Forest Carbon

Plants absorb carbon dioxide (CO_2) from the atmosphere as they grow, accumulating and storing 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 (metric tonnes of carbon dioxide equivalent, MtCO2e) to gage the value of forests in 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 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.

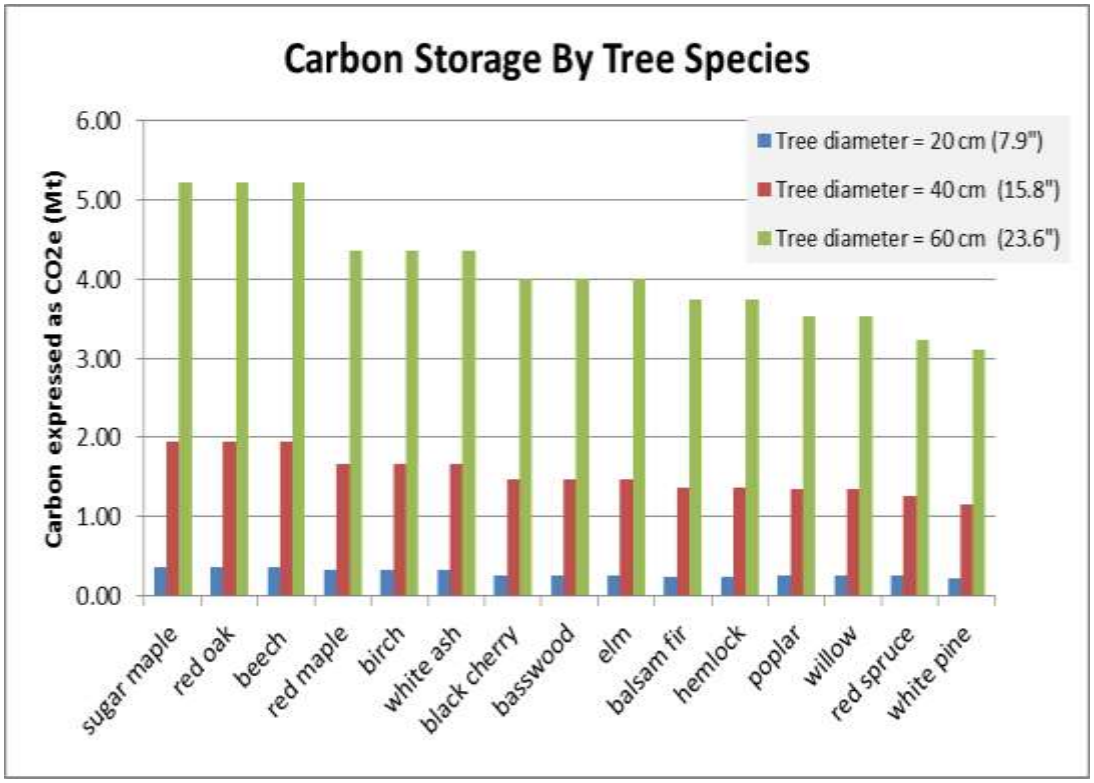

Figure 1. Illustration of the range of carbon storage based on species and size of trees.

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 can a forest store?

The range of carbon stored in forest trees and soil can be large. The most recent forest inventory (2015) showed that on average an acre of forest in Vermont stores 393 MtCO2e.

Vermont forests on average store 107 metric tonnes carbon (MtC) per acre or 393 MtCO2e per acre.

Factors influencing forest carbon:

- Size of the forest area
- Tree characteristics: species, number of trees per acre and age of trees
- Soil type, depth, and amount of organic matter
- Abundance of down and dead trees
- Disturbances such as insect defoliations, ice storm damage, or human activities in the forest, which can significantly reduce carbon storage.

One Acre of Forest stores ...

Each vehicle's annual emissions = 4.75 MtCO2e
Each acre of Vermont forestland stores 393 MtCO2e

... the equivalent of annual emissions from 83 vehicles.

How much carbon is stored Statewide?

Emissions or sequestration of CO_2 can occur as land uses change. For example, CO_2 is exchanged between air, plants, and soil when new areas are cultivated for crops or when pastureland reverts to forest. With so many land use changes occurring daily, it is challenging to inventory forest carbon storage and uptake.

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. In many areas of the world, the opposite is true. In countries where large areas of forest land are cleared, for development or agricultural purposes, this change in land use can be a net source of greenhouse gas emissions.

The latest greenhouse gas inventory for Vermont shows emissions for 2012 at 8.27 MMtCO2e. For comparison, carbon uptake by Vermont forests was equivalent to 4.44 MMtCO2e (2012 updated methods*).

Vermont Emissions (2012) = 8.27 MMtCO2e
Forest Uptake (2012) = 4.44 MMtCO2e

Conserving forest land and expanding areas of healthy forests will maximize carbon uptake and storage. Where development does occur, re-planting trees will minimize carbon losses from soil, and accelerate vegetation growth to sequester additional carbon.

**Recent changes have been made in how forest carbon in the U.S. is calculated. See: Woodall, C.W. et al. The U.S. Forest Carbon Accounting Framework: Stocks and Stock Change, 1990-2016. USDA FS GTR NRS-154. 2015.*