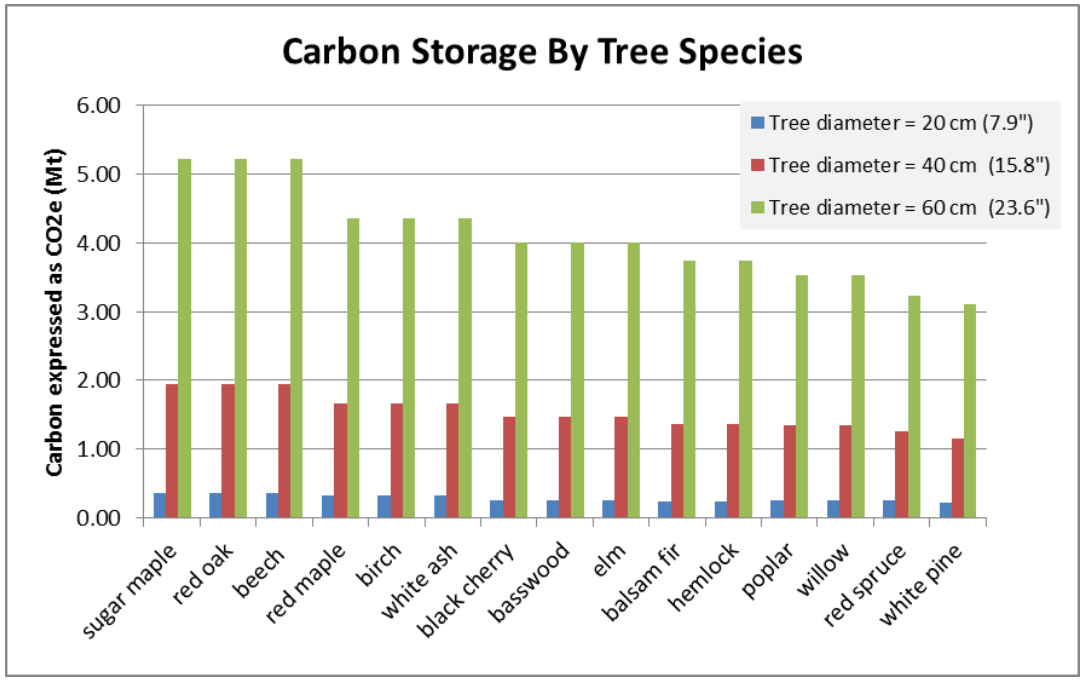
Forest Carbon

Plants absorb carbon dioxide (CO_2) from the atmosphere as they grow, and they store some of the carbon throughout their lifetime. Soils also store carbon, and in some cases may store greater amounts of carbon than the vegetation above ground. Three different aspects of forests and carbon are discussed here: individual trees, individual forests, and forest landscapes of Vermont.

Note: there is a difference between tree uptake of carbon (annual uptake) and tree storage of carbon (over the lifetime of trees). Both will be discussed.

Note: The amount of carbon in trees and forests is expressed here in the same units as our emissions to gage the value of forests to emission reductions.

How much carbon is in Vermont trees?



Trees of different species and ages can differ greatly in the amount of carbon uptake and storage. Hardwoods with dense wood tend to store more carbon than softwoods with lighter wood. Young trees have only a fraction of the amount of carbon stored in older, large diameter trees. Annual uptake of carbon is related to tree vigor and growth rate, so healthy, fast growing trees can accumulate carbon faster.

Figure 1. Illustration of the range of carbon storage based on species and size of trees.

Emissions By One Car Traveling For One Year …

Average Vehicle Miles Traveled per year = 11,318 miles
Average car and light trucks get 21.4 mpg
Each vehicle's annual emissions = 4.75 MtCO2e

Uptake of a 1" diameter conifer growing for 10 years = 0.039 MtCO2e
It would take 121, 1" diameter trees growing for 10 years to sequester emissions from one car.

= Sequestration By 121 Trees (1" diameter) Growing For 10 Years

How much carbon is stored in forests?

Factors influencing the amount of carbon in a forest:

- Size of the forest area
- Number, species and age of trees
- Soil type and depth
- Amount of dead and down organic material
- Disturbances such as insect defoliations or ice storm damage, which can significantly reduce carbon storage in forests.

The range of carbon stored in forests can be large, but the US Forest Service inventory estimates that privately owned forestland stores 77.1 metric tons carbon per acre; public forestland stores 81.6 to 84.6 Mt/A, with the National Forest storing the largest amount per acre.

Vermont forests on average store about 80 MtC per acre (293 MtCO2e) in above ground tree biomass.

Emissions Reduction By One Acre of Forest …

Each vehicle's annual emissions = 4.75 MtCO2e
Each acre of Vermont forestland sequesters 293 MtCO2e

= annual emission from 62 vehicles

How much carbon is stored in Vermont's forestland?

Emissions or sequestration of CO_2 can occur as land uses change. For example, CO_2 is exchanged between the atmosphere and the plants and soils on land when new areas are cultivated and become cropland or as pastureland reverts to forests.

In Vermont since 1990, land use, land-use change, and forestry activities have resulted in more removal of CO_2 from the atmosphere than emissions. Because of this, forests are considered a net sink, rather than a source, of CO_2 over this period. In many areas of the world, the opposite is true: In countries where large areas of forest land are cleared, often for agricultural purposes or for development, this change in land use can be a net source of greenhouse gas emissions.

Statewide greenhouse gas emissions are estimated at 8.37 million metric tons of CO2 equivalent (MMTCO2e) per year. Vermont forests remove an estimated 8.23 MMTCO2e per year. At the same time, storage of carbon in Vermont forests is about 469 MMTCO2e above ground and 1,315 MMTCO2e below ground.

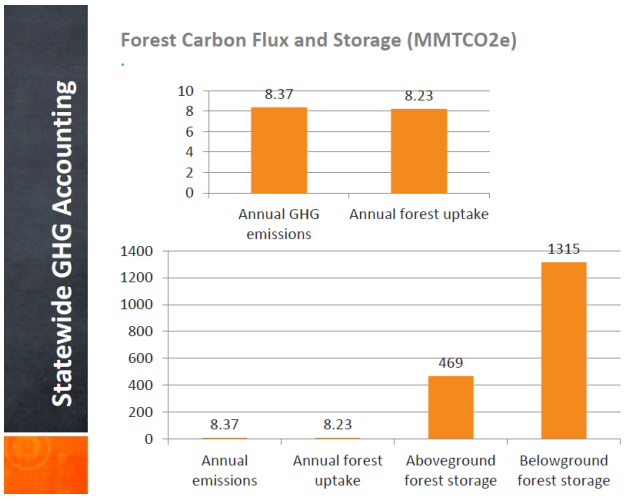


Figure 2. Annual uptake of carbon dioxide by forests (flux) compared to annual greenhouse gas emissions (GHG) (top graph). These same metrics are compared with long term storage of carbon in trees and in soils (lower graph).

Expanding areas of healthy forests will maximize carbon uptake and storage, more than any other land use. Where development does occur, planting trees will minimize carbon losses from soil, and accelerate vegetation growth to sequester additional carbon.