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# Greenhouse Gas Emissions and Removals From Forest Land, Woodlands, and Harvested Wood Products in the United States, 1990–2024

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**Cover image:** Tamarack bog in Sawyer County, WI. Forest Service photo by Sjana Schanning.

## Introduction

Historically, the United States reported an annual inventory of greenhouse gas emissions and removals by sector under the United Nations Framework Convention on Climate Change, using methodological guidance from the Intergovernmental Panel on Climate Change (IPCC). The U.S. Environmental Protection Agency (EPA) coordinated these inventories (U.S. EPA 2025) and presented them in a common and consistent format to support transparency, completeness, and comparability across sectors and over time. Researchers and partners from the U.S. Department of Agriculture (USDA), Forest Service have compiled estimates of land use and land use change as well as greenhouse gas emissions and removals from forest land, woodlands in the grassland category, and harvested wood products that have been reported in the land sector chapter of the EPA inventory for more than three decades.

Because recent changes in Federal greenhouse gas reporting arrangements have resulted in the discontinuation of a centralized national inventory compilation and reporting under this framework, the Center for Global Sustainability at the University of Maryland has coordinated and compiled a nongovernmental inventory report that adheres to international standards and is consistent with IPCC good practice (Desai et al. 2026). The report uses national estimates of land use and land use change as well as estimates of greenhouse gas emissions and removals from forest land, woodlands, and harvested wood products from the Forest Service. This resource bulletin, like those that have come before it (e.g., Domke et al. 2024), provides an overview of the status and trends in emissions and removals for these categories from 1990 to 2 years before present, 2024, in this case. The estimates are consistent with methods used in the most recent compilation reported in U.S. EPA (2025) and rely on the latest data available from the Nationwide Forest Inventory (NFI) collected and maintained by the Forest Service's Forest Inventory and Analysis (FIA) program. This information is compiled to support national reporting requirements (e.g., Resources Planning Act Assessment, 2030 National Report on Sustainable Forests) and FIA stakeholder needs (e.g., Desai et al. 2026).

In 2024, the balance of U.S. greenhouse gas emissions and removals increased by an estimated 0.2 percent relative to 2023 (Desai et al. 2026). Within the land sector, forest land, harvested wood products, and woodlands collectively continue to represent the largest net carbon sink in the United States, accounting for nearly 90 percent of total land sector removals—the equivalent of more than 13 percent of total (i.e., gross) emissions in 2024 (Desai et al. 2026).

Most of the national-scale estimates compiled by the Forest Service and used in U.S. EPA (2025) and Desai et al. (2026) have also been developed and published at the individual State level (fig. 1) for the entire 1990–2024 time series and are available in companion research datasets (Walters et al. 2026a, 2026b). This resource bulletin also includes regional carbon stock and stock change estimates for forest land by broad ownership category (i.e., private or public land), the National Forest System, Tribal lands (included in the private ownership category for reporting purposes), and estimates on forest land for each national forest (fig. 2).

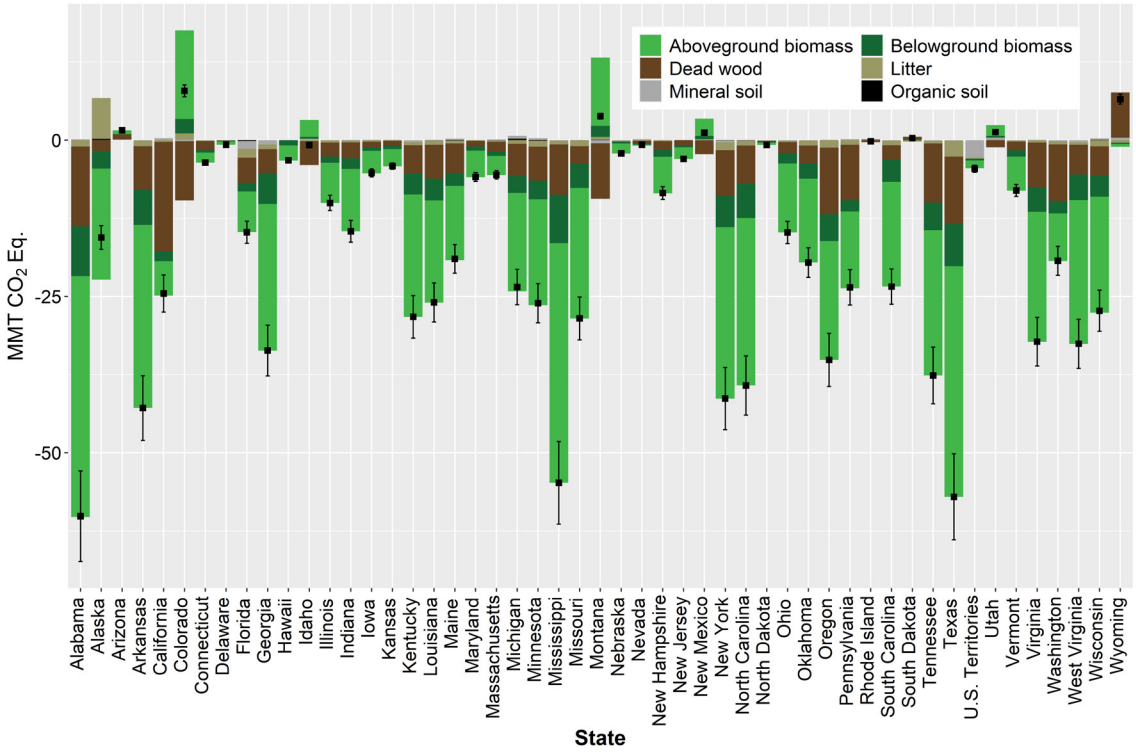


**Figure 1**—Estimated annual carbon stock changes by ecosystem pool for forest land remaining forest land and land converted to forest land (MMT $CO_2$ Eq.) in each of the conterminous United States, Alaska, Hawaii, and the U.S. Territories (American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and U.S. Virgin Islands) in 2024. Note that points and uncertainties represented by confidence intervals (95 percent) reflect net flux for all ecosystem pools in each State and the combined U.S. Territories. Negative estimates indicate net carbon uptake (i.e., a net removal of carbon from the atmosphere or transfer of carbon between ecosystem pools or land use categories).

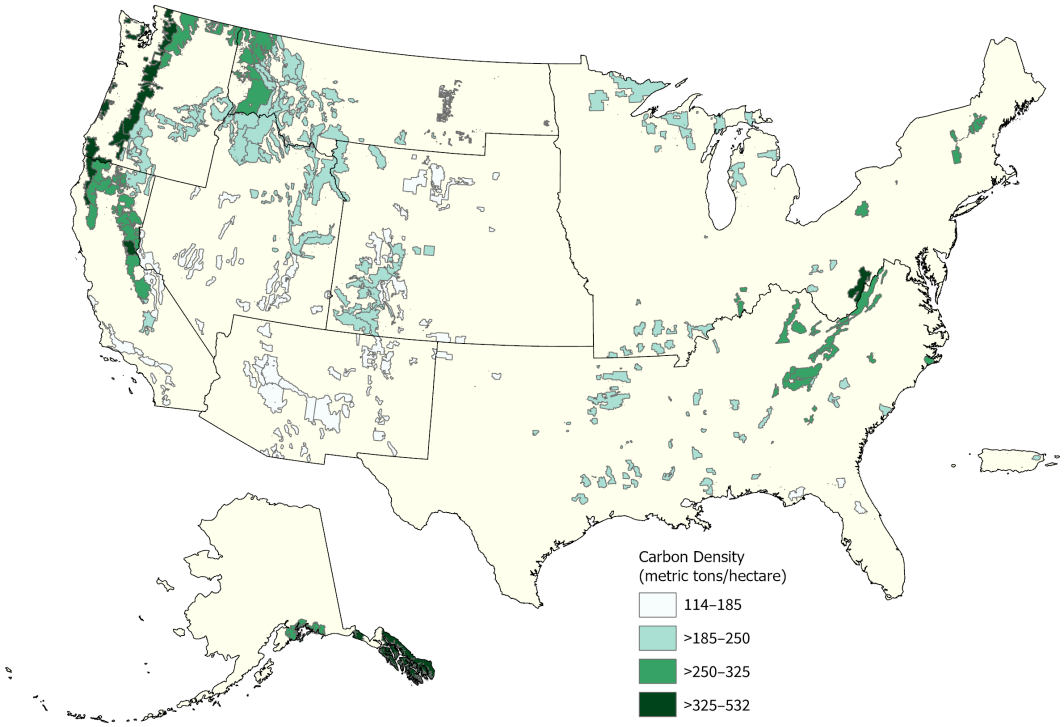


**Figure 2**—Total forest ecosystem carbon density (MT C $ha^{-1}$) for each national forest in the United States.

## Forest Carbon Cycle

In forests, carbon is cycled among ecosystem pools and the atmosphere as a result of biogeochemical processes (e.g., photosynthesis, respiration, decomposition), disturbances such as fires or pest outbreaks, and anthropogenic activities (e.g., land use and land use change). Living trees remove carbon from the atmosphere through photosynthesis, and that carbon is allocated to and stored in aboveground and belowground biomass; respiration returns carbon to the atmosphere. Carbon can also be transferred from live tree biomass to the dead wood pool through mortality. Stems, foliage, and other debris deposited on the forest floor transfer carbon to either the dead wood, litter, or soil pools, depending on attributes (e.g., size) of the debris and how the pools are defined (see sidebar). Carbon is cycled between dead wood, litter, and soil pools by organisms that facilitate decomposition and transfer of carbon between pools and the atmosphere through heterotrophic respiration.

The net change in forest carbon is not equivalent to the net flux between forests and the atmosphere because timber harvests do not result in an immediate release of all harvested biomass carbon to the atmosphere. Instead, following harvesting, a portion of the carbon stored in wood may be transferred to a wood "product pool." Once in a product pool, the carbon is emitted over time as carbon dioxide ($CO_2$) from decomposition; emitted as $CO_2$, methane ($CH_4$), nitrous oxide ($N_2O$), carbon monoxide (CO), and other nitrogen oxides ($NO_x$) through combustion; and/or may be transferred and stored in solid waste disposal sites. The rate of emission varies considerably among different product pools and solid waste disposal sites (U.S. EPA 2025).

In addition, carbon can cycle among forest land and other land use categories (e.g., grasslands, croplands, settlements, wetlands, or other lands). Carbon can enter or exit a forest ecosystem through processes such as lateral transport (e.g., through erosion and land-water transport). Carbon can also be transferred from forest land to other land use categories through land conversion, or the reverse can occur through reforestation, afforestation, or both. Finally, emissions estimates associated with some of the human activities within U.S. forest ecosystems (e.g., fuel use associated with forest harvesting) and the use of products (e.g., energy use and/or waste disposal from paper manufacturing) resulting from those activities are included in other sectoral chapters in U.S. EPA (2025) and Desai et al. (2026).

## Carbon Pools

**When estimating carbon stocks or stock change (flux), carbon in forest ecosystems can be divided into the following five storage pools (IPCC 2006):**

- Aboveground biomass—All living biomass above the soil including stems, stumps, branches, bark, seeds, and foliage. This pool also includes live understory biomass.
- Belowground biomass—All living biomass of coarse living roots with diameters greater than 2 mm.
- Dead wood—All nonliving woody biomass either standing, lying on the ground (but not including litter), or in the soil.
- Litter—All duff, humus, and fine woody debris above the mineral soil, including woody fragments with diameters of up to 7.5 cm.
- Soil organic carbon—All organic material in soil to a depth of 1 m but excluding the coarse roots of the belowground pools. Organic (e.g., peat and muck) soils have a minimum of 12 to 20 percent organic matter by mass and develop under poorly drained conditions of wetlands. All other soils are classified as mineral soil types and typically have relatively low amounts of organic matter.

**Two harvested wood pools are also included when estimating carbon flux:**

- Harvested wood products in use.
- Harvested wood products in solid waste disposal sites.

## Total Emissions and Removals

Forest land, harvested wood products, and woodlands individually and collectively represent a net carbon sink over the 1990–2024 time series, with interannual variability driven, in large part, by natural and anthropogenic forest disturbances (e.g., wildfire, harvesting), transfers resulting from land conversions (e.g., forest land converted to cropland and settlements, reforestation/afforestation), and changes in harvested wood products stocks in use and transfers to solid waste disposal sites (table 1). In 2024, forest land, harvested wood products, and woodlands collectively represented an estimated net increase in carbon stocks of 819.1 million metric tons of carbon dioxide equivalent (MMT $CO_2$ Eq.). The forest land remaining forest land category is the largest net carbon sink in the land sector, with an estimated uptake of -758.5 MMT $CO_2$ Eq. from forest ecosystem pools. For categories included in this resource bulletin, the largest source of emissions and/or transfers of carbon was from the conversion of forest land to other land uses, with estimated emissions of 141.5 MMT $CO_2$ Eq. (table 1).

**Table 1**—Emissions and removals (net flux) from land use, land use change, and forestry (MMT $CO_2$ Eq.) by year

| Emissions and removals category[a] | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| Forest land remaining forest land[b] | (924.5) | (919.3) | (892.9) | (842.2) | (827.1) | (782.9) | (745.6) | (779.7) | (758.5) |
| Non-$CO_2$ emissions from fire | 5.8 | 1.0 | 11.1 | 17.6 | 5.7 | 26.6 | 15.7 | 6.0 | 4.4 |
| Non-$CO_2$ emissions from drained organic soils | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Forest land converted to nonforest land[b] | 133.1 | 134.3 | 135.5 | 136.7 | 138.0 | 139.5 | 141.4 | 141.3 | 141.5 |
| Nonforest land converted to forest land[b] | (100.7) | (100.8) | (100.9) | (101.1) | (101.2) | (101.4) | (100.8) | (100.8) | (100.9) |
| Harvested wood products | (123.8) | (112.2) | (93.5) | (106.1) | (69.1) | (91.4) | (92.8) | (90.9) | (100.5) |
| Woodlands remaining woodlands[c] | (1.3) | (1.2) | (1.2) | (1.1) | (1.0) | (1.0) | (0.8) | (0.8) | (0.8) |
| **Total carbon stock change[d]** | **(1,017.1)** | **(999.3)** | **(952.9)** | **(913.7)** | **(860.4)** | **(837.3)** | **(798.6)** | **(830.9)** | **(819.1)** |
| **Total net emissions and removals[e]** | **(1,011.3)** | **(998.2)** | **(941.8)** | **(896.0)** | **(854.6)** | **(810.6)** | **(782.8)** | **(824.8)** | **(814.6)** |

Notes: Estimates of $N_2O$ emissions and urban trees in settlements have been removed from this table in the latest compilation due to changes in national reporting and capacity to compile those estimates. Totals may not sum due to independent rounding. Parentheses indicate net carbon uptake (i.e., a net removal of carbon from the atmosphere or transfer from another carbon pool).

[a] For details on these estimates and how they were compiled, see U.S. EPA (2025).

[b] Estimated emissions and removals include the net changes to carbon stocks stored in all ecosystem pools. Note that in the forest land converted to nonforest land category, emissions and removals from forest land converted to other lands are not currently included in U.S. EPA (2025); forest land converted to wetlands estimates were not compiled by the Forest Service in U.S EPA (2025) but are included here based on methods used to compile estimates for other land conversion categories. Estimates of soil carbon change are not included for forest land converted to other lands and forest land converted to wetlands.

[c] Estimates for woodlands, which are included in the grassland land use category, were compiled using the same methods and models as those in the forest land category.

[d] Total carbon stock change includes any carbon stock gains and losses from all land use and land use conversion categories.

[e] Total net emissions and removals are the net sum of all non-$CO_2$ ($CH_4$ and $N_2O$) emissions to the atmosphere plus net carbon stock changes in units of MMT $CO_2$ Eq.

## Forest Land Remaining Forest Land and Harvested Wood Products

Within the forest land remaining forest land category, aboveground live biomass is the largest contributor to the net uptake over the reporting period, followed by transfers from live biomass to dead wood and belowground live biomass (table 2). Harvested wood products in use and in solid waste disposal sites are also important contributors to the net carbon sink in the land sector; in 2024, net uptake/transfer for both of these harvested wood products pools increased from previous years.

Carbon stock estimates for forest ecosystem and harvested wood carbon storage pools are presented in table 3. Together, the estimated aboveground biomass and soil carbon pools account for nearly 82 percent of total forest ecosystem carbon stocks. By maintaining current harvesting practices and regeneration activities on these forested lands, along with continued input into the harvested wood products pool, carbon stocks in forests are likely to continue to increase in the near term, though possibly at a lower rate. Because most of the timber harvested from U.S. forest land is used in wood products and many discarded wood products are disposed of in solid waste disposal sites rather than by incineration, significant quantities of carbon in harvested wood are transferred to these long-term storage pools rather than being released rapidly to the atmosphere (Skog 2008).

**Table 2**—Emissions and removals (net flux) from forest land remaining forest land and harvested wood pools (MMT $CO_2$ Eq.) by year

| Carbon pool[a] | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| **Forest** | **(924.5)** | **(919.3)** | **(892.9)** | **(842.2)** | **(827.1)** | **(782.9)** | **(745.6)** | **(779.7)** | **(758.4)** |
| Aboveground biomass | (606.6) | (593.9) | (579.2) | (555.7) | (534.0) | (517.1) | (489.1) | (491.8) | (480.0) |
| Belowground biomass | (119.1) | (116.4) | (113.6) | (109.5) | (105.3) | (102.5) | (97.4) | (97.4) | (95.1) |
| Dead wood | (201.5) | (201.6) | (199.7) | (194.3) | (192.9) | (190.6) | (185.3) | (186.5) | (183.8) |
| Litter | (3.6) | (13.2) | (5.0) | 14.3 | 3.9 | 28.0 | 29.6 | (0.8) | 3.4 |
| Soil (mineral) | 6.1 | 5.5 | 4.4 | 2.7 | 0.6 | (1.4) | (4.2) | (4.1) | (3.9) |
| Soil (organic) | (0.5) | (0.5) | (0.5) | (0.4) | (0.2) | (0.0) | 0.2 | 0.1 | 0.1 |
| Drained organic soil | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| **Harvested wood** | **(123.8)** | **(112.2)** | **(93.4)** | **(106.0)** | **(69.1)** | **(91.4)** | **(92.8)** | **(90.9)** | **(100.5)** |
| Products in use | (54.8) | (51.7) | (31.9) | (42.6) | (7.4) | (27.1) | (28.8) | (27.4) | (35.5) |
| Solid waste disposal sites | (69.0) | (60.5) | (61.5) | (63.4) | (61.7) | (64.3) | (63.9) | (63.5) | (64.9) |
| **Total net flux** | **(1,048.2)** | **(1,031.5)** | **(986.3)** | **(948.2)** | **(896.2)** | **(874.4)** | **(838.3)** | **(870.6)** | **(858.9)** |

Notes: Totals may not sum due to independent rounding. Parentheses indicate net carbon uptake (i.e., a net removal of carbon from the atmosphere or transfer from another carbon pool).

[a] For details on these estimates and how they were compiled, see U.S. EPA (2025).

**Table 3**—Carbon stocks in forest land remaining forest land and harvested wood pools (MMT C) by year

| Carbon pool[a] | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2022 | 2023 | 2024 | 2025[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| **Forest** | **55,518** | **56,783** | **58,023** | **59,200** | **60,357** | **61,489** | **63,031** | **63,234** | **63,447** | **63,654** |
| Aboveground biomass | 12,575 | 13,396 | 14,198 | 14,973 | 15,722 | 16,445 | 17,429 | 17,563 | 17,697 | 17,828 |
| Belowground biomass | 2,219 | 2,380 | 2,537 | 2,690 | 2,837 | 2,980 | 3,175 | 3,201 | 3,228 | 3,254 |
| Dead wood | 2,798 | 3,074 | 3,347 | 3,615 | 3,882 | 4,146 | 4,513 | 4,564 | 4,614 | 4,665 |
| Litter | 3,777 | 3,792 | 3,806 | 3,792 | 3,788 | 3,790 | 3,779 | 3,771 | 3,771 | 3,770 |
| Soil (mineral) | 28,303 | 28,295 | 28,288 | 28,283 | 28,281 | 28,281 | 28,287 | 28,288 | 28,289 | 28,290 |
| Soil (organic) | 5,845 | 5,846 | 5,847 | 5,847 | 5,848 | 5,848 | 5,848 | 5,848 | 5,848 | 5,847 |
| **Harvested wood** | **1,895** | **2,061** | **2,218** | **2,353** | **2,462** | **2,567** | **2,747** | **2,772** | **2,797** | **2,824** |
| Products in use | 1,249 | 1,326 | 1,395 | 1,447 | 1,471 | 1,490 | 1,547 | 1,555 | 1,562 | 1,572 |
| Solid waste disposal sites | 646 | 735 | 823 | 906 | 991 | 1,076 | 1,200 | 1,217 | 1,235 | 1,252 |
| **Total stocks** | **57,413** | **58,844** | **60,241** | **61,553** | **62,819** | **64,056** | **65,777** | **66,006** | **66,244** | **66,478** |

Notes: Totals may not sum due to independent rounding. Forest carbon stock estimates include all forest land remaining forest land in the conterminous United States, Alaska, Hawaii, and U.S. Territories (American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and U.S. Virgin Islands). Forest ecosystem carbon stocks on managed forest land in Alaska, Hawaii, and U.S. Territories were compiled using the gain-loss method described in Annex 3.14 of U.S. EPA (2025). Harvested wood product stocks include exports, even if the logs are processed in other countries, and exclude imports. Harvested wood estimates are based on results from annual surveys and models. Totals may not sum due to independent rounding. Population estimates compiled using Forest Inventory and Analysis data are assumed to represent stocks as of January 1 of the inventory year.

[a] For details on these estimates and how they were compiled, see U.S. EPA (2025).

[b] Flux is the net annual change in stock and thus flux estimates for 2024 require carbon stocks for 2024 and 2025.

### Ownership

Private forest land accounts for more than 80 percent (-607 MMT $CO_2$ Eq.) of the estimated net carbon sink strength in the conterminous United States, coastal Alaska, Hawaii, and the U.S. Territories of American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and U.S. Virgin Islands (hereafter referred to as the U.S. Territories) in 2024. The private forests of the Southern United States, in particular, continue to account for the majority (-367 MMT $CO_2$ Eq.) of carbon uptake.

The majority (62 percent) of Tribal forest land area is in the Rocky Mountain region (3.1 million ha), which also represents more than 50 percent (473 MMT C) of the forest ecosystem carbon in this ownership category. Tribal forest lands are a net carbon sink in each region of the United States, with the largest annual net uptake in the North region (-2.5 MMT $CO_2$ Eq.) followed by the Pacific Coast region (-2.1 MMT $CO_2$ Eq.; table 4).

Public forest land makes up a relatively small but important part of the U.S. forest carbon sink. Much of the public forest land is in the Western United States, where wildfire (see "Fire Emissions and Area Burned") and other disturbances have led to substantial emissions and transfers of carbon from live trees to the dead organic matter pools (i.e., dead wood and litter), altering the capacity of forests to sequester and store carbon. This is particularly true on forest land within the National Forest System, which accounts for approximately 34 percent (-50.8 MMT $CO_2$ Eq.) of the public land carbon sink in 2024, although nearly all the annual net carbon sink (-41.4 MMT $CO_2$ Eq.) is due to transfers from the live biomass carbon pool to dead wood carbon pool in the Western United States (table 5). The regional National Forest System estimates have been further disaggregated by individual national forest (fig. 2) and can be found in the research datasets (Walters et al. 2026a, 2026b).

**Table 4**—Carbon stock changes (net flux) from Tribal forest land remaining forest land (MMT $CO_2$ Eq.) by region and year

| Region | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| North | (2.4) | (2.4) | (2.4) | (2.5) | (2.5) | (2.5) | (2.5) | (2.5) | (2.5) |
| Pacific Coast | (2.0) | (2.1) | (2.2) | (2.4) | (2.4) | (2.5) | (2.2) | (2.1) | (2.1) |
| Rocky Mountain | (1.1) | (1.1) | (1.1) | (1.1) | (1.0) | (1.0) | (1.0) | (1.0) | (1.0) |
| South | (0.6) | (0.6) | (0.6) | (0.7) | (0.8) | (0.9) | (0.8) | (0.8) | (0.8) |
| **Net carbon stock changes** | **(6.0)** | **(6.1)** | **(6.3)** | **(6.5)** | **(6.7)** | **(6.9)** | **(6.5)** | **(6.4)** | **(6.4)** |

Note: Parentheses indicate net carbon uptake (i.e., a net removal of carbon from the atmosphere or transfer from another carbon pool).

**Table 5**—Carbon stock changes (net flux) from forest land remaining forest land within the National Forest System (MMT $CO_2$ Eq.) by region and year

| National Forest System region | 2005 | 2010 | 2015 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|
| Alaska | (5.2) | (5.6) | (5.9) | (6.0) | (6.0) | (6.0) | (6.0) | (6.0) |
| Eastern | (18.8) | (18.9) | (19.4) | (19.8) | (19.7) | (19.5) | (19.4) | (19.3) |
| Intermountain | 11.6 | 11.5 | 12.2 | 13.3 | 13.5 | 13.6 | 13.8 | 13.9 |
| Northern | (4.2) | (3.9) | (3.6) | (3.1) | (3.0) | (2.9) | (2.7) | (2.6) |
| Pacific Northwest | (26.7) | (28.0) | (29.3) | (29.8) | (29.8) | (29.9) | (29.9) | (30.0) |
| Pacific Southwest | (4.8) | (5.2) | (5.7) | (3.8) | (3.3) | (2.9) | (2.5) | (2.0) |
| Rocky Mountain | 11.7 | 12.3 | 12.9 | 13.0 | 13.0 | 12.9 | 12.8 | 12.7 |
| Southern | (27.2) | (27.4) | (27.5) | (27.2) | (27.0) | (26.6) | (26.1) | (25.6) |
| Southwestern | 6.4 | 6.7 | 7.0 | 7.6 | 7.7 | 7.8 | 7.9 | 8.1 |
| **Net emissions and removals** | **(57.2)** | **(58.5)** | **(59.3)** | **(56.0)** | **(54.6)** | **(53.4)** | **(52.1)** | **(50.8)** |

Note: Parentheses indicate net carbon uptake (i.e., a net removal of carbon from the atmosphere or transfer from another carbon pool).

## Forest Land Conversions

Land use conversions to and from forest land result in substantial emissions and removals each year. This section includes all emissions and removals for land conversions to and from forest land, as reported in U.S. EPA (2025) and Desai et al. (2026). It is important to note that, in some cases, the reported emissions or removals from one land use category are transfers to another land use category. Forest land conversion to settlements was the largest source of emissions in the conversion categories, while grassland conversion to forest land resulted in the largest annual uptake/transfer. Considering all forest land conversions included in U.S. EPA (2025) and Desai et al. (2026), there have been net emissions each year throughout the reporting period. Estimated net emissions of ~40.6 MMT $CO_2$ Eq. were recorded for each of the last 3 reporting years (table 6).

**Table 6**—Carbon stock changes (net flux) from conversions to and from forest land (MMT $CO_2$ Eq.) by year

| Land conversions[a] | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| Forest land converted to cropland | 18.2 | 18.2 | 18.2 | 18.2 | 18.3 | 18.4 | 18.6 | 18.6 | 18.6 |
| Forest land converted to grassland | 49.6 | 49.1 | 48.4 | 47.6 | 46.7 | 45.6 | 44.2 | 44.2 | 44.2 |
| Forest land converted to other land | 2.4 | 2.3 | 2.2 | 2.2 | 2.1 | 2.2 | 3.1 | 3.1 | 3.1 |
| Forest land converted to settlements | 56.3 | 58.0 | 59.8 | 61.8 | 63.9 | 66.2 | 68.6 | 68.6 | 68.7 |
| Forest land converted to wetlands | 6.6 | 6.7 | 6.8 | 6.9 | 7.0 | 7.1 | 7.0 | 7.0 | 7.0 |
| Cropland converted to forest land | (18.4) | (18.3) | (18.3) | (18.2) | (18.2) | (18.1) | (18.0) | (18.0) | (18.0) |
| Grassland converted to forest land | (37.8) | (38.0) | (38.1) | (38.2) | (38.4) | (38.5) | (38.6) | (38.6) | (38.6) |
| Other land converted to forest land | (3.9) | (4.0) | (4.1) | (4.2) | (4.2) | (4.3) | (3.8) | (3.8) | (3.8) |
| Settlements converted to forest land | (32.9) | (32.8) | (32.8) | (32.7) | (32.7) | (32.6) | (32.5) | (32.5) | (32.5) |
| Wetlands converted to forest land | (7.7) | (7.7) | (7.7) | (7.8) | (7.8) | (7.8) | (7.8) | (7.8) | (7.8) |
| **Net emissions and removals** | **32.4** | **33.5** | **34.6** | **35.6** | **36.8** | **38.1** | **40.6** | **40.5** | **40.6** |

Notes: Totals may not sum due to independent rounding. Parentheses indicate net carbon uptake (i.e., a net removal of carbon from the atmosphere or transfer from another carbon pool). Emissions and removals from forest land converted to other lands are not currently included in U.S. EPA (2025); forest land converted to wetlands estimates were not compiled by the Forest Service in U.S EPA (2025) but are included here based on methods used to compile estimates for other land conversion categories. Estimates of organic soil carbon are not included for any of the land conversion categories and mineral soil carbon change is not included for forest land converted to other lands and forest land converted to wetlands.

[a] For details on these estimates and how they were compiled, see U.S. EPA (2025).

## Land Area

The land area covered in U.S. EPA (2025) and Desai et al. (2026) includes lands directly influenced by human intervention. Direct intervention mostly occurs in areas accessible to human activity and includes altering or maintaining the condition of the land for the following reasons: to produce commercial or noncommercial products or services; to serve as transportation corridors or locations for buildings, landfills, or other developed areas for commercial or noncommercial purposes; to extract resources or facilitate acquisition of resources; or to provide social functions for personal, community, or societal objectives where these areas are readily accessible to society. FIA data from each of the conterminous United States, Alaska, Hawaii, and the U.S. Territories comprise an estimated 281 million ha of forest land that are considered managed and are included in this report along with an additional 1.0 million ha of nonforest land converted to forest land (table 7). Some differences exist in forest land area estimates in the latest Resources Planning Act Assessment as noted in Nelson et al. (2020) and the forest land area estimates included in U.S. EPA (2025), which are based on annual FIA data through 2023 for all States (USDA Forest Service 2026a, 2026b). These differences are mainly due to the separation of land categories and the managed land definition used in U.S. EPA (2025) (Nelson et al. 2020). Agroforestry systems that meet the definition of forest land were not included in U.S. EPA (2025) or Desai et al. (2026) since they are not explicitly inventoried (i.e., they are classified as agroforestry systems) by the FIA program or the National Resources Inventory of the USDA Natural Resources Conservation Service. Woodland area is included in the grassland remaining grassland category and was not explicitly separated in U.S. EPA (2025) or Desai et al. (2026) as a subcategory of grasslands. Combined, managed forest land and woodland area account for more than 300 million ha (table 7). There is also forest land converted to nonforest land, which has increased slightly since 2010 and in 2025 accounted for 1 million ha (table 7).

**Table 7**—Annual estimates of forest land and woodland area (1,000 ha) by year

| Land area category[a] | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Forest land remaining forest land | 279,355 | 279,469 | 279,620 | 279,845 | 280,039 | 280,328 | 280,578 | 280,583 | 280,590 | 280,598 |
| Nonforest land converted to forest land | 1,057 | 1,064 | 1,056 | 1,061 | 1,051 | 1,075 | 1,022 | 1,025 | 1,025 | 1,025 |
| Woodland remaining woodland[b] | 25,871 | 25,166 | 24,396 | 23,412 | 22,384 | 20,955 | 19,289 | 19,113 | 18,938 | 18,763 |
| Forest land converted to nonforest land | 1,043 | 1,041 | 1,026 | 1,020 | 1,017 | 1,018 | 1,018 | 1,023 | 1,023 | 1,023 |
| **Total area** | **306,284** | **305,699** | **305,072** | **304,319** | **303,474** | **302,359** | **300,889** | **300,721** | **300,554** | **300,386** |

Notes: Totals may not sum due to independent rounding. The estimates reported here may differ from the Land Representation section of U.S. EPA (2025) but are consistent with estimates used to compile emissions and removals in these categories. See Annex 3.14 in U.S. EPA (2025) for more details.

[a] For details on these estimates and how they were compiled, see U.S. EPA (2025).

[b] Woodland area is included in the "grassland remaining grassland" category and is not explicitly separated in U.S. EPA (2025).

## Fire Emissions and Area Burned

Carbon dioxide emissions from wildfire and prescribed fire on forest land are inherently captured in the carbon stock change estimates described in tables 1 and 2. Fire emissions estimates from forest land are also compiled separately in U.S. EPA (2025) and Desai et al. (2026) using a combination of field inventories, remotely sensed information, and models, and these estimates are reported for each year in the time series (fig. 3) and by State in Walters et al. (2026a, 2026b). There is substantial interannual variability in forest land area burned and associated greenhouse gas emissions resulting from fire over the last three decades. In 2024, the area of forest land burned was estimated at 361,580 ha, $CO_2$ emissions were 42.5 MMT $CO_2$, and non-$CO_2$ emissions estimates were 4.4 MMT $CO_2$ Eq. (fig. 3). Note that the Monitoring Trends in Burn Severity (MTBS) program updates burn mosaics used in the compilation of fire emissions (Smith et al. 2024) on an ongoing basis, so the estimates reported in this resource bulletin and in Walters et al. (2026b), particularly for the year 2024, may not include all fires in the latest MTBS product and thus may underestimate fire emissions.

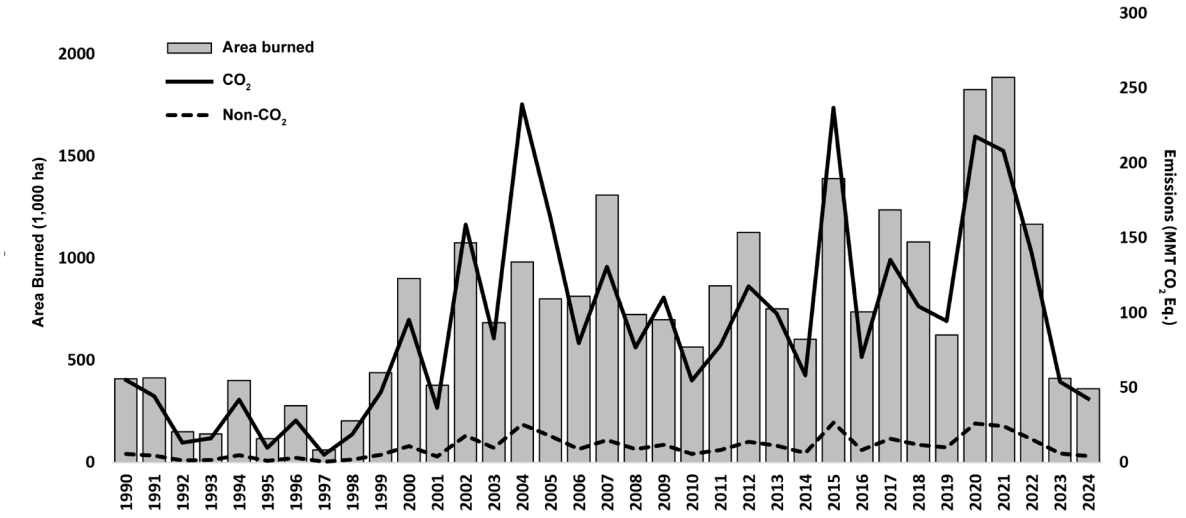


**Figure 3**—Estimated annual $CO_2$ and non-$CO_2$ ($N_2O$ and $CH_4$) emissions from wildfire and prescribed fire and area burned on forest land in the United States, 1990–2024.

## Planned Improvements

While recent changes in Federal greenhouse gas reporting arrangements have resulted in the discontinuation of a centralized national inventory compilation, the Forest Service continues to plan for and make improvements to estimation and reporting methods, models, and tools to support stakeholder needs. Research is underway to leverage auxiliary information (i.e., remotely sensed information) to operate at finer spatial and temporal scales (e.g., Johnson et al. 2025a, 2025b). As in past resource bulletins, emissions and removals associated with natural (e.g., wildfire, insects, disease) and human (e.g., harvesting) disturbances are implicitly included in reporting given the design of the annual NFI but are not explicitly estimated. In addition to integrating auxiliary information into the estimation framework, alternative estimators are also being evaluated (e.g., Doser et al. 2025, White et al. 2026) that will reduce or eliminate lag bias in population estimates from the NFI, improve annual estimation and characterization of interannual variability (e.g., Shannon et al. 2025), facilitate correlation of fluxes with particular disturbances and/or activities (e.g., Liu et al. 2025, Hogan et al. 2024, Fitts et al. 2022), and allow for easier harmonization of NFI data with auxiliary data products (Walters et al. 2026a, 2026b). Investments are also being made to leverage subnational wood products and harvest information to allow for the disaggregation of harvested wood products estimates at the subnational scale (e.g., Nash and Domke 2026). Collectively, these improvements are expected to reduce uncertainties in the estimates at the national and State scales and facilitate entity-level estimation and reporting (e.g., individual national forest estimates).

## 2024 Estimates at a Glance

**The following results for 2024 are summarized from the compilation of the forest land, woodlands, and harvested wood products:**

- Economywide greenhouse gas emissions increased from 2023 to 2024 by approximately 0.2 percent.
- Several improvements in the methods and models used in the latest inventory resulted in substantial changes in estimates over the time series for several key categories included in this resource bulletin.
- Forest land, harvested wood products, and woodlands collectively removed the equivalent of more than 13 percent (814.6 MMT $CO_2$ Eq.) of total greenhouse gas emissions or 16.6 percent of $CO_2$ emissions in 2024.
- Private forest land accounts for more than 80 percent (-607 MMT $CO_2$ Eq.) of the estimated net carbon sink strength in the conterminous United States and coastal Alaska in 2024.
- Land conversions to and from forest land continue to result in net emissions and/or transfers of carbon to other land uses (40.6 MMT $CO_2$ Eq.).
- Soils store nearly 54 percent of all the carbon in forest ecosystems, with small stock changes annually.
- Forest land area burned in 2024 (361,580 ha) was well below the 1990–2024 average as were non-$CO_2$ emissions at 4.4 MMT $CO_2$ Eq.
- Forest uptake averages 0.7 MT C $ha^{-1}$ $yr^{-1}$, with live vegetation accounting for more than 76 percent (0.6 MT C $ha^{-1}$ $yr^{-1}$) of the uptake.

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