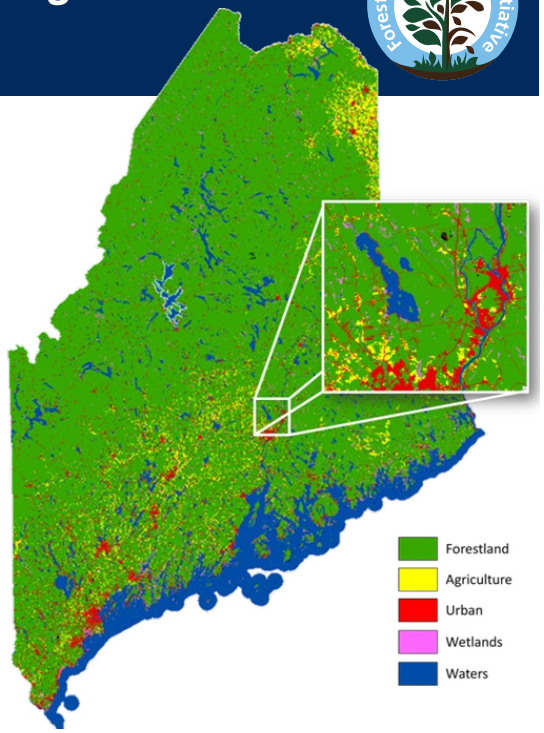
The State of Maine's Carbon Budget

Version 2.0

The state of Maine is increasingly experiencing the impacts of climate change through warming temperatures, more frequent and severe storms, periods of drought, flooding, and sea-level rise. These impacts are having dramatic effects on Maine's landscapes and ecosystems, its infrastructure and economy, and human health. In response, in 2019 Maine established statutory mitigation targets requiring a 45% reduction in greenhouse gas (GHG) emissions below 1990 levels by 2030, and at least 80% reduction by 2050. A critical part of this process is the tracking and biennial reporting of progress toward these goals by the Maine Department of Environmental Protection (DEP).



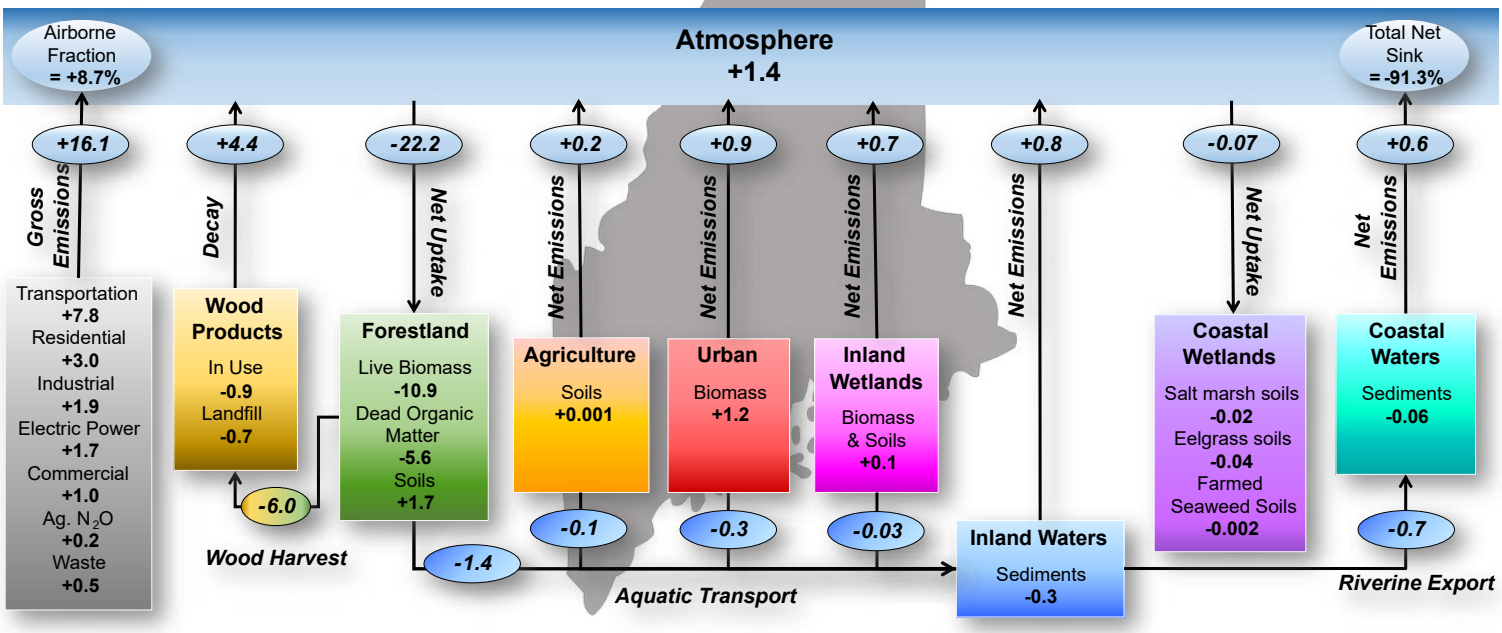
This map combines categories from the USGS National Land Cover Database (NLCD) for 2021 to show the general distribution of the major natural and working lands and waters sectors across Maine, with an inset map shown in greater spatial detail.

Greenhouse gases (GHGs) are emitted by human activities to the atmosphere (sources) and contribute to climate warming, but with some portion of the carbon (C) taken up and sequestered in natural and managed ecosystems (sinks). Accounting for this C budget is required for understanding human impacts on climate, guiding mitigation strategies, and informing future projections.

The carbon budget assessment shown here is the second iteration of an estimate of the major flows of carbon among the various component pools of The State of Maine's Carbon Budget. Fluxes are estimated as either stock changes (differences in stocks between two years divided by the number of years) or direct fluxes (typically estimated by factors derived from the literature and/or as reported annually by the U.S. Environmental Protection Agency [EPA] in the "Inventory of U.S. Greenhouse Gas Emissions and Sinks"). The data represent an approximate 5-year period of averaging to estimate an annual change or flux for most compartments in this budget, which are compared with an accounting of annual gross GHG emissions over the same time period, as required by Maine statutes.

The State of Maine Carbon Budget ca. 2021

Average annual emissions and removals ($MMTCO_2e$ per year) from 2017 to 2021



Note. This budget diagram illustrates the contemporary state of the carbon cycle in the State of Maine, USA, with estimates of carbon stock change within and fluxes between the major component pools, or "buckets". The estimates are provided here as annual averages, in million metric tons of carbon dioxide equivalent per year ($MMTCO_2e/yr$), approximating the time period from 2017 to 2021. The estimates are given from the atmospheric perspective, where positive values represent net emissions and negative values are net removals.

Key Takeaways

- Gross GHG emissions have declined but are still projected to be slightly higher than reduction targets.
- Maine's natural resources offset approximately 91% of the state's gross GHG emissions.
- Forestland is the most significant contributor to GHG removals in Maine.
- Coastal wetlands are highly effective for long-term carbon burial.
- Both GHG gross emissions and sequestration are needed to determine Maine's progress towards carbon neutrality.

Carbon Storage in Natural & Working Lands & Waters

- Maine's estimated gross GHG emissions (2017–2021) are the sum of sources from the Transportation, Residential, Industrial, Electric Power, Commercial, Agricultural N_2O and Waste categories (all expressed as $MMTCO_2e/yr$).
- Gross GHG emissions have declined over the last three inventory periods, from an average of +20.2 $MMTCO_2e/yr$ from 2007 to 2011 to +17.9 $MMTCO_2e/yr$ from 2012 to 2016.
- Data show steady declines in the Commercial and Industrial sectors, but the other energy sectors have been variable.
- Transportation has been responsible for the majority of GHG emissions.

Carbon input to the Forestland component happens through the fixation of CO_2 from the atmosphere into live biomass through the process of photosynthesis. Carbon is returned from the forest ecosystem to the atmosphere as CO_2 or CH_4 through plant maintenance respiration, organic matter decomposition, methane production, and biomass burning. The balance between uptake and release indicates more C is being removed from the atmosphere than is being released by the Forestland pools.

Questions? Concerns?
Email us! crsf@maine.edu

USFS Forest Inventory Analysis Estimates of Forest Carbon Emissions/Removals by Pool ($MMTCO_2e/yr$) on Forestland in Maine for Each 5-year Inventory Period

(MMT CO_2e / year)	2007–2011	2012–2016	2017–2021
Forest Carbon Pools	-10.4	-14.9	-14.8
Live Aboveground	-8.7	-14.2	-9.3
Live Belowground	-1.5	-2.6	-1.6
Dead Wood	-1.0	-1.4	-5.6
Litter	-0.1	0.2	0.0
Soil Organic	0.8	3.1	1.7
Wood Products	-1.5	-1.2	-1.6
In Use	-1.2	-0.8	-0.9
SWDS	-0.4	-0.4	-0.7
TOTAL	**-11.9**	**-16.0**	**-16.4**

This analysis was compiled as an outreach effort by researchers affiliated with the Center for Research on Sustainable Forests at the University of Maine, in collaboration with other partners in Maine. More information, including data sources and references, can be found online by visiting the Forest Climate Change Initiative website at: crsf.umaine.edu/forest-climate-change-initiative/carbon-budget. Data provided by Maine Dept. of Environmental Protection and USFS FIA; funding provided, in part, by USDA, NASA, NSF, and Northeastern States Research Cooperative.