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. This fact sheet illustrates an initial attempt to piece together the full C budget for the state of Maine.

**Key Findings**
- GHG emissions in Maine are dominated by burning fossil fuels, primarily from the transportation sector, but with a sharp decline in electric power emissions over the last decade.
- Carbon ‘offsets’ are estimated as 55% for forest growth and 75% for the total annual C cycle.
- Critical uncertainties in the budget arise from undersampled or unknown components. Improved assessments require advances in stock quantification and flux monitoring.

The plot below shows C emissions over time (since 1990) from the major sources of fossil fuel combustion in Maine. Carbon emissions from fossil fuel combustion in Maine peaked in 2002-04, and have been declining by ~3% per year since. Despite the decline, transportation emissions have maintained a steady pace and currently account for more than half of total emissions.

Carbon in crop residues can be incorporated into the soil, depending on management practices across the diversity of Maine’s 7,600 farms. Livestock are a major source of the emissions from this sector.

In built environments, the C stored in trees, gardens, lawns, and wooden structures from residential areas and parks are increasingly important in keeping C out of the atmosphere.
There are more than 277,000 acres of wetlands in Maine, including bogs and fens where C is stored in saturated organic (e.g., peat) and mineral soils. Carbon is transported from land through Maine’s rivers to the ocean. Some of that C is buried in lake sediments, while much of it outgasses from the water column. “Blue Carbon” is found in salt marshes and eelgrass ecosystems, which have high rates of C storage in their relatively small area in Maine.

The Major Components of Maine’s Carbon Cycle

The budget illustration below depicts the current state of the C cycle in Maine (all estimates are given as annual averages, in thousand metric tons of C per year, for 2007 to 2016). The synthesis of C flows through the various components represents the net effect of Maine’s C cycle on the amount of GHGs in the atmosphere—or its contribution to the speeding-up or slowing down of climate warming. This budget analysis suggests that ~25% of the 4.9 MMTC/yr emitted on average from fossil fuels in Maine is effectively contributed to the atmosphere (i.e., the “airborne fraction”) after accounting for sources and sinks in the state’s lands and waters. Using this full budget approach, Maine’s net emissions are estimated to be approximately 1.2 MMTC/yr.

The U.S. Energy Information Administration reports annual estimates of fossil fuel emissions by energy-consuming sector in each state. Agricultural emissions and other sources are compiled in the U.S. Environmental Protection Agency’s National Greenhouse Gas Inventory and Reporting.

Forest stocks and wood products are estimated by the U.S. Forest Service, which updates its Forest Inventory Analysis plot measurements across the country on a 5- to 10-year cycle. Fluxes in other land covers are estimated locally and extrapolated by satellite imagery, such as with the National Land Cover Dataset.

The U.S. Geological Survey maintains a large network of river sampling stations throughout the country that are used to estimate the lateral flux of C from land to the coastal ocean.

In Maine, atmospheric GHGs are measured at a NOAA “tall tower” in Argyle, and the Howland Research Forest is one of the longest-running ecosystem C flux monitoring sites in the world.

This analysis was compiled by the Center for Research on Sustainable Forests at the University of Maine, in collaboration with the Maine Forest Service and Bates College. 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