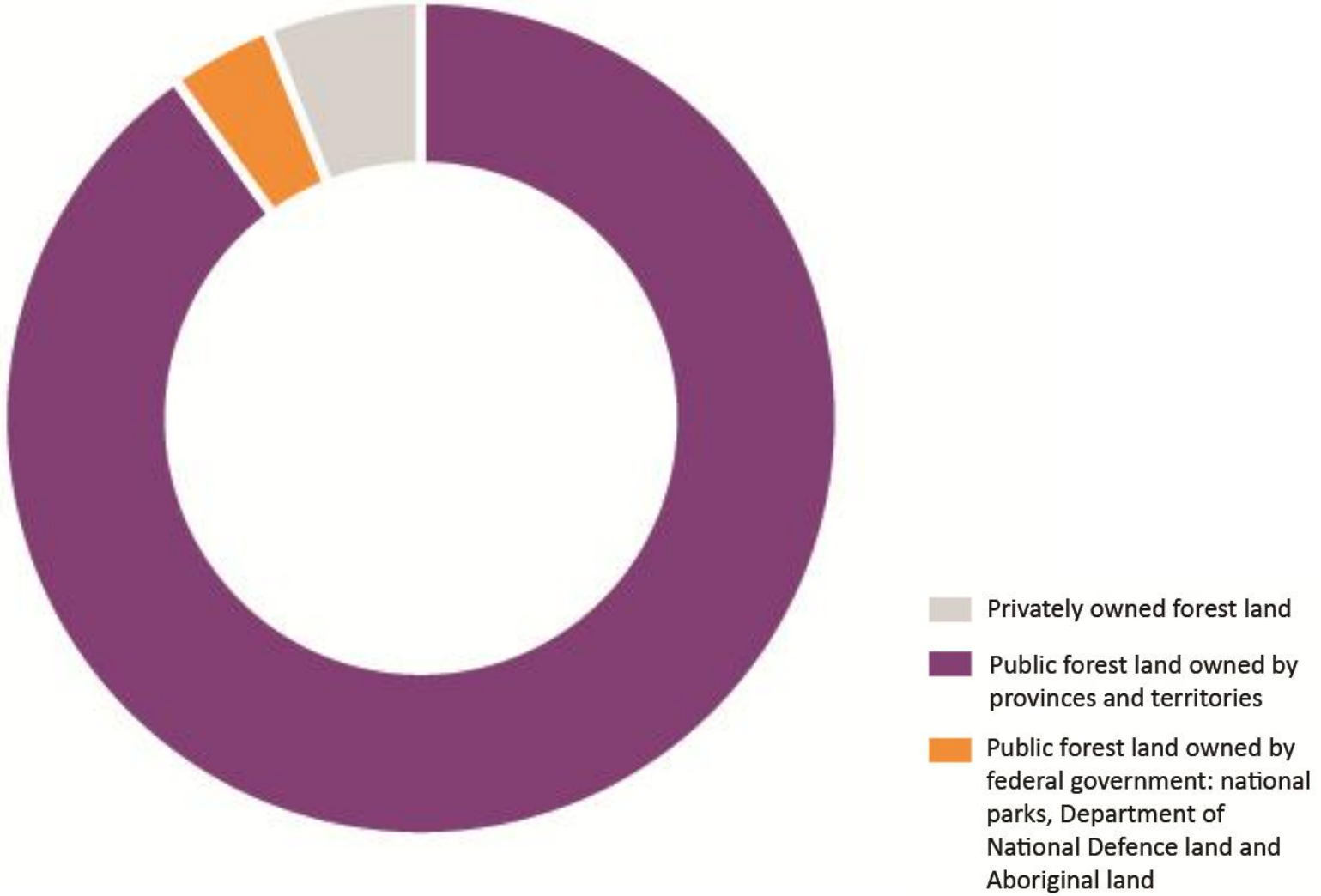
Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

90% of Canada's forests are publicly owned (Crown Lands) and managed for the public by provincial and territorial governments.

4% of Canada's forests are publicly owned and managed for the public by the federal government.

6% of Canada's forests are privately owned.

- Most harvesting in public forests in Canada is done by private forestry companies.
- These companies have an agreement with the provincial or territorial government to supply timber and must comply with laws and regulations.



Data Source: Natural Resources Canada. (2020). *Forest land ownership*. Natural Resources Canada. https://www.nrcan.gc.ca/our-natural-resources/forests/sustainable-forest-management/forest-land-ownership/17495

Provincial Forest Laws

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

Provinces and territories were given the power to manage their own forests (90% of Canada's forests) in the *Constitution Act, 1867* (also known as the *British North America Act*) and this was reaffirmed in Section 92A in the 1982 amendments to the *Constitution Act.*

Provinces and territories develop and enforce laws, regulations, and policies related to forests, ensuring that:

- Indigenous interests are considered
- Wildlife habitat is protected
- Timber harvesting is regulated
- Forest regeneration occurs
- Canada has many laws and regulations ensuring that forestry operations only occur in approved areas where there has been adequate and long-term planning.

Amendments to the Constitution Act were made in 1982 and reaffirmed the power of provinces and territories to manage their own forests.

Image Credit: https://www.justice.gc.ca/eng/csj-sjc/rfc-dlc/ccrf-ccdl/learn-apprend.html

Federal Forest Laws

- The federal government's power to manage their forest lands (only 4% of Canada's forests) was reaffirmed in Section 91 in the 1982 amendments to the *Constitution Act.*
- HOWEVER, the federal government has a major influence over Canadian forests because of responsibilities for Indigenous peoples and global agreements.
- Federal laws that apply to these forests include the Indian Act, First Nations Land Management Act, National Parks Act, Species at Risk Act, Migratory Birds Convention Act, Plant Protection Act, and Fisheries Act.
- International agreements that Canada is a signatory to include the Convention on Biological Diversity and the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Image (Above) Credit: https://nationtalk.ca/story/nafa-encourages-canadian-leadership-on-indigenous-rights-in-the-forest-and-welcomes-ainu-representation-to-the-permanent-indigenous-peoples-committee-of-fsc

Image (Below) Credit: https://cites.org/eng/news/pr/CITES_Animals_and_Plants_Committee_Meetings_attract_record_turnout_of_the_worlds_scientific_experts_18072017

Canada is a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Old-Growth Forests

- Society's views on forests were influenced by environmental ideas and philosophies for decades.
- Old-growth forests are a focus of forest management involving:
  - Aesthetics
  - Cultural importance
  - Biodiversity
- This has led to political and social tension among the government, industry, Northern and Indigenous communities, and environmental groups.

Fairy Creek Protests, 2021.

Many people and communities find inherent value in old-growth forests.

Image (Left) Credit: Jesse Winter. (May 25, 2021). [Protesters march near the fairy creek watershed after RCMP left] [Photograph]. The Globe and Mail. https://www.theglobeandmail.com/canada/british-columbia/article-loggers-protestors-remain-in-fairy-creek-as-rcmp-depart/

Image (Right) : Sooke News Mirror (https://www.sookenewsmirror.com/news/conservation-groups-discover-ancient-old-growth-forest-near-port-renfrew/)

Protecting Biodiversity

- Global biodiversity needs protection on two main fronts:
  - 1. Maximizing the number of species is important as biodiversity loss leads to unforeseen consequences (Cardinale et al., 2012).
  - 2. Protecting plant and forest biodiversity contributes to climate crisis solutions (Langford et al., 2022).
- Forest fragmentation refers to a loss of forest and the division of the remaining forest into smaller blocks (Riitters, 2007).
- The government of Canada is currently working towards habitat restoration for woodland caribou (Natural Resources Canada 2021).
- Canada is a signatory to the High Ambition Coalition for Nature and People, which is committed to a global goal of protecting at least 30% of the world's lands and oceans by 2030

One focus in Canadian biodiversity protection is the conservation of woodland caribou and habitat.

Image Credit: Wikimedia Commons.

Cardinale, B. J., Duffy, J. E., Gonzalez, A., Hooper, D. U., Perrings, C., Venail, P., Narwani, A., MacE, G. M., Tilman, D., Wardle, D. A., Kinzig, A. P., Daily, G. C., Loreau, M., Grace, J. B., Larigauderie, A., Srivastava, D. S., & Naeem, S. (2012). Biodiversity loss and its impact on humanity. In *Nature* (Vol. 486, Issue 7401, pp. 59–67). Nature Publishing Group. https://doi.org/10.1038/nature11148

Langsdorf, S., Löschke, S., Möller, V., & Okem, A. (2022). *Climate Change 2022 Impacts, Adaptation and Vulnerability Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. www.ipcc.ch

Natural Resources Canada. (2021). *Woodland caribou – boreal population*. Government of Canada. https://www.Natural Resources Canada.gc.ca/our-natural-resources/forests/sustainable-forest-management/conservation-and-protection-canadas-forests/woodland-caribou-boreal-population/13201

Riitters, Kurt H. 2007. Forest Fragmentation. Pages 9-15 In: Forest health monitoring: 2005 national technical report. General Technical Report SRS-104. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

Forest Management Planning is Required by Law in Canada

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

- One of the main tools used to ensure forest sustainability in Canada
- There is long-term monitoring of forestry practices to ensure plan adherence
- Forest science is the foundation of forest management planning

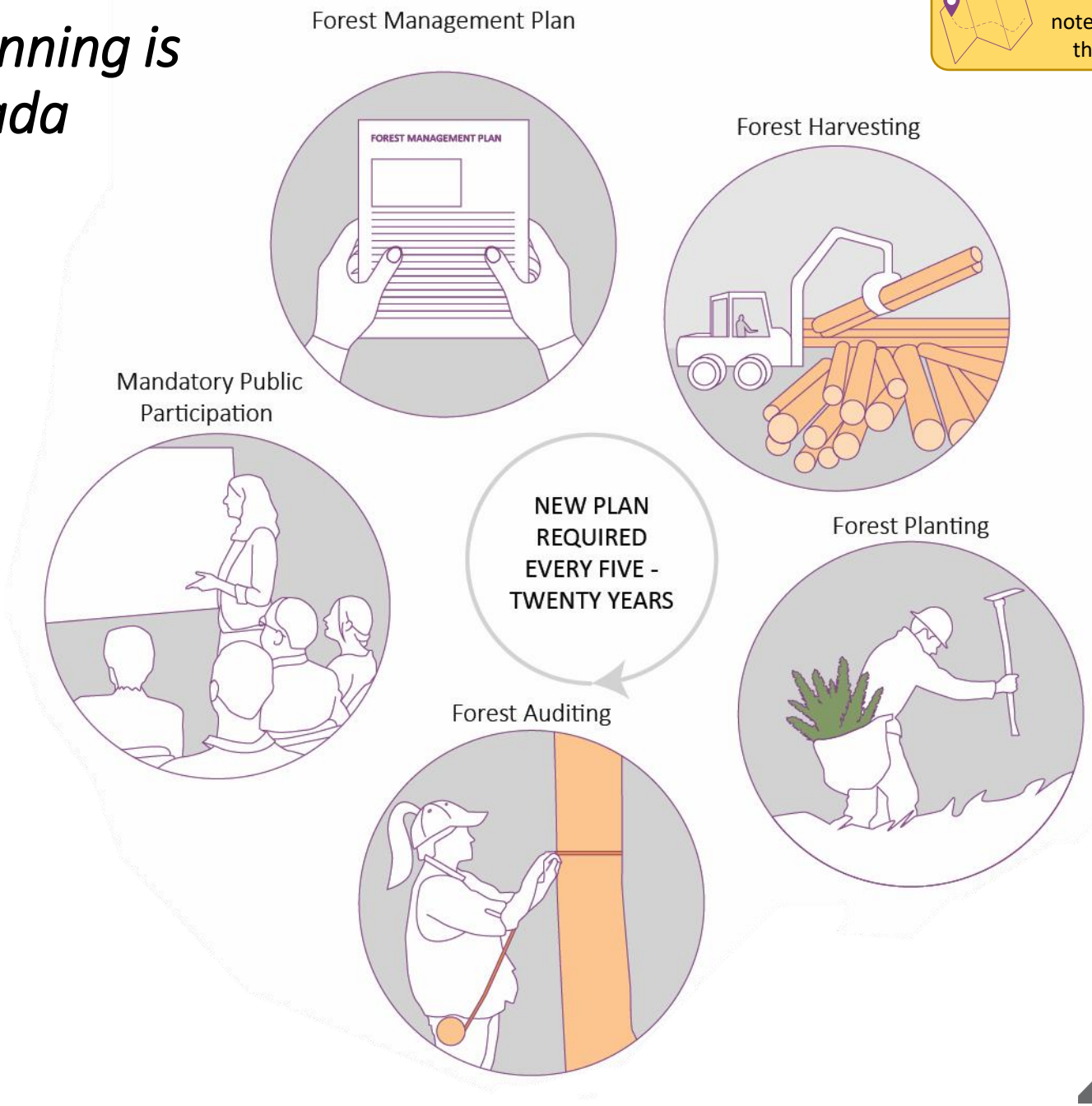


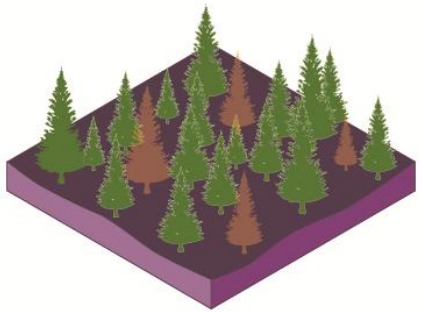
Image Credit: Sanjana Patel

Silvicultural Systems

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

- Silviculture (from the Latin *silvi*, which means 'forest') is the art and science of growing trees.
- The silvicultural systems typically used in Canada are:
  - Single tree selection
  - Group selection
  - Shelterwood
  - Clear-cut (most controversial)
- Silvicultural system selection depends on the condition of the forest stand such as the species' shade tolerance and moisture needs.

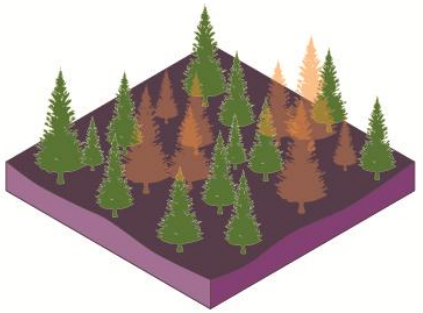
Single Tree Selection



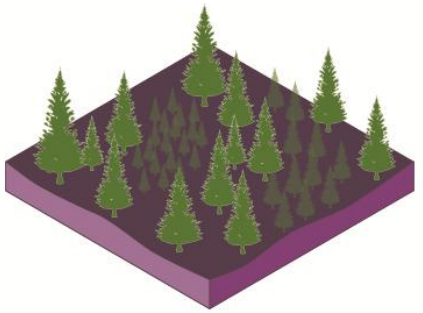
Harvest Pattern

Regeneration

Group Selection

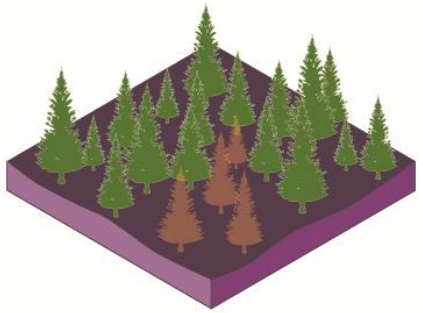


Harvest Pattern

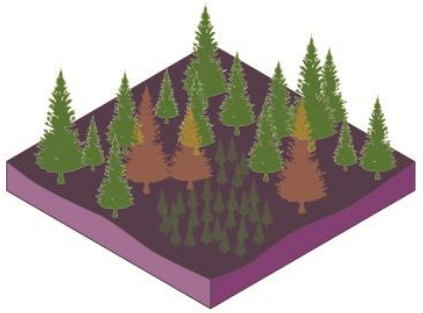


Regeneration

Shelterwood

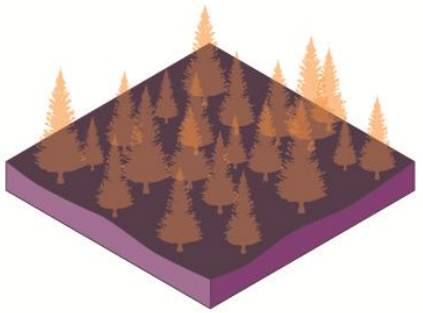


Harvest Pattern

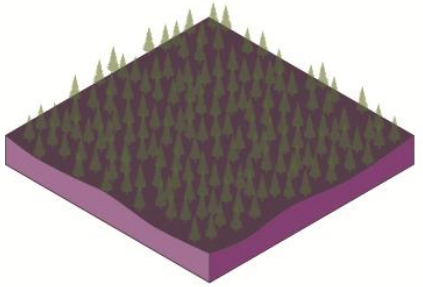


Regeneration

Clear Cut



Harvest Pattern



Regeneration

Image Credit: Sanjana Patel

Causes of Deforestation

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

Estimated area (hectares) of annual deforestation in Canada, by industrial sector, 1990–2019

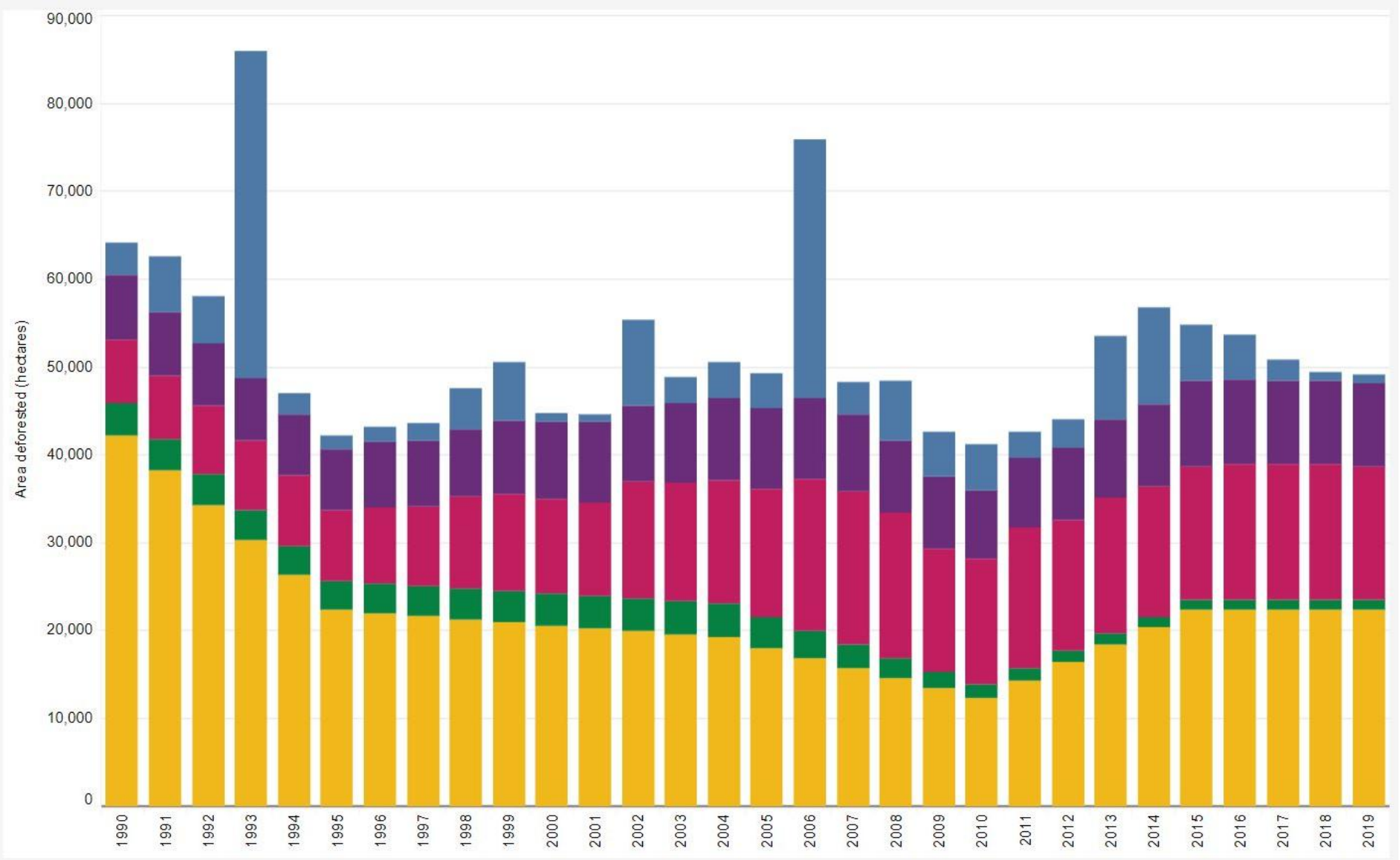


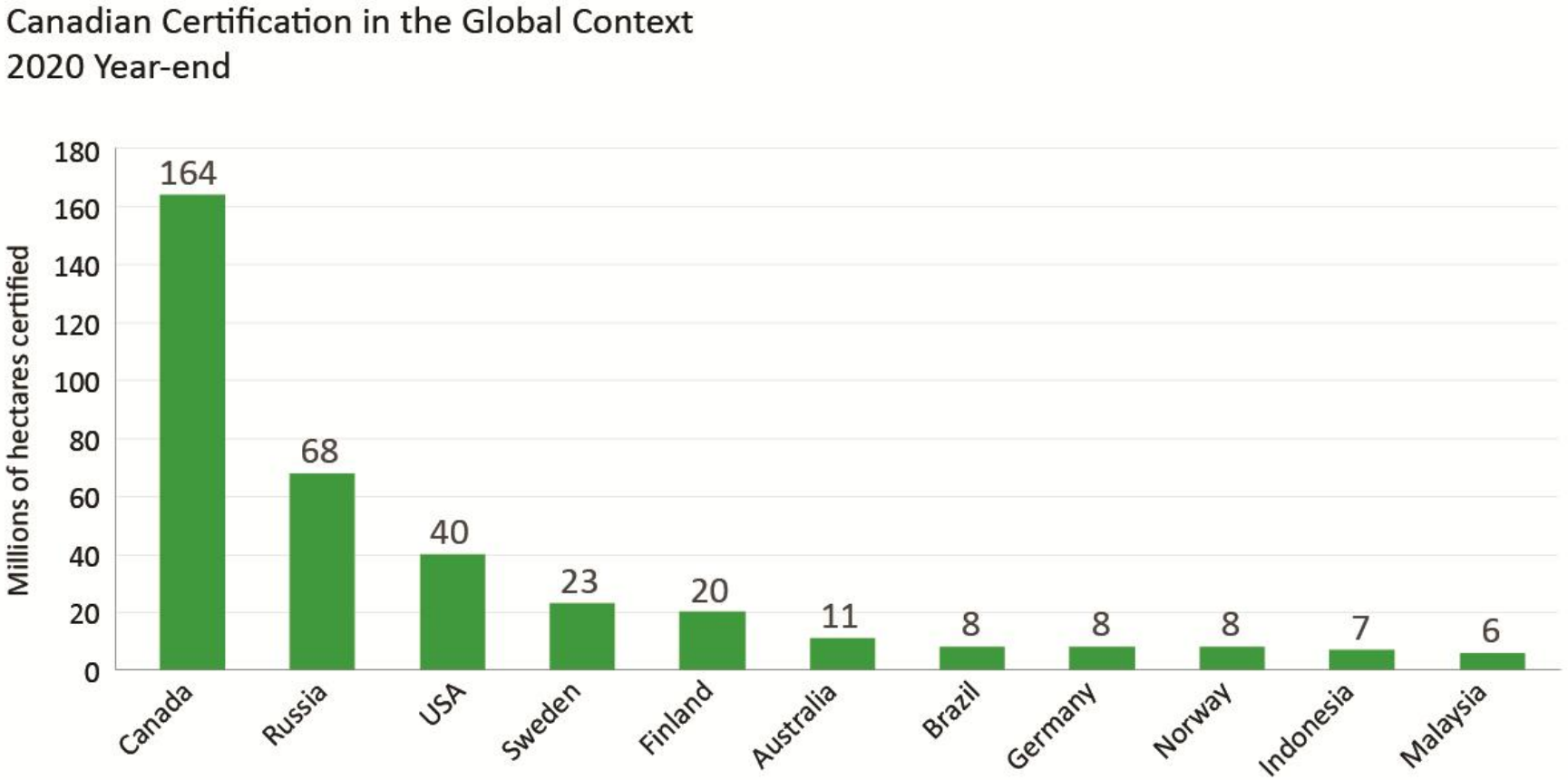
Image Credit:

Natural Resources Canada. (2022, March 25). *How much forest does Canada have?* State of Canada's Forests Report. https://www.nrcan.gc.ca/our-natural-resources/forests/state-canadas-forests-report/how-much-forest-does-canada-have/17601

What is Forest Certification?

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

- Forest management certification (which is done by third-party independent auditors) is the public's source of info to assess the sustainability of forestry operations.
- In 2020, more than *75% of Canada's managed forests* were certified.
- Some environmental advocates call for improvements to forest certification (Greenpeace International, 2021).



Greenpeace International. (2021). Destruction: Certified. Greenpeace. https://www.greenpeace.org/static/planet4-international-stateless/2021/04/b1e486be-greenpeace-international-report-destruction-certified_finaloptimised.pdf

Image Credit: Forest Products Association of Canada. (2019). *Canadian Certification in the Global Context*. https://certificationcanada.org/wp-content/uploads/2020/02/CertificationGlobalContext2019.pdf

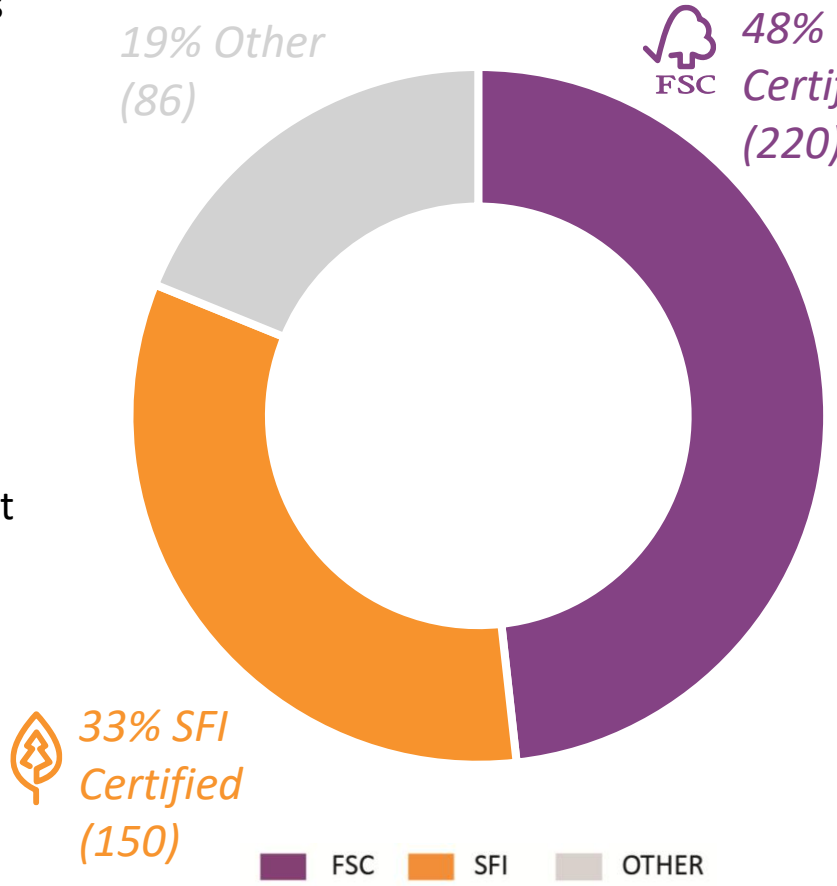
Canada's Certification Systems

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

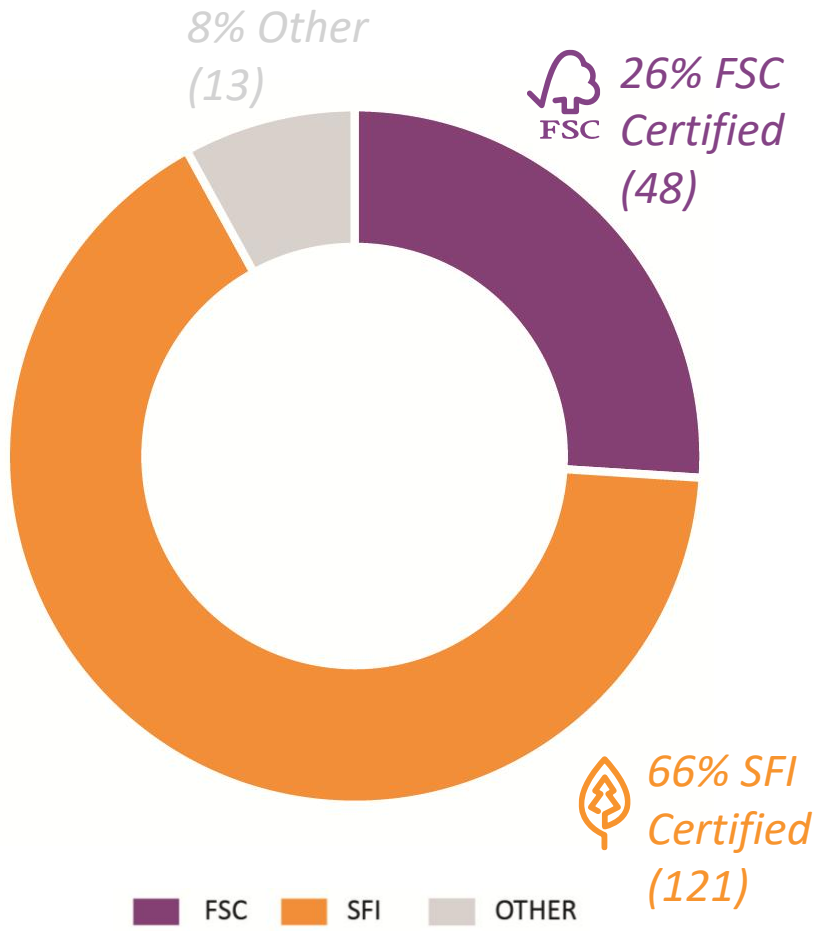
The 2 largest forest certification systems in Canada are:

- **Forest Stewardship Council (FSC)**
  - Supported by environmental organizations
- **Sustainable Forestry Initiative (SFI)**
  - Developed by the forest industry

The Woodworkers Alliance for Rainforest Protection developed the idea of forest certification in the early 1990s.



Global Forest Certification (millions of ha)



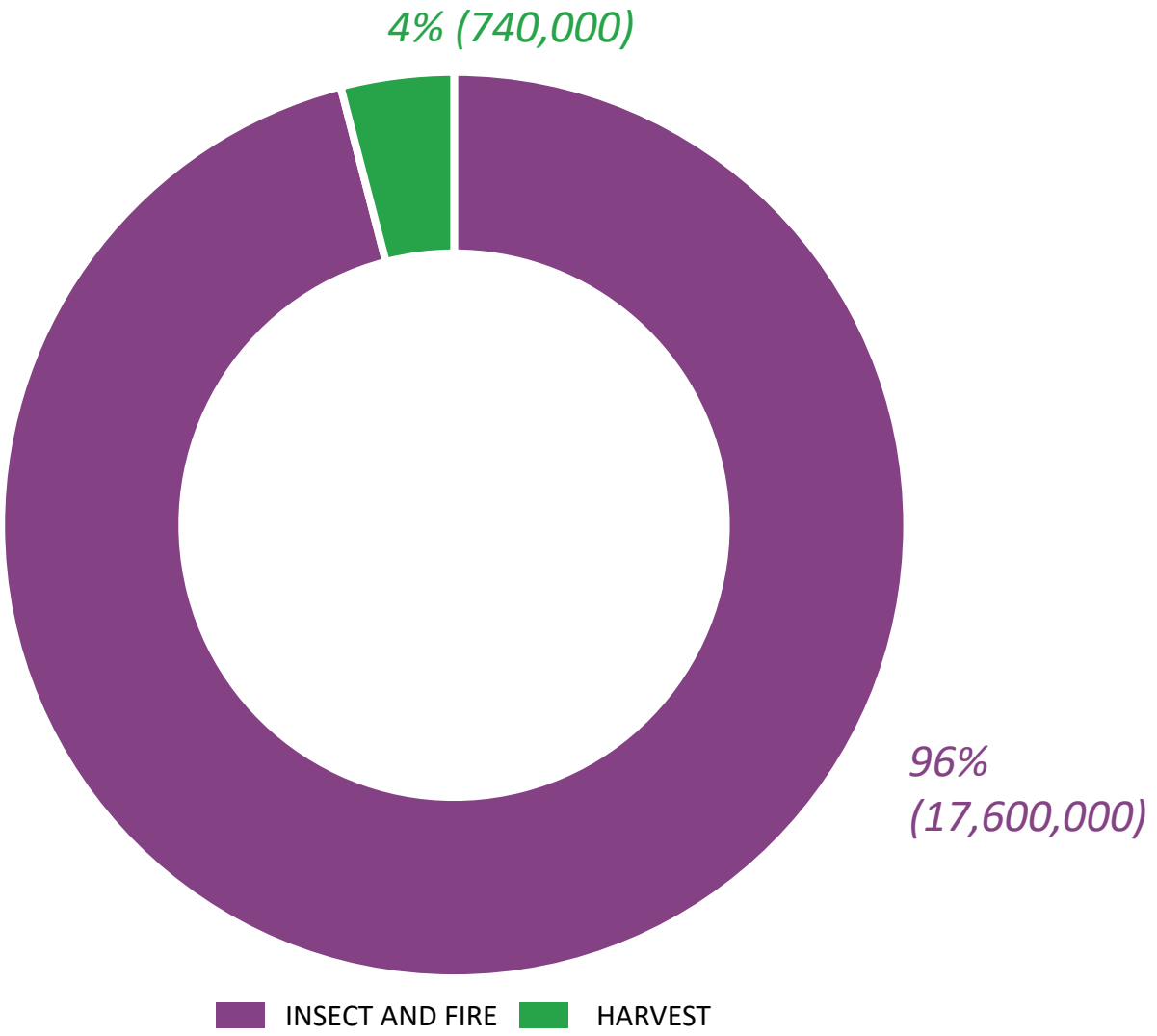
Canadian Forest Certification (millions of ha)

Data Source: Certification Canada, 2021. 2020 Year-end Statistics. https://certificationcanada.org/en/statistics/canadian-statistics/

Natural Disturbance is in the Life Cycle of Forests

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

- Disturbances, such as forest fires, insect outbreaks, and diseases have regenerated forests for thousands of years.
- Sustainable forest management practices attempt to mimic natural disturbances (clearcuts in the disturbance-driven boreal forest).
- Fire, insect outbreaks, and other natural disturbances have a much larger impact on forests than harvesting does.



Disturbance due to Harvest vs. Insect and Fire (ha), Average from 2009-2019.

Data Source: Natural Resources Canada, 2021. *The State of Canada's Forests: Annual Report 2021*, 33.
https://www.nrcan.gc.ca/sites/nrcan/files/forest/sof2021/6317_NRCan_SoF_AR_2021_EN_P7B_web_accessible.pdf

The Climate Crisis is Increasing the Frequency and Intensity of Natural Disturbance

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

- Fires, insect outbreaks, and diseases are becoming more frequent and severe due to climate change.
- This puts communities and forests at risk and releases large amounts of CO_2 into the atmosphere.
- Forest management practices to help forests adapt to climate change are being explored.

Forest fires are becoming more frequent and severe, putting communities and forests at risk.

Image Credit: Williams, S. B. T. (2018). *Wildfire Destruction — A Random Forest Classification of Forest Fires | by Sky B.T. Williams | Towards Data Science*. Towards Data Science. https://towardsdatascience.com/wildfire-destruction-a-random-forest-classification-of-forest-fires-e08070230276

Forests Capture and Store Carbon

Forests are essential to absorbing carbon dioxide from the atmosphere.
They have absorbed 25% of carbon emitted by human activities in the last 40 years

Forests were carbon sinks, but are now turning to carbon sources.

Canada monitors greenhouse gas (GHG) emissions under the United Nations Framework Convention on Climate Change.

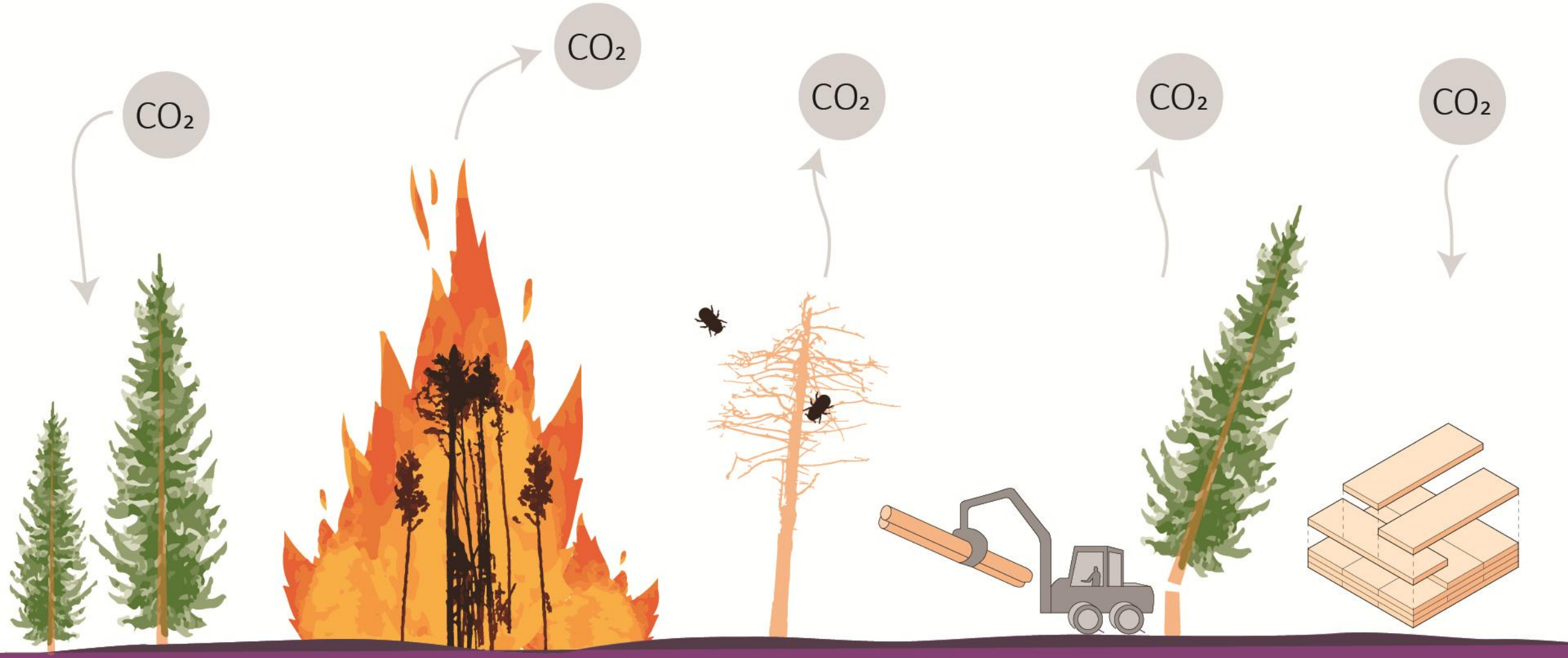
Peat in the boreal forests of Canada stores large amounts of carbon.

Image Credit: Sanjana Patel

Factors Impacting Forest Carbon Storage

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

Image Credit: Sanjana Patel



Indigenous Participation in Forestry

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

- Important Indigenous traditional knowledge and experience can improve Canadian forest management.
- More than 70% of Indigenous peoples live near forest lands.
- Forests are associated with their Aboriginal and Treaty rights.
- Collaboration is growing with Indigenous communities:
  - Sustainable Forestry Initiative (SFI)
  - Natural Resources Canada (NRCan)
  - Canadian Council of Forest Ministers (CCFM)
  - Ontario Professional Forestry Association (OPFA)
- Forestry is one of the largest Indigenous employers in Canada (FPAC).

Graduate university student from Quebec and member of the Conseil des Atikamekw learning about light footprint forestry from Pikangikum Elders.

Forest Ecosystem Management Technicians graduation from Confederation College (convocation held in Pikangikum).

Image Credits: Whitefeather Forest Community Resource Management Authority

Indigenous Communities and Forests

- Canadian courts have established the rights of Indigenous communities to be consulted for forest management activities.
- The National Aboriginal Forestry Association (NAFA) is involved in successes and challenges in Indigenous forestry.
- There are Indigenous criticisms about their access to practicing forestry according to their cultural beliefs.
- A few notable Indigenous communities involved in forestry:
  - Whitefeather Forest Initiative from Pikangikum First Nation
  - Wabaseemoong Independent Nations

Images from the Long-Term Management Direction Open House at Pikangikum for the 2012-22 Forest Management Plan.

Image Credits: Whitefeather Forest Community Resource Management Authority

New Directions for Sustainable Forest Products

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

Benefits of Building with Wood

- Renewable and abundant
- Low embodied carbon and energy
- Visually appealing and enhanced wellbeing
- Strong, durable, and resilient
- Faster to build and often cost-effective
- Biodegradable and recyclable

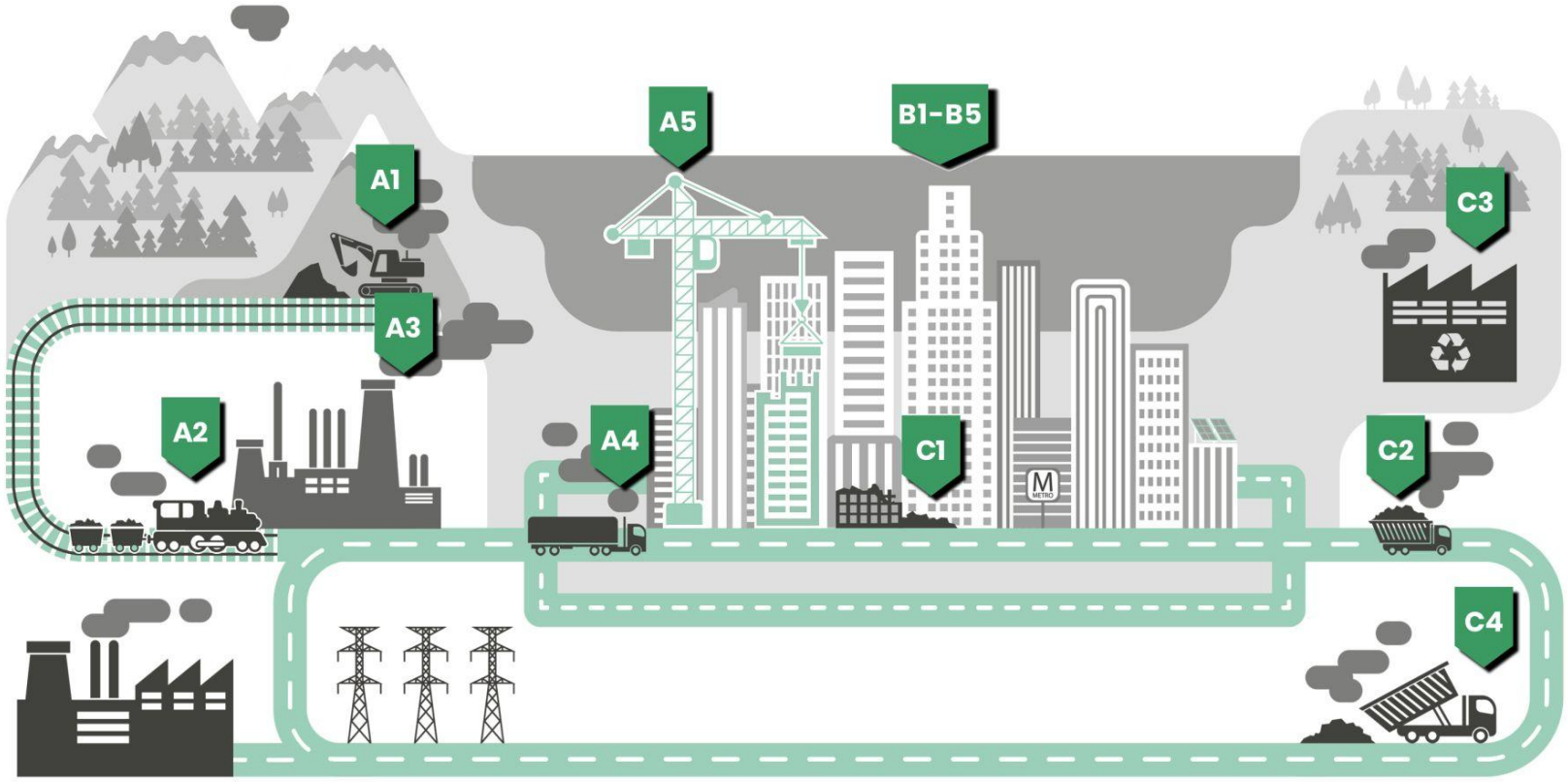
Construction workers in the process of building a traditional wood framed house

Image Credit: Cavins, S. (2021). *Do Lower Lumber Prices Mean Lower Home Prices? - Merit Real Estate*. Merti Real Estate, Inc. https://meritrealestate.com/lumber-prices/

Life-Cycle Assessment (LCA) Comparing Wood, Concrete, and Steel

- There is sometimes controversy when comparing the environmental impact of certain materials.
- LCA is used to compare the embodied carbon of different processes and materials.
- In LCA studies, wood as a building material produces less carbon compared to concrete and steel.
- Scientists and practitioners continue to investigate biogenic features or characteristics.
- There is still a need for standardized LCA methodology.

Sources of embodied carbon across the construction lifecycle



A1 - A3 Product stage

A1 Raw material extraction
A2 Transport to manufacturing site
A3 Manufacturing

A4 - A5 Construction stage

A4 Transport to construction site
A5 Installation / Assembly

B1-B5 Use stage

B1 Use
B2 Maintenance
B3 Repair
B4 Replacement
B5 Refurbishment

C1 - C4 End of life stage

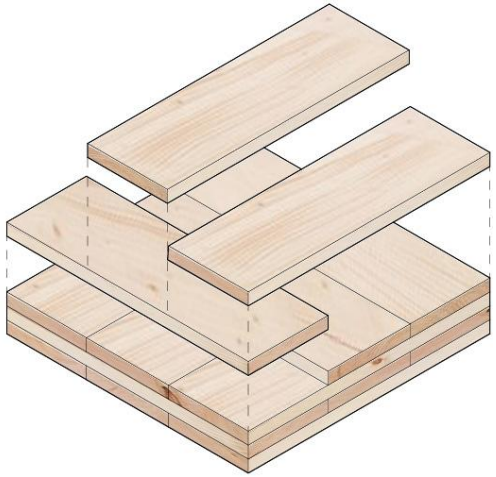
C1 Deconstruction & demolition
C2 Transport
C3 Waste processing
C4 Disposal

Image Credit: World Business Council for Sustainable Development. (2021). *Decarbonizing construction Guidance for investors and developers to reduce embodied carbon*

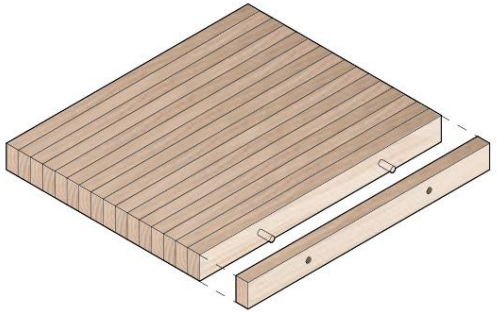
Potential for Mass Timber

Each PPT slide is accompanied by notes and links. See other resources in the learning module PDF document.

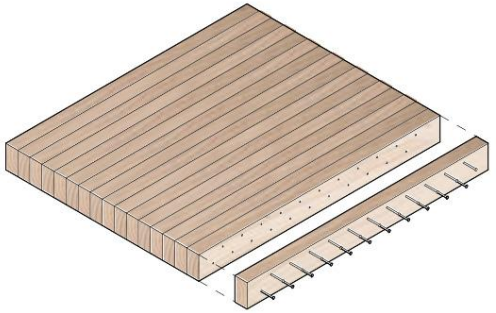
- Mass timber is an engineered wood structural building material used for large-scale infrastructure (mid-rise to tall buildings and bridges).
- Mass timber is a renewable building material with numerous environmental, social, and economic benefits.
- Canada could become a global leader in mass timber given its supply of wood from sustainably managed forests.



Cross Laminated Timber

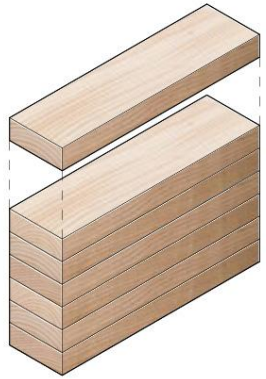


Dowel Laminated Timber

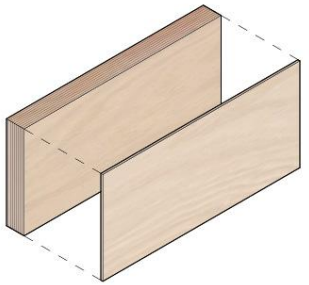


Nail Laminated Timber

Mass Plywood Panel



Glue Laminated Timber



Laminated Veneer Lumber

Image Credit: Sanjana Patel

Contact for More Information and Updates

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Mass Timber Institute:
www.academic.daniels.utoronto.ca/masstimberinstitute

CWC:
www.cwc.ca

Daniels Faculty architecture students learn about sustainable forest management while visiting the Hendrie Tract in Anten Mills as part of Ha/f Studio.

Daniels Faculty architecture students visiting Timmerman Timberworks sawmill in New Lowell, ON as part of Ha/f Studio, led by professor Kelly Doran.

Image Credits: Daniels Ha/f Studio