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LAND-BASED GREENHOUSE GAS EMISSIONS AND REMOVALS

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

LAND-BASED GREENHOUSE GAS EMISSIONS AND REMOVALS

November 2024

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Land-based greenhouse gas emissions and removals

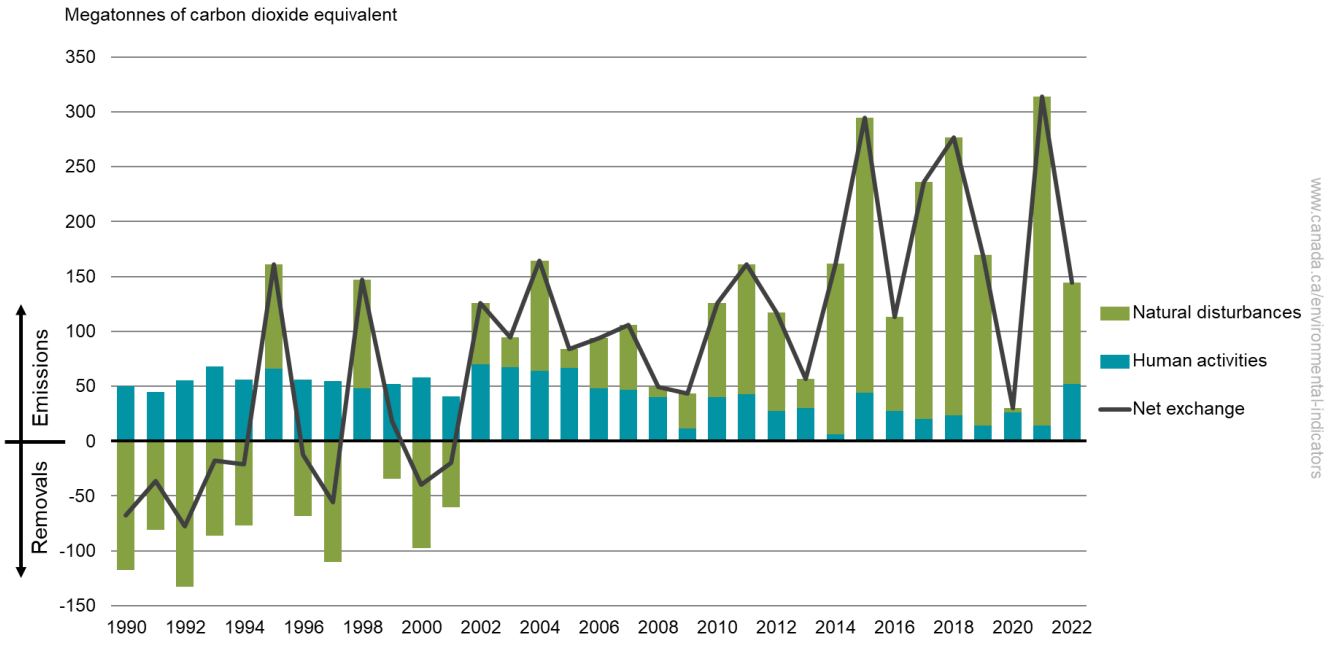
Greenhouse gas (GHG) emissions are the major drivers of climate change. Land use activities (such as timber harvesting and land conversion) as well as natural disturbances (such as forest fires and insect infestations) result in GHG emissions. Land use activities can also result in GHG removals. For example, as forests grow or recover, carbon is removed from the atmosphere and converted into wood by trees. Tracking the trends in Canada's land-based GHG emissions and removals can help us understand how land management decisions could reduce emissions and increase removals over time.

The indicator provides annual estimates of Canada's GHG emissions and removals from managed lands. These are lands influenced by human intervention to perform production, ecological or social functions. Examples include agricultural land, wetlands, settlements, and managed forests.

Key results

- In 2022,
  - Natural disturbances accounted for emissions of about 93 megatonnes of carbon dioxide equivalent (Mt CO_2 eq)
  - Human activities accounted for emissions of 52 Mt CO_2 eq
- Between 1990 to 2001, estimates of land-based GHGs showed more removals than emissions in all years except for 1995 (net emissions of 161 Mt CO_2 eq), 1998 (net emissions of 147 Mt CO_2 eq) and 1999 (net emissions of 18 Mt CO_2 eq)
- Since 2002, estimates show more emissions than removals, with net emissions ranging between 30 Mt CO_2 eq and 314 Mt CO_2 eq

Figure 1. National land-based greenhouse gas emissions and removals, Canada, 1990 to 2022



Data for Figure 1

Note: Natural disturbances refer to emissions and removals related to wildfires and large insect infestations of the forest. Human activities refer to emissions and removals from managed lands (such as settlements, forested lands, agricultural land and wetlands) as well as transfers to harvested wood products. For more information, see the section on emissions and removals from human activities.
Source: Environment and Climate Change Canada (2024) National Inventory Report 1990-2022: Greenhouse gas sources and sinks in Canada.

Natural disturbances, such as forest fires and large insect infestations, have occurred in Canada's forests for thousands of years. These disturbances are part of the natural life cycle of the forest and generally help the forest renew itself. However, there is evidence that climate change is driving an increase in natural disturbances. These

disturbances can contribute to emissions of large amounts of GHGs into the atmosphere through the burning and decay of dead trees, as well as significant removals as the forest regenerates over time.[1]

For the past 20 years, the total managed forest's net GHG exchange (that is, the land-based GHG emissions minus removals) has been significantly impacted by these natural disturbances. In 2002, the net exchange shifted from removals to emissions as a result of an increase in emissions from natural disturbances.

In managed forests, emissions and removals due to natural disturbances are associated with human activities under specific circumstances. These circumstances are described in the methods section.

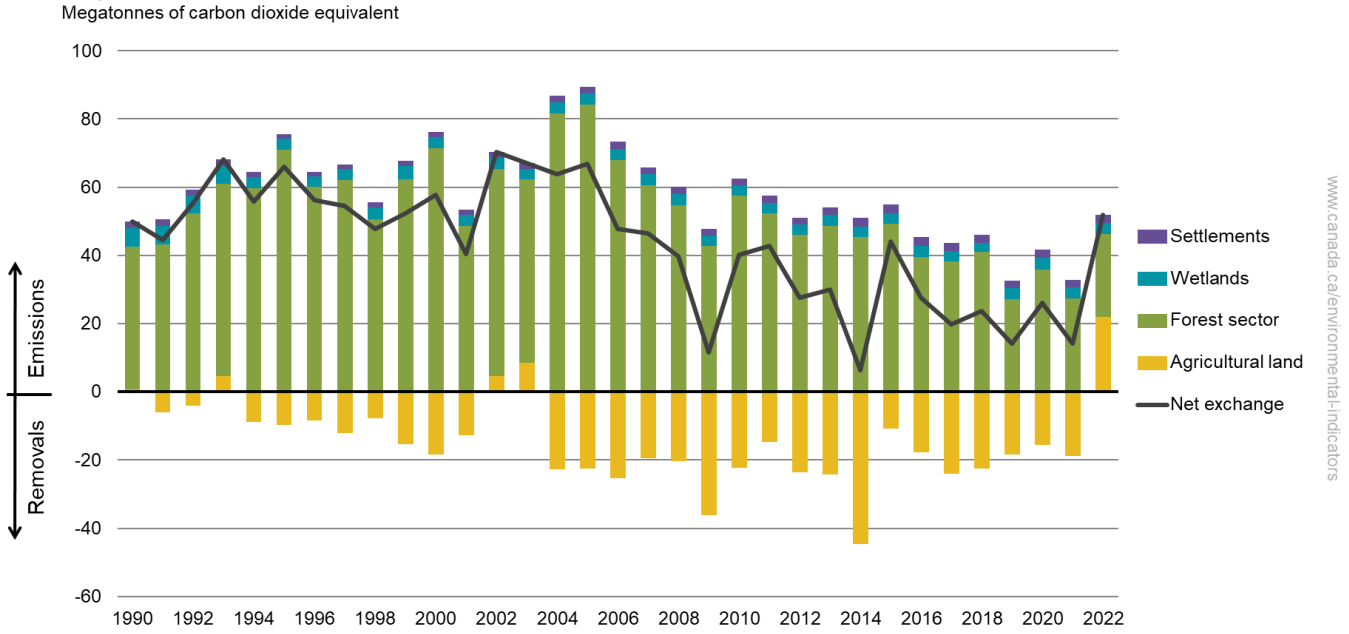
Land-based GHG emissions and removals from human activities

Land-based GHG emissions and removals from human activities are commonly referred to as land use, land-use change and forestry (LULUCF) according to international standards.

Key results

- In 2022, all four categories of land use activities emitted GHGs, with the forest sector and agricultural land being the largest emitters (24 and 22 megatonnes of carbon dioxide equivalent [Mt CO_2 eq], respectively)
- The emission level in 2022 (52 Mt CO_2 eq) is similar to the level observed in 1990 (50 Mt CO_2)
- Between 1990 and 2022, human activities on managed lands resulted in net emissions for all years, ranging between 6.4 Mt CO_2 eq and 70 Mt CO_2 eq

Figure 2. Land-based greenhouse gas emissions and removals from human activities by activity sector, Canada, 1990 to 2022



Data for Figure 2

Note: Greenhouse gas exchange from the forest sector considers emissions and removals from managed forests and transfers to and from the harvested wood products pool. Harvested wood products originate from forest trees with contributions of bioenergy from urban trees and agricultural land. As such, the reported forest sector emissions may differ at times from some information presented in the National Inventory Report. For more information, see Chapter 6.4 of the National Inventory Report.
Source: Environment and Climate Change Canada (2024) National Inventory Report 1990-2022: Greenhouse gas sources and sinks in Canada.

[1] Warren FJ and Lemmen DS, editors (2014) Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation. Government of Canada, Ottawa, ON, 286p. Retrieved August 22, 2024.

Forest sector

The forest sector category refers to emissions and removals from forest management activities such as timber harvesting, thinning and replanting and ecological processes, such as tree growth and decomposition. It also includes transfers to and from the harvested wood products pool, which are the wood materials removed from the harvested site and turned into consumer products, such as timber for construction, furniture or paper products. The carbon removed from the atmosphere by trees is stored in the harvested wood products and tracked over the lifespan of the consumer products. The carbon is emitted back into the atmosphere or transferred into the waste stream where the product is disposed.

In 2022, the GHG contribution from the forest sector was a net emissions of 24 Mt CO_2 eq. The growth of Canadian forests resulted in net removals of 108 Mt CO_2 eq. On the other hand, the emissions and disposals of Canadian harvest wood products to the global waste stream reduced stocks of carbon in wood products in use by 132 Mt CO_2 eq.[2]

GHG contributions from the forest sector have varied between 1990 and 2022, peaking at 84 Mt CO_2 eq in 2005 and since generally decreasing to 24 Mt CO_2 eq in 2022. These variations are related to harvest rates over the past several decades, particularly in the Mountain and Boreal regions, and increased indirectly due to a rise in natural disturbances.

As forest harvest expanded in Canada in the decades prior to 2005, increasing areas were converted to emissions sources. When forests are harvested, the sites act as emission sources over many years following the disturbance because of the decaying debris left on the site and the slow regrowth of woody biomass. Furthermore, large proportions of harvested wood were used for short-lived products (such as paper) where the carbon is rapidly transferred out of the harvested wood product pool to the waste stream or used for bioenergy. These emissions were not offset by the removals from the regrowth of the harvested areas.

Since 2004, the rate of area harvested in Canada has leveled off, and as a result removals from the land that was historically harvested is increasing at a greater rate than the emissions resulting from new harvests. Forest carbon emissions and harvested wood product emissions and disposals peaked in 2005 and have since decreased. This decreasing trend in emissions happened as carbon stocks in solid wood products have continued to increase, while those in paper products have declined since 2005. Additionally, since the early 2000s, most wood waste has been used for bioenergy production (converting biomass to energy), reducing transfers of waste to solid waste disposal where it is a source of methane.

Natural disturbances indirectly impact GHG emissions in the forest sector through the decomposition of trees killed by low-level insect disturbances and reducing the areas of commercially mature growing trees that remove carbon.

Note that the analysis of forest sector emissions and removals has changed compared with previous versions of this indicator. Due primarily to corrections to the pre-1990 Forest Land disturbance history data, recalculations have been made which reflect a reclassification from human activity to natural origin. The impact of these recalculations is to change the forest sector from a net sink (removals) to a net source (emissions) for the entire time series. Refer to the Data sources and methods section for more information.

Agricultural land

The agricultural land category reports emissions and removals from annual and perennial cropland, as well as from forest lands and grassland converted to cropland. Cropland includes lands in annual crops, summerfallow[3], and perennial crops. Managed agricultural grassland refers to rangeland that is used only for grazing domestic livestock.

Since 1990, agricultural land has typically contributed to GHG removals and has consistently done so between 2004 and 2021. Removals by agricultural land has ranged between 4.0 Mt CO_2 eq to 45 Mt CO_2 eq. This is due to

[2] Net emissions include disposals of harvest wood products that do not necessarily represent emissions of CO_2 to the atmosphere. Significant portions of harvest wood products disposals are transferred to the waste stream where long-term storage of carbon may occur.

[3] Fallow (also called summerfallow) is the practice of not planting a crop for one growing season. This helps build soil moisture reserves and can control problem weed infestation. However, fallow also contributes to environmental degradation by causing soil erosion, organic matter loss, carbon dioxide emissions, leaching of water and increased surface water runoff.

changes in agricultural practices, such as the adoption of conservation tillage,[4] increases in crop yield, and the reduced use of summerfallow. However, the removal rate from agricultural land has been decreasing in recent years due to a decline in the adoption rate of conservation tillage and land used to grow perennial crops and increases in the conversion of forested land and grassland to agricultural land. The shift from net removals to emissions in 2022 was primarily driven by a significant drought in 2021, which reduced crop yields and carbon inputs from residues resulting in a very small loss of soil carbon over large areas of the Prairies.

Wetlands

The wetlands category includes activities such as peat extraction for use in horticulture and land flooding to develop reservoirs for hydropower development.

Trends in wetlands are mainly driven by the creation of large reservoirs before 1990, resulting in higher emissions over the 1990 to 1993 period. Emissions from reservoirs declined from 1990 to 2022, while emissions from drained and excavated wetlands for peat extraction increased. Overall, during this time period, total emissions declined from 5.4 Mt CO_2 eq to 3.5 Mt CO_2 eq.

Settlements

The settlements category refers to emissions and removals occurring on developed lands (such as urban environments, transport infrastructure, oil and gas infrastructure and mining) and from the conversion of forests and agricultural land to settlements.

Total emissions for settlements fluctuated between 1.3 Mt CO_2 eq and 2.8 Mt CO_2 eq. Emissions were mainly driven by rates of forested land converted to settlements and are offset by the storage of carbon in urban trees (annual removals of about 4.3 Mt CO_2 eq).

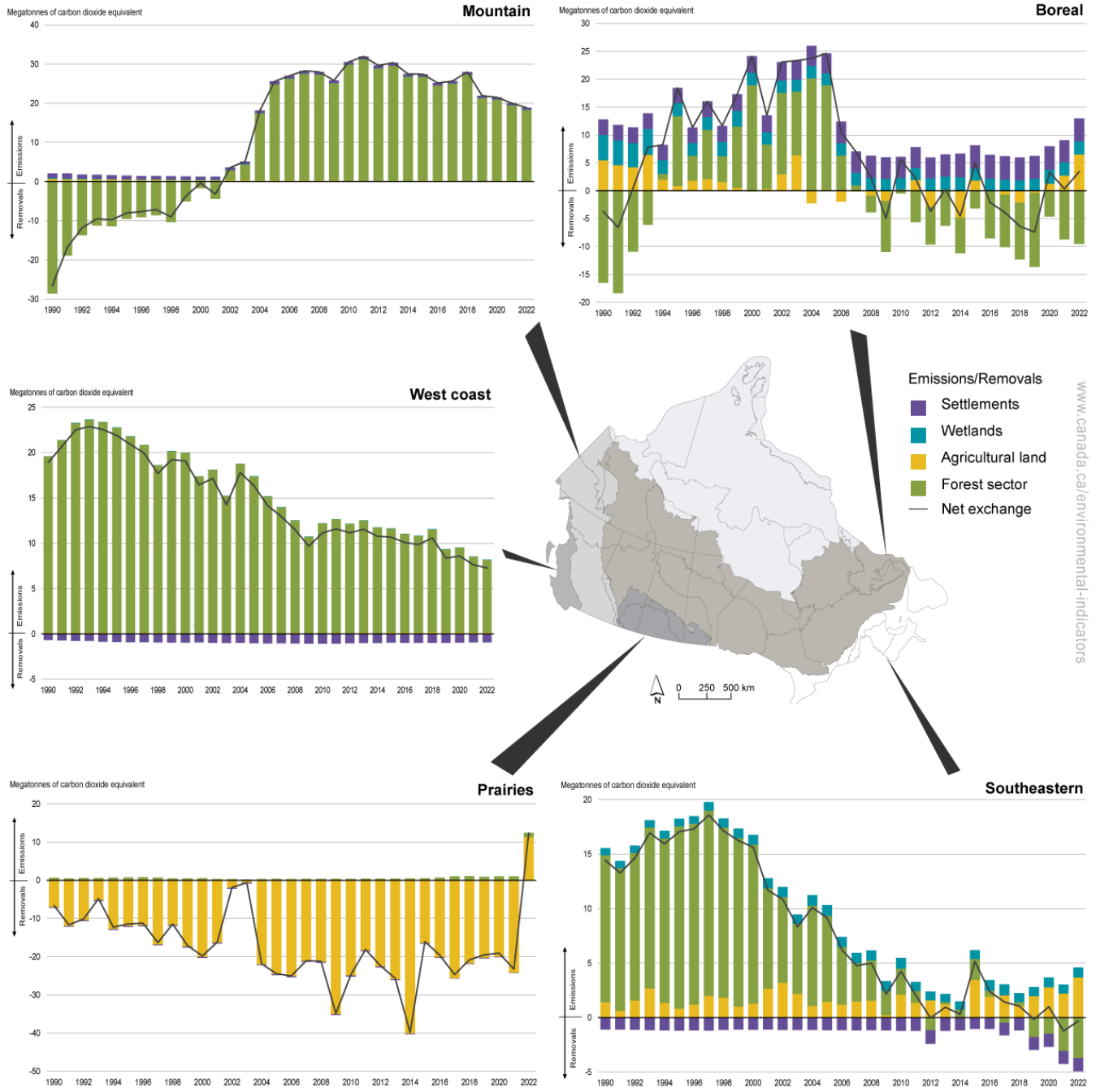
Regional land-based emissions and removals from human activities

Key results

- From 1990 to 2022,
    - The West coast region consistently emitted GHGs, but showed a decrease in emissions from 19 megatonnes of carbon dioxide equivalent (Mt CO_2 eq) to 7.3 Mt CO_2 eq
    - The Boreal, the Mountain and the Prairies regions shifted from removals to emissions
        - The Boreal region showed fluctuations in the net exchanges, switching from removals to emissions since 2008 (ranging between removals of 7.4 Mt CO_2 eq and emissions of 5.6 Mt CO_2 eq)
        - The Mountain region, which is important for forestry, had been the region contributing the most to removals in 1990 (27 Mt CO_2 eq) and to emissions since 2005 (ranging between 18 Mt CO_2 eq and 32 Mt CO_2 eq)
        - The Prairies region had contributed to removals from 1990 to 2021 (ranging between 0.6 Mt CO_2 eq and 40 Mt CO_2 eq) and experienced emissions for the first time in 2022 (12 Mt CO_2 eq) as a result of the 2021 drought
    - Southeastern region shifted from emissions of 14 Mt CO_2 eq to removals of 0.3 Mt CO_2 eq

[4] The adoption of conservation tillage (examples include no till or minimum till practices) reduces soil disturbance and prevents the release of stable carbon that has built up in soils from past plant growth.

Figure 3. Regional land-based greenhouse gas emissions and removals from human activities, Canada, 1990 to 2022



Data for Figure 3

Note: Regions are based on the location of the human activities across the country. Forest sector regional estimates provided do not include the long-term impact of emissions from forest harvest or deforestation prior to 1990.
Source: Environment and Climate Change Canada (2024) National Inventory Report 1990-2022: Greenhouse gas sources and sinks in Canada.

The overall increase in removals of GHGs on the Prairies between 1990 and 2014 can be attributed to changes in agricultural land management practices, such as the adoption of conservation tillage, the proportion of annual and perennial crops, and the reduced use of summerfallow. These changes in land management decrease soil disturbance and thereby lower releases of carbon from the soil. In recent years, the decline in the proportion of perennial crops on the landscape and the rate of conservation tillage practices have been offset by increasing

yields contributing to increased inputs of crop residue resulting in variable, but stable GHG removals for croplands as a whole. The transition from net removals to net emissions in 2022 stemmed largely from a major drought in 2021, reflecting how weather-related impacts can significantly affect crop production and reduce carbon inputs from residues. When crop yields decline due to drought, there are fewer plant residues to decompose and add organic carbon to the soil, leading to increased emissions instead of carbon storage (removals).

The increase in GHG emissions in the Boreal region and the shift from removals to emissions in the Mountain region are related to increased forest harvesting (in part to salvage timber from trees killed by the Mountain Pine Beetle and prevent its spread) as well as a reduction in net carbon removals from forests. The latter is due to insect infestations and fires in managed forests. The Boreal and the Mountain regions account for over 70% of the carbon transferred to harvested wood products. While timber harvesting transfers most of the carbon from stem wood to harvested wood products, it also results in emissions at the harvest site in the years immediately following the disturbance, primarily due to decomposition. The disturbances reduce the area of mature growing trees, which is already known to be slow in these regions and increase decomposition and salvage logging (the harvest of dead or dying standing trees). For more information, see the Forest sector in Land-based emissions and removals from human activities.

In the West Coast and Southeastern regions, forestry management practices (changes in harvest rates and forest regeneration) contributed to the reduction in emissions. That said, the West Coast still has the highest rate of carbon transfers to harvested wood products per hectare in Canada. In recent years, net GHG emissions have been increasing in the Southeastern region, partly due to shifts in agricultural land management practices, similar to the Prairies.

The previously reported carbon sink in 1990 and subsequent years have been adjusted based on corrections made to the pre-1990 Forest Land disturbance history data and now more accurately reflect a reclassification from human activity to natural origin. The Mountain, Boreal and Southeastern regions saw changes in emissions and removals from the forest sector as a result of these recalculations. Refer to the Data sources and methods section for more information.

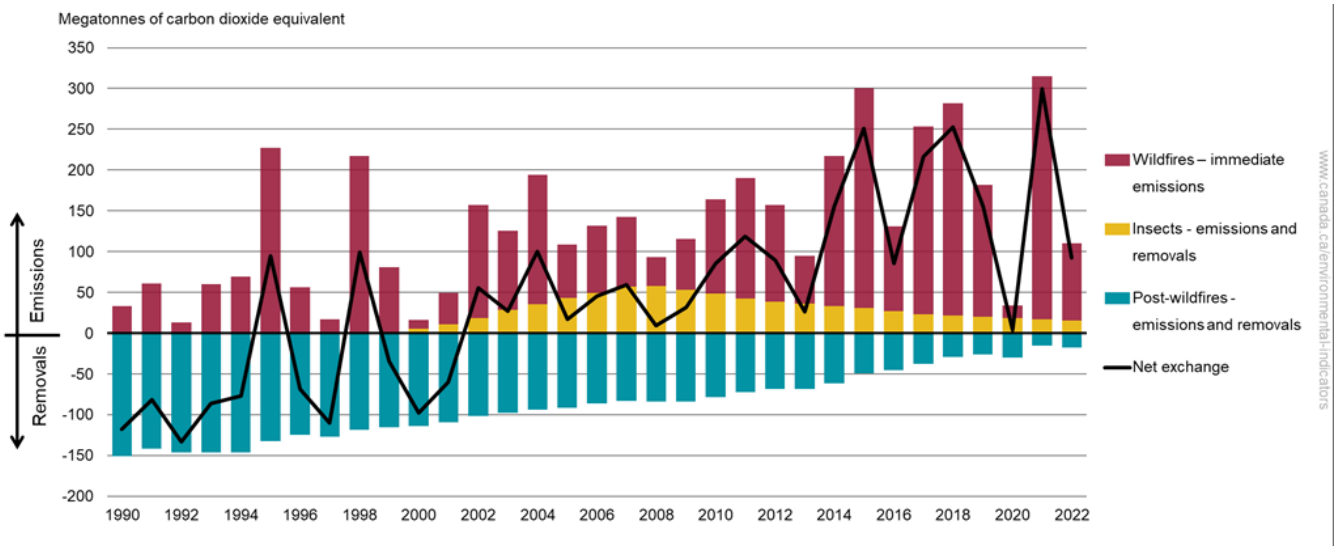
Land-based emissions and removals from natural disturbances

Forests remove carbon from the atmosphere as they grow and release it along with other GHGs when they decay after dying or burn in forest fires.

Key results

- In 2022,
    - Emissions from wildfires (immediate emissions) contributed 95 megatonnes of carbon dioxide equivalent (Mt CO_2 eq)
    - Emissions caused by insect infestations were 16 Mt CO_2 eq
    - Removals due to forest regrowth post-wildfires were 18 Mt CO_2 eq
- Since 2002, the net exchange from natural disturbances resulted in GHG emissions, ranging between 4.2 Mt CO_2 eq and 300 Mt CO_2 eq

Figure 4. Land-based greenhouse gas emissions and removals from natural disturbances in managed areas, Canada, 1990 to 2022



Data for Figure 4

Note: Wildfire emissions and removals are divided in 2 categories, (1) wildfire – immediate emissions and (2) post wildfire. Wildfire – immediate emissions include emissions from trees and soils from the burning of wildfires. Post wildfire includes emissions released by the decay of dead trees and soil organic matter and removals related to forest regeneration. Insect disturbances include emissions from the decay of organic matter and removals from natural regeneration.
Source: Environment and Climate Change Canada (2024) National Inventory Report 1990-2022: Greenhouse gas sources and sinks in Canada.

Natural disturbances are an important factor in determining whether forests remove or release GHGs each year. These disturbances contribute to immediate emissions (for example, from the burning of trees), as well as post-disturbance emissions and removals. Post-disturbance emissions are from the gradual decay of dead organic matter. Post-disturbance removals are related to the natural regeneration and regrowth of forests.

The variability in emissions and releases from natural disturbances can vary greatly from year to year. For example, emissions from managed lands were lower in 2020 than in adjacent years because of the smaller area burned.[5] However, since the mid-2000s, emissions from wildfires and insect disturbances have generally been increasing. Severe insect infestations in the early 2000s are having an effect on today's net GHG exchange and are expected to influence GHG emissions over the next few decades.

About the indicator

What the indicator measures

The Land-based greenhouse gas emissions and removals indicator tracks exchanges of greenhouse gas (GHG) emissions and removals between the atmosphere and Canada's managed lands. Reported GHG emissions and removals are annual totals from:

- Land use and land-use change activities
    - Forest sector (managed forested land and harvested wood products)
    - Agricultural land (cropland and agricultural grassland)
    - Wetlands (peat extraction and reservoirs for hydropower)
    - Settlements (developed land and land conversion to settlement)
- Natural disturbances (insect infestations and wildfires)

[5] Natural Resources Canada (2023) The State of Canada's Forests 2023. Retrieved August 12, 2024.

The indicator does not report emissions from Canadian economic sectors: oil and gas, transport, buildings, electricity, heavy industry, agriculture (such as fuel use, and crop and animal production) and waste. For information on those GHG emissions, refer to the Greenhouse gas emissions indicator.

Why this indicator is important

GHG emissions and their increasing concentrations in the atmosphere are having significant impacts on the environment, human health and the economy. Tracking the trends in Canada's land-based GHG emissions and removals provides a useful context for understanding how different management activities could reduce emissions and increase removals over time. This indicator could also help identify opportunities for mitigating the impacts of climate change and the potential for enhancing carbon sequestration.

The distinction between emissions and removals from human activities versus natural disturbances allows for a better understanding of emissions that could be directly managed in the near to medium term. The National Inventory Report has made this distinction since 2017 in the 2015 National Inventory Report.

Related indicators

The Greenhouse gas emissions indicators report trends in total anthropogenic (human-made) GHG emissions at the national level, per person and per unit gross domestic product, by province and territory and by economic sector.

The Global greenhouse gas emissions indicator provides a global perspective on Canada's share of global GHG emissions.

The Carbon dioxide emissions from a consumption perspective indicator shows the impact of Canada's consumption of goods and services, regardless of where they are produced, on the levels of carbon dioxide released into the atmosphere.

The Greenhouse gas emissions projections indicator provides an overview of Canada's projected GHG emissions up to 2030.

The Greenhouse gas emissions from large facilities indicator reports GHG emissions from the largest GHG emitters in Canada (industrial and other types of facilities).

The Greenhouse gas concentrations indicators present atmospheric concentrations as measured from sites in Canada and at a global scale for 2 greenhouse gases: carbon dioxide and methane.

The Forest management and disturbances indicator presents a series of measures covering timber harvest, forest disturbances, and forest regeneration.

Data sources and methods

Data sources

This indicator is developed using data from Canada's National Inventory Report and includes emissions and removals associated with natural disturbances and with land use, land-use change and forestry (LULUCF) activity on managed lands. Managed lands are defined by the Intergovernmental Panel on Climate Change (IPCC) as "land where human interventions and practices have been applied to perform production, ecological or social functions."[6] Information on the land category definition and representation of managed lands is available in Chapter 6 of the National Inventory Report.

Land-based greenhouse gas (GHG) emissions and removals include emissions and removals of carbon dioxide (CO_2). It also includes emissions of methane (CH_4), nitrous oxide (N_2O), and indirect CO_2 from the atmospheric oxidation of carbon monoxide (CO) due to controlled biomass burning; CH_4 and N_2O emissions from wetland drainage and rewetting due to peat extraction; and N_2O released following land conversion to cropland.

[6] Intergovernmental Panel on Climate Change (2006) 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 4: Agriculture, Forestry and Other Land Use. Retrieved August 22, 2024.

More information

Data used to develop the land-based emission and removal estimates presented in the National Inventory Report are drawn from published and unpublished sources from various government departments, industry sources and scientific papers.

Land-based GHG emission estimates are provided at the national level, by sector and by region. Annual GHG emission estimates are updated each year; the most recent edition of the inventory reported estimates for the period from 1990 to 2022. Complete details of the temporal coverage for each data source used for the indicators can be found in Chapter 6 of the National Inventory Report.

Preparation of the GHG inventory, including the land-based emission and removal estimates, takes almost 16 months from the end of the reporting year because of the time needed to collect, validate, calculate and interpret the data. In keeping with good practice guidance for managing national inventories, methods and data are improved on an on-going basis to reflect new knowledge and improved data or methods. Inventory estimates are prepared by Environment and Climate Change Canada's Pollutant Inventories and Reporting Division with input from numerous experts and scientists across Canada. Preliminary estimates and draft text are reviewed extensively by experts and officials, before they are finalized. The final report is submitted electronically to the United Nations Framework Convention on Climate Change (UNFCCC) no later than mid-April, as required.

Methods

Land-based GHG emissions and removals are quantified using methods that are consistent with an internationally agreed methodological framework set out in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and 2019 IPCC Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The methodologies used to estimate emissions and removals are reviewed, updated and improved on a periodic basis. Collaborative work with sector experts from within and outside Environment and Climate Change Canada is undertaken to incorporate available expertise and the latest advancements in scientific knowledge. Further information on these methods is available through Environment and Climate Change Canada's National Inventory Report.

More information

Land-based GHG emissions and removals are reported in carbon dioxide equivalents (CO_2 eq), determined by multiplying the amount of emissions of a particular GHG by the global warming potential of that gas. GHGs differ in their ability to absorb heat in the atmosphere due to their differing chemical properties and atmospheric lifetimes. For example, over a period of 100 years, the potential of methane to trap heat in the atmosphere is 28 times greater than that of carbon dioxide. Therefore, methane is considered to have a global warming potential of 28. The UNFCCC Reporting Guidelines (PDF; 258 KB) publish the global warming potentials and atmospheric lifetimes to be used for each GHG reported in national GHG inventories; these can be found in Table 1-1 of the National Inventory Report.

Areas within managed forests are subject to both forest management and natural disturbances. Emissions and removals from these areas are associated with human activities under specific circumstances. All stands harvested or that have been affected by stand-replacing natural disturbances in the past but have reached commercial maturity, or a minimum operable age (for a given region) are recognized to be under human influence. Commercially mature stands subject to natural disturbances causing less than or equal to 20% biomass mortality (for example some insects that cause defoliation but low mortality) remain associated with human activities. Large, uncontrollable natural disturbances (for example wildfires or insect outbreaks causing more than 20% biomass mortality) are recognized to result from natural occurrences and the associated emissions and removals are reflected in the natural disturbance category. See Part II Annex 3 of the National Inventory Report for more information on the tracking and reporting of natural disturbances.[7]

[7] Kurz et al. (2018) Quantifying the impacts of human activities on reported greenhouse gas emissions and removals in Canada's managed forest: conceptual framework and implementation. Canadian Journal of Forest Research 48: 1-14. Retrieved August 22, 2024.

Spatial aggregation

Estimates for the land use, land-use change and forestry (LULUCF) sector in the National Inventory Report are provided for 18 reporting zones (Chapter 6, Figure 6-1 Canada's National Inventory Report). These reporting zones are similar to the ecozones of the National Ecological Framework, a hierarchical, spatially consistent national ecosystem classification.

In this indicator, the reporting zones were grouped into regional categories that better reflect trends in management practices. Table 1 shows the indicator regional categories and the corresponding National Inventory Report reporting zones.

Table 1. Indicator regional categories and National Inventory Report reporting zones

Indicator regional categories	National Inventory Report reporting zones
Mountain	Taiga Cordillera
	Boreal Cordillera
	Montane Cordillera
Boreal	Taiga Plains
	Taiga Shield West
	Boreal Plains
	Boreal Shield West
	Hudson Plains
	Boreal Shield East (excluding Newfoundland)
	Taiga Shield East
West Coast	Pacific Maritime
Prairies	Subhumid Prairies
	Semiarid Prairies
Southeastern	Boreal Shield East (Newfoundland)
	Atlantic Maritime
	Mixedwood Plains
Not reported	Arctic Cordillera
	Northern Arctic
	Southern Arctic

Land-based greenhouse gas emissions and removals by land use categories

In this indicator, calculated emissions and removals data from the National Inventory Report are grouped into 4 broad classes. Table 2 shows the categories of Land-based GHG emissions and removals reported in the indicator compared with those reported in the National Inventory Report.

Table 2. Land-based emissions and removals categories

Land-based emissions and removals categories reported in the indicator	Land-based emissions and removals categories reported in the National Inventory Report
Forest sector	Forest land
	Harvested wood products (HWP)
Agricultural land	Cropland
	Agricultural grassland

Land-based emissions and removals categories reported in the indicator	Land-based emissions and removals categories reported in the National Inventory Report
Wetlands	Peat extraction and flooded lands
Settlements	Settlements

Note: Definitions for land-use change and forest land as reported in the National Inventory Report are consistent with the International Panel on Climate Change land categories. Harvested wood product includes those that originate from forest trees, urban trees or agricultural land.

Recent changes

Recalculations occurred for the forest sector, most significantly due to corrections made to the pre-1990 Forest Land disturbance history data. A multi-year analysis was completed to determine the area of forest land that had been historically harvested in Canada. The historical harvest area is a key factor in determining the area of land reported as anthropogenic and, consequently, the emissions and removals that are reported in the forest sector. The new compilation of historic (1889 to 1989) harvest data in Canada showed that the area of historically harvested forests was smaller by about 20%.[8] In other words, a smaller area of growing forest that actively removes CO_2 from the atmosphere is counted as a smaller anthropogenic sink (lower removals). The previously reported carbon sink in 1990 and subsequent years has been adjusted based on these recalculations and now more accurately reflects a reclassification from human activity to natural origin. The impact of these recalculations shifted the forest sector from a net sink (removals) to a net source (emissions) for the entire time series. Refer to Section 6.3.1.5 of the National Inventory Report (Part 1) for more information.

Caveats and limitations

The methodologies for compiling land-based GHG emissions and removals improve over time. As a result, the land-based emissions and removals data reported in the indicator may be different from previously published estimates.

Harvested wood products are not limited to those that originate from forests and include those from urban trees and agricultural land. As such, the reported emissions from the forest sector may differ from the National Inventory Report. For more information, see Chapter 6.4 of the National Inventory Report.

Canada is a vast country with heterogeneous landscapes and climates. Factors such as geographic location, climatic conditions, plant species and age, and management activities all play a role in influencing the net amount of GHG that is removed or released back to the atmosphere from each location in Canada. The land-based emissions and removals data provide a simplified representation of the complex reality and may not account for all relevant ecological processes.

Current reporting of land-based emissions and removals does not account for climate feedback other than what is captured through natural disturbances such as wildfires and insect infestations. Climate feedback mechanisms can either amplify (positive feedback) or diminish (negative feedback) the effects of a changing climate. For example, as rising concentrations of GHGs warm Earth's climate, permafrost begins to melt. This melting releases the organic carbon stored, contributing to GHG releases that cause more warming, which causes more melting, and so on, in a self reinforcing cycle.

For a complete discussion of the caveats and limitations with respect to land-based GHG emissions and removals data, refer to the methodological issues sections in Chapter 6 of Canada's National Inventory Report.

[8] Kurz et al. (2024) Revised historic harvest data improve estimates of the impacts of human activities on reported greenhouse gas emissions and removals in Canada's managed forest. Canadian Journal of Forest Research. Retrieved on August 22, 2024.

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Related information

Canada's Action on Climate Change

Climate Change

Land-based greenhouse gas emissions and removals infographic

Annex

Annex A. Data tables for the figures presented in this document

Table A.1. Data for Figure 1. National land-based greenhouse gas emissions and removals, Canada, 1990 to 2022

Year	Natural disturbances (megatonnes of carbon dioxide equivalent)	Human activities (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
1990	-117.27	49.82	-67.45
1991	-81.15	44.49	-36.65
1992	-133.03	55.33	-77.70
1993	-86.02	68.15	-17.87
1994	-77.01	55.74	-21.28
1995	95.12	65.89	161.01
1996	-68.32	56.12	-12.20
1997	-109.89	54.53	-55.36
1998	99.24	47.79	147.03
1999	-34.44	52.28	17.84
2000	-97.41	57.82	-39.59
2001	-60.17	40.46	-19.70
2002	55.75	70.25	126.00
2003	27.42	67.08	94.50
2004	100.58	63.88	164.46
2005	17.20	66.77	83.97
2006	45.82	47.83	93.66
2007	59.40	46.44	105.84
2008	9.44	39.82	49.26
2009	31.85	11.59	43.44
2010	85.56	40.08	125.63
2011	118.45	42.72	161.18
2012	89.56	27.48	117.04
2013	26.71	29.87	56.58
2014	155.36	6.35	161.72
2015	250.73	44.12	294.85
2016	85.57	27.64	113.21
2017	216.09	19.77	235.86
2018	252.83	23.63	276.46
2019	155.56	14.16	169.73
2020	4.21	26.12	30.33
2021	299.62	14.04	313.66

Year	Natural disturbances (megatonnes of carbon dioxide equivalent)	Human activities (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
2022	92.64	51.94	144.58

Note: Data are accurate to 2 significant figures in accordance with Part III Annex 8 of the National Inventory Report. Net exchange is calculated by subtracting removals from emissions. Natural disturbances refer to emissions and removals related to wildfires and large forest insect infestations. Human activities refer to emissions and removals from managed lands (such as settlements, forested lands, agricultural land and wetlands) as well as emissions from harvested wood products. For more information, see the section on emissions and removals from human activities.
Source: Environment and Climate Change Canada (2024) National Inventory Report 1990-2022: Greenhouse gas sources and sinks in Canada.

Table A.2. Data for Figure 2. Land-based greenhouse gas emissions and removals from human activities by activity sector, Canada, 1990 to 2022

Year	Forest sector (megatonnes of carbon dioxide equivalent)	Agricultural land (megatonnes of carbon dioxide equivalent)	Wetlands (megatonnes of carbon dioxide equivalent)	Settlements (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
1990	41.83	0.64	5.42	1.93	49.82
1991	43.23	-6.04	5.31	1.99	44.49
1992	52.36	-3.99	5.18	1.78	55.33
1993	56.39	4.54	5.49	1.73	68.15
1994	59.70	-8.75	3.30	1.49	55.74
1995	71.02	-9.68	3.20	1.35	65.89
1996	60.02	-8.33	3.09	1.34	56.12
1997	62.09	-12.11	3.19	1.35	54.53
1998	50.60	-7.74	3.50	1.43	47.79
1999	62.32	-15.36	3.82	1.50	52.28
2000	71.49	-18.41	3.22	1.52	57.82
2001	48.60	-12.84	3.21	1.50	40.46
2002	60.64	4.69	3.21	1.70	70.25
2003	53.86	8.40	3.09	1.74	67.08
2004	81.52	-22.82	3.25	1.94	63.88
2005	84.26	-22.54	3.17	1.88	66.77
2006	67.90	-25.44	3.25	2.12	47.83
2007	60.45	-19.40	3.26	2.13	46.44
2008	54.63	-20.30	3.35	2.14	39.82
2009	42.72	-36.26	3.14	1.99	11.59
2010	57.42	-22.39	3.16	1.89	40.08
2011	52.42	-14.71	3.02	2.00	42.72
2012	45.98	-23.56	3.07	1.99	27.48
2013	48.59	-24.19	3.21	2.26	29.87
2014	45.27	-44.73	3.21	2.60	6.35
2015	49.21	-10.76	3.04	2.63	44.12

Year	Forest sector (megatonnes of carbon dioxide equivalent)	Agricultural land (megatonnes of carbon dioxide equivalent)	Wetlands (megatonnes of carbon dioxide equivalent)	Settlements (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
2016	39.53	-17.78	3.14	2.75	27.64
2017	38.11	-23.95	3.08	2.54	19.77
2018	40.94	-22.49	2.76	2.42	23.63
2019	27.21	-18.43	3.09	2.30	14.16
2020	35.75	-15.60	3.50	2.47	26.12
2021	27.37	-18.81	3.20	2.29	14.04
2022	24.27	21.96	3.35	2.36	51.94

Note: Data are accurate to 2 significant figures in accordance with Part III Annex 8 of the National Inventory Report. Net exchange is calculated by subtracting removals from emissions. Greenhouse gas exchange from the forest sector considers emissions and removals from managed forests and transfers to and from the harvested wood products pool. Harvested wood products originate from forest trees with contributions of bioenergy from urban trees and agricultural land. As such, the reported forest sector emissions may differ at times from some information presented in the National Inventory Report. For more information, see Chapter 6.4 of the National Inventory Report.
Source: Environment and Climate Change Canada (2024) National Inventory Report 1990-2022: Greenhouse gas sources and sinks in Canada.

Table A.3. Data for Figure 3. Regional land-based greenhouse gas emissions and removals from human activities, Canada, 1990 to 2022

Region	Year	Forest sector (megatonnes of carbon dioxide equivalent)	Agricultural land (megatonnes of carbon dioxide equivalent)	Wetlands (megatonnes of carbon dioxide equivalent)	Settlements (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
Mountain	1990	-28.61	0.70	0.21	1.15	-26.54
Mountain	1991	-18.91	0.62	0.20	1.24	-16.84
Mountain	1992	-13.66	0.61	0.18	1.04	-11.82
Mountain	1993	-11.23	0.55	0.17	1.02	-9.48
Mountain	1994	-11.37	0.55	0.12	0.96	-9.74
Mountain	1995	-9.53	0.51	0.11	0.89	-8.02
Mountain	1996	-9.08	0.46	0.11	0.87	-7.64
Mountain	1997	-8.59	0.51	0.10	0.84	-7.15
Mountain	1998	-10.35	0.45	0.09	0.83	-8.99
Mountain	1999	-5.05	0.40	0.09	0.81	-3.75
Mountain	2000	-1.66	0.41	0.08	0.78	-0.38
Mountain	2001	-4.41	0.42	0.08	0.74	-3.18
Mountain	2002	2.49	0.38	0.08	0.67	3.61
Mountain	2003	3.98	0.41	0.07	0.67	5.14
Mountain	2004	17.11	0.30	0.07	0.66	18.14
Mountain	2005	24.52	0.33	0.06	0.67	25.59
Mountain	2006	25.93	0.34	0.06	0.69	27.02
Mountain	2007	27.24	0.29	0.06	0.69	28.28
Mountain	2008	27.01	0.28	0.06	0.65	28.00

Region	Year	Forest sector (megatonnes of carbon dioxide equivalent)	Agricultural land (megatonnes of carbon dioxide equivalent)	Wetlands (megatonnes of carbon dioxide equivalent)	Settlements (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
Mountain	2009	24.89	0.27	0.05	0.62	25.83
Mountain	2010	29.63	0.22	0.05	0.63	30.53
Mountain	2011	30.94	0.23	0.05	0.73	31.95
Mountain	2012	28.71	0.19	0.05	0.70	29.65
Mountain	2013	29.35	0.22	0.05	0.74	30.36
Mountain	2014	26.60	0.18	0.04	0.65	27.47
Mountain	2015	26.52	0.27	0.04	0.60	27.43
Mountain	2016	24.22	0.28	0.04	0.64	25.19
Mountain	2017	24.78	0.24	0.04	0.60	25.65
Mountain	2018	27.13	0.22	0.04	0.60	27.99
Mountain	2019	21.15	0.18	0.04	0.56	21.93
Mountain	2020	20.70	0.23	0.04	0.55	21.51
Mountain	2021	19.21	0.26	0.03	0.52	20.02
Mountain	2022	18.08	0.25	0.03	0.51	18.88
Boreal	1990	-16.49	5.48	4.55	2.75	-3.71
Boreal	1991	-18.38	4.58	4.46	2.76	-6.58
Boreal	1992	-10.89	4.22	4.32	2.81	0.47
Boreal	1993	-6.11	6.42	4.65	2.83	7.79
Boreal	1994	1.00	2.04	2.48	2.74	8.26
Boreal	1995	12.49	0.86	2.37	2.71	18.44
Boreal	1996	4.51	1.79	2.28	2.75	11.33
Boreal	1997	8.80	2.13	2.29	2.82	16.04
Boreal	1998	4.61	1.60	2.56	2.88	11.65
Boreal	1999	10.97	0.55	2.82	2.95	17.29
Boreal	2000	18.93	-0.10	2.23	3.01	24.06
Boreal	2001	7.98	0.33	2.18	3.02	13.52
Boreal	2002	14.57	3.00	2.19	3.34	23.09
Boreal	2003	11.45	6.36	2.13	3.42	23.36
Boreal	2004	20.18	-2.27	2.19	3.61	23.71
Boreal	2005	18.76	0.17	2.11	3.61	24.65
Boreal	2006	6.32	-1.93	2.24	3.85	10.49
Boreal	2007	0.96	-0.10	2.25	3.85	6.96
Boreal	2008	-2.98	-0.87	2.36	3.92	2.42
Boreal	2009	-9.11	-1.83	2.18	3.83	-4.93
Boreal	2010	-0.49	0.20	2.12	3.77	5.60
Boreal	2011	-5.63	1.94	2.11	3.78	2.20

Region	Year	Forest sector (megatonnes of carbon dioxide equivalent)	Agricultural land (megatonnes of carbon dioxide equivalent)	Wetlands (megatonnes of carbon dioxide equivalent)	Settlements (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
Boreal	2012	-6.81	-2.85	2.21	3.76	-3.68
Boreal	2013	-6.26	0.18	2.40	3.93	0.25
Boreal	2014	-6.39	-4.81	2.40	4.26	-4.53
Boreal	2015	-3.19	1.83	2.18	4.16	4.98
Boreal	2016	-8.53	0.08	2.11	4.25	-2.09
Boreal	2017	-9.38	-0.70	2.01	4.19	-3.89
Boreal	2018	-10.18	-2.15	1.89	4.08	-6.36
Boreal	2019	-13.26	-0.38	2.19	4.06	-7.40
Boreal	2020	-4.61	1.25	2.54	4.17	3.35
Boreal	2021	-8.73	2.75	2.34	4.00	0.36
Boreal	2022	-9.53	6.51	2.38	4.09	3.44
West coast	1990	19.48	0.11	0.01	-0.68	18.92
West coast	1991	21.26	0.11	0.01	-0.72	20.66
West coast	1992	23.16	0.10	0.01	-0.77	22.51
West coast	1993	23.53	0.10	0.01	-0.78	22.87
West coast	1994	23.28	0.10	0.01	-0.85	22.54
West coast	1995	22.64	0.11	0.01	-0.87	21.89
West coast	1996	21.70	0.08	0.01	-0.91	20.89
West coast	1997	20.74	0.10	0.01	-0.91	19.94
West coast	1998	18.52	0.10	0.01	-0.93	17.70
West coast	1999	20.08	0.09	0.01	-0.95	19.23
West coast	2000	19.92	0.08	0.01	-0.95	19.07
West coast	2001	17.28	0.09	0.01	-0.95	16.44
West coast	2002	18.01	0.10	0.01	-0.97	17.15
West coast	2003	15.14	0.09	0.01	-1.00	14.25
West coast	2004	18.69	0.08	0.01	-0.98	17.80
West coast	2005	17.29	0.09	0.01	-1.02	16.37
West coast	2006	15.08	0.11	0.01	-1.05	14.15
West coast	2007	13.88	0.09	0.01	-1.03	12.95
West coast	2008	12.41	0.11	0.01	-1.04	11.50
West coast	2009	10.63	0.09	0.01	-1.06	9.68
West coast	2010	12.12	0.08	0.01	-1.08	11.14
West coast	2011	12.53	0.11	0.01	-1.07	11.58
West coast	2012	12.06	0.09	0.01	-1.02	11.15
West coast	2013	12.39	0.13	0.01	-1.00	11.53
West coast	2014	11.67	0.08	0.01	-0.99	10.77

Region	Year	Forest sector (megatonnes of carbon dioxide equivalent)	Agricultural land (megatonnes of carbon dioxide equivalent)	Wetlands (megatonnes of carbon dioxide equivalent)	Settlements (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
West coast	2015	11.47	0.15	0.01	-0.96	10.67
West coast	2016	10.91	0.13	0.01	-0.97	10.08
West coast	2017	10.70	0.12	0.02	-0.98	9.85
West coast	2018	11.38	0.17	0.02	-0.98	10.59
West coast	2019	9.22	0.11	0.01	-0.98	8.37
West coast	2020	9.37	0.16	0.01	-0.95	8.60
West coast	2021	8.39	0.16	0.01	-0.94	7.62
West coast	2022	8.05	0.14	0.01	-0.94	7.27
Prairies	1990	0.64	-7.05	0.00	-0.18	-6.58
Prairies	1991	0.50	-11.97	0.00	-0.18	-11.66
Prairies	1992	0.59	-10.49	0.00	-0.18	-10.09
Prairies	1993	0.62	-5.22	0.00	-0.18	-4.79
Prairies	1994	0.70	-12.79	0.00	-0.19	-12.27
Prairies	1995	0.76	-11.99	0.00	-0.19	-11.41
Prairies	1996	0.82	-11.84	0.00	-0.19	-11.21
Prairies	1997	0.71	-16.83	0.00	-0.19	-16.31
Prairies	1998	0.46	-11.71	0.00	-0.19	-11.44
Prairies	1999	0.50	-17.41	0.00	-0.20	-17.10
Prairies	2000	0.51	-20.09	0.00	-0.20	-19.78
Prairies	2001	0.32	-16.34	0.00	-0.20	-16.22
Prairies	2002	0.33	-1.97	0.00	-0.20	-1.84
Prairies	2003	0.20	-0.64	0.00	-0.20	-0.64
Prairies	2004	0.31	-22.00	0.00	-0.20	-21.89
Prairies	2005	0.35	-24.60	0.00	-0.21	-24.45
Prairies	2006	0.33	-25.15	0.00	-0.21	-25.03
Prairies	2007	0.34	-21.16	0.00	-0.21	-21.03
Prairies	2008	0.37	-21.36	0.00	-0.22	-21.20
Prairies	2009	0.38	-35.03	0.00	-0.22	-34.86
Prairies	2010	0.36	-24.97	0.00	-0.22	-24.82
Prairies	2011	0.44	-18.35	0.00	-0.21	-18.11
Prairies	2012	0.42	-22.58	0.00	-0.20	-22.36
Prairies	2013	0.44	-25.93	0.00	-0.19	-25.68
Prairies	2014	0.47	-40.17	0.00	-0.16	-39.85
Prairies	2015	0.57	-16.46	0.00	-0.13	-16.02
Prairies	2016	0.71	-20.19	0.00	-0.12	-19.60
Prairies	2017	1.05	-25.63	0.00	-0.11	-24.69

Region	Year	Forest sector (megatonnes of carbon dioxide equivalent)	Agricultural land (megatonnes of carbon dioxide equivalent)	Wetlands (megatonnes of carbon dioxide equivalent)	Settlements (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
Prairies	2018	1.07	-21.80	0.00	-0.10	-20.83
Prairies	2019	0.92	-20.29	0.00	-0.15	-19.52
Prairies	2020	1.04	-20.00	0.00	-0.10	-19.07
Prairies	2021	1.03	-24.19	0.00	-0.09	-23.26
Prairies	2022	1.07	11.38	0.00	-0.08	12.36
Southeastern	1990	13.50	1.40	0.64	-1.11	14.42
Southeastern	1991	13.11	0.61	0.64	-1.11	13.26
Southeastern	1992	13.56	1.57	0.65	-1.12	14.65
Southeastern	1993	14.76	2.69	0.66	-1.17	16.94
Southeastern	1994	15.08	1.35	0.69	-1.18	15.94
Southeastern	1995	16.72	0.83	0.70	-1.19	17.05
Southeastern	1996	16.61	1.18	0.70	-1.18	17.31
Southeastern	1997	17.01	1.98	0.79	-1.20	18.58
Southeastern	1998	15.61	1.82	0.83	-1.15	17.12
Southeastern	1999	15.45	1.01	0.89	-1.11	16.24
Southeastern	2000	14.58	1.28	0.90	-1.12	15.64
Southeastern	2001	9.20	2.65	0.93	-1.11	11.68
Southeastern	2002	7.87	3.18	0.94	-1.14	10.85
Southeastern	2003	6.42	2.18	0.87	-1.15	8.32
Southeastern	2004	9.19	1.07	0.97	-1.14	10.10
Southeastern	2005	7.87	1.47	0.98	-1.17	9.15
Southeastern	2006	5.28	1.19	0.93	-1.17	6.24
Southeastern	2007	3.52	1.48	0.93	-1.17	4.76
Southeastern	2008	3.71	1.54	0.92	-1.17	5.00
Southeastern	2009	2.20	0.24	0.90	-1.18	2.15
Southeastern	2010	2.41	2.08	0.98	-1.22	4.25
Southeastern	2011	1.08	1.35	0.84	-1.22	2.05
Southeastern	2012	-1.16	1.58	0.79	-1.25	-0.04
Southeastern	2013	0.21	1.21	0.75	-1.22	0.95
Southeastern	2014	0.74	-0.01	0.75	-1.17	0.31
Southeastern	2015	1.92	3.46	0.80	-1.04	5.14
Southeastern	2016	0.56	1.91	0.98	-1.05	2.40
Southeastern	2017	-0.47	2.03	1.02	-1.16	1.42
Southeastern	2018	0.34	1.08	0.82	-1.18	1.06
Southeastern	2019	-1.79	1.95	0.86	-1.18	-0.16
Southeastern	2020	-1.49	2.77	0.91	-1.20	0.99

Region	Year	Forest sector (megatonnes of carbon dioxide equivalent)	Agricultural land (megatonnes of carbon dioxide equivalent)	Wetlands (megatonnes of carbon dioxide equivalent)	Settlements (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
Southeastern	2021	-3.05	2.22	0.82	-1.21	-1.23
Southeastern	2022	-3.70	3.67	0.93	-1.21	-0.32

Note: Data are accurate to 2 significant figures in accordance with Part III Annex 8 of the National Inventory Report. Net exchange is calculated by subtracting removals from emissions. Regions are based on the location of the human activities across the country. Forest sector regional estimates provided do not include the long-term impact of emissions from forest harvest or deforestation prior to 1990.
Source: Environment and Climate Change Canada (2024) National Inventory Report 1990-2022: Greenhouse gas sources and sinks in Canada.

Table A.4. Data for Figure 4. Land-based greenhouse gas emissions and removals from natural disturbances in managed areas, Canada, 1990 to 2022

Year	Wildfire – immediate emissions (megatonnes of carbon dioxide equivalent)	Post wildfire (megatonnes of carbon dioxide equivalent)	Insects (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
1990	33.12	-150.64	0.24	-117.27
1991	60.30	-141.79	0.34	-81.15
1992	12.71	-146.07	0.34	-133.03
1993	60.08	-146.44	0.35	-86.02
1994	68.70	-146.08	0.37	-77.01
1995	226.75	-132.08	0.45	95.12
1996	55.82	-124.64	0.49	-68.32
1997	16.51	-126.91	0.51	-109.89
1998	216.71	-118.08	0.61	99.24
1999	79.61	-115.45	1.40	-34.44
2000	11.19	-113.86	5.26	-97.41
2001	38.06	-109.43	11.20	-60.17
2002	138.62	-101.24	18.37	55.75
2003	96.73	-97.89	28.57	27.42
2004	158.91	-93.75	35.42	100.58
2005	65.83	-91.60	42.96	17.20
2006	82.25	-85.73	49.31	45.82
2007	85.55	-82.93	56.77	59.40
2008	35.62	-84.03	57.84	9.44
2009	62.72	-83.90	53.03	31.85
2010	115.58	-78.66	48.64	85.56
2011	147.80	-72.03	42.68	118.45
2012	118.68	-68.00	38.88	89.56
2013	58.59	-68.06	36.18	26.71
2014	183.59	-61.60	33.38	155.36
2015	268.98	-49.34	31.09	250.73

Year	Wildfire – immediate emissions (megatonnes of carbon dioxide equivalent)	Post wildfire (megatonnes of carbon dioxide equivalent)	Insects (megatonnes of carbon dioxide equivalent)	Net exchange (megatonnes of carbon dioxide equivalent)
2016	103.45	-45.20	27.32	85.57
2017	230.10	-37.29	23.28	216.09
2018	260.36	-29.05	21.52	252.83
2019	161.52	-25.98	20.02	155.56
2020	15.30	-29.79	18.70	4.21
2021	297.82	-15.24	17.04	299.62
2022	94.46	-17.52	15.70	92.64

Note: Data are accurate to 2 significant figures in accordance with Part III Annex 8 of the National Inventory Report**.** Net exchange is calculated by subtracting removals from emissions. Wildfire emissions and removals are divided in 2 categories, (1) wildfire – immediate emissions and (2) post wildfire. Wildfire – immediate emissions include emissions from trees and soils from the burning of wildfires. Post wildfire includes emissions released by the decay of dead trees and soil organic matter and removals related to forest regeneration. Insect disturbances include emissions from the decay of organic matter and removals from natural regeneration.
Source: Environment and Climate Change Canada (2024) National Inventory Report 1990-2022: Greenhouse gas sources and sinks in Canada.

Additional information can be obtained at:

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Email: enviroinfo@ec.gc.ca