

CARBON DIOXIDE (CO₂) SEQUESTRATION

CALCULATOR

A tool for calculating the carbon dioxide capture potential of existing or planned trail

BACKGROUND

Plant life captures and stores carbon found in the environment. These natural “hoarders” capture carbon dioxide resulting from sources like automobiles and industry. With this in mind, granting agencies seek data on how much carbon a landscaped trail may capture as one measure of a project’s environmental benefit.

This Fact Sheet outlines the Trail Program’s calculation. We’ve made it available to support greater discussion, refinement of the process, and eventual uniformity for this measure.

This calculator was developed because we could not find a CO₂ Sequestration Calculator. The data gathered for our calculation is drawn from web-sourced agencies and organizations that appear to be credible.

The calculator can be used to generally understand how much CO₂ a single tree has potentially sequestered over its life span. The calculator works for trees only and not other plants like shrubs and ground covers.

Assumptions made should be carefully considered when running your own calculations.

BASE DATA COLLECTION

Gather basic data about your existing or proposed trees; specifically, the species, diameter & height, and green weight

Determining Tree Species

If you’re working with an existing tree, characteristics of the bark and leaves can help you determine the tree species. If unsure, the Arbor Day Foundation website provides a [tree identification tool](#). Other resources may be a trained arborist, Landscape Architect, Landscape Designer or other professionals, and documents like Sunset Magazine’s Western Garden Guide.

Determining Tree Diameter and Height

Measure the existing trees’ diameter consistently by measuring the trunk at 4-1/2 feet from ground elevation. Measure in inches.

If unable to measure your trees or proposing new trees, you can make use of multiple resources that provide information on the average mature tree size (approx. 20 years +) for different species. We found the US Forest Service Silvics Manual² to be helpful in providing this information.



Determining Tree Green Weight

Wood is measured in cords so you will need to determine how many potential cords are in your existing trees or future trees at maturity. A cord is harvested wood stacked to occur a volume of 4' high by 4' wide and deep (4' x 4' x 4'). The University of New Hampshire (Cooperative Extension) has produced a table which provides estimated cord weight based on tree height and diameter³.

The species of tree also yields different weight per cord. The University of Utah (Agricultural Extension) provides this information for various western tree species⁴. Consult your local universities for your geographic area.

THE CALCULATION⁵

With gathered data, calculate an approximation of the amount of carbon retained by the tree(s):

Step 1: Determine Dry Weight of Tree

Take the *Green Weight* of your tree and multiply by 72.5%. This percentage is the assumed amount of dry matter in the average tree⁶.

Green Weight of Tree x 0.725 = Dry Weight (in lbs)

Step 2: Determine Weight of Carbon in Tree

Take the *Dry Weight* of your tree and multiply by 50%. This percentage is the assumed volume of carbon content in the average tree⁷.

Dry Weight of Tree x 0.50 = Weight of Carbon in Tree (in lbs)

Step 3: Determine Weight of Carbon Dioxide (CO₂) Sequestered in Tree

Take the *Weight of Carbon in your Tree* and multiply by 3.6663. The factor 3.6663 results from a calculation measuring the atomic weights of Carbon (C), Oxygen (O) and Carbon Dioxide (CO₂) and then calculating the ratio of CO₂ to Carbon.

Weight of Carbon in Tree x 3.6663 = Weight of CO₂ Sequestered in Tree (in lbs)

Step 4: Converting from Pounds to Metric Tons

Finally, carbon sequestration is measured in metric tons so you'll want to make sure to convert your pounds to the correct measurement. There are a variety of tools online. The linked web page offers an easy-to-use convertor: http://www.onlineconversion.com/weight_all.htm

ADDITIONAL CALCULATIONS

Once you have determined the Weight of CO₂ sequestered in your tree you can run additional calculations including:

Average amount of CO₂ sequestered per year over the life of the tree:

Divide the *Weight of the CO₂ Sequestered in Tree* by the age of the tree. The number you get is the average

amount of carbon sequestered by your tree annually.

Weight of CO₂ Sequestered ÷ Age of Tree = Avg. Amt. of CO₂ Sequestered Per Year

Amount of CO₂ sequestered by a stand of same-species trees of generally similar size and age:

Multiply the *Weight of CO₂ Sequestered* by the number of trees you have or expect to have in your stand. The number you get is the total amount of CO₂ sequestered by your stand of trees at a given point in time.

Weight of CO₂ Sequestered x No. of Trees = Total Amount of CO₂ Sequestered Overall

DISCLAIMER

Trail Program staff are not experts in this field. We offer this calculator as a tool to get you started on developing carbon sequestration estimates of your own. We strongly recommend that you review the resources referenced in the footnotes and conduct your own research to gauge your level of comfort with the methodology used and assumptions made.

REFERENCES

¹ USDA Forest Service Silvics Manual: http://www.na.fs.fed.us/pubs/silvics_manual/table_of_contents.shtm

² University of New Hampshire Cooperative Extension Fact Sheet: *Estimating Firewood from Standing Trees* <http://ucanr.edu/sites/placernevadasmallfarms/files/76320.pdf>

³ Utah State University Extension Webpage: *Heating with Wood—Species Characteristics and Volumes*: <http://forestry.usu.edu/hm/forest-products/wood-heating>

⁴ Trees for the Future and the Climate Action Reserve have produced similar calculations, via the following websites:

-Trees for the Future: <https://www.broward.org/NaturalResources/ClimateChange/Pages/Carbon.aspx>

-Climate Action Reserve: <http://www.climateactionreserve.org/how/protocols/urban-forest/>

⁵ Calculation based on research done by Trees for the Future: <https://www.broward.org/NaturalResources/ClimateChange/Pages/Carbon.aspx>

⁶ Percentage based on research done by Trees for the Future: <https://www.broward.org/NaturalResources/ClimateChange/Pages/Carbon.aspx>

⁷ Ratio calculated by Trees for the Future: <https://www.broward.org/NaturalResources/ClimateChange/Pages/Carbon.aspx>